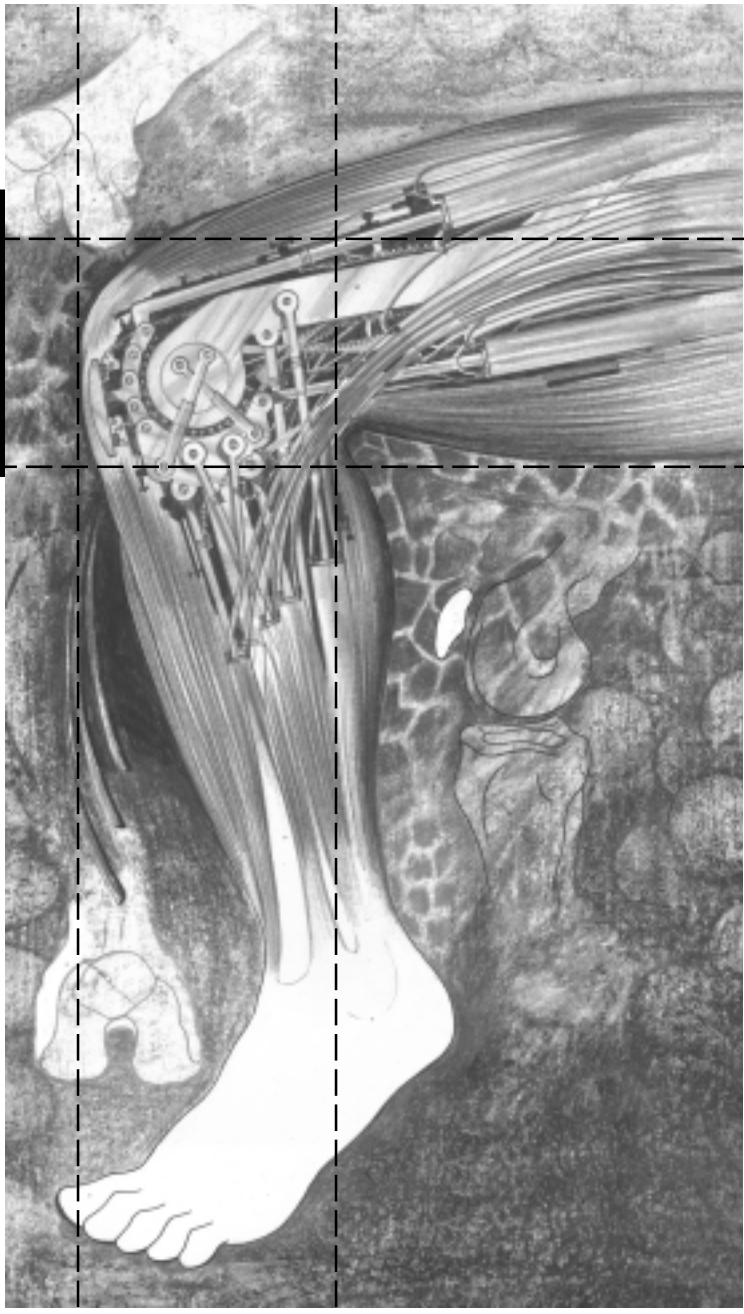
III Curso Internacional de Artroplastias

III International Course in Arthroplasties

LIBRO DE RESÚMENES

ABSTRACT BOOK



Barcelona,
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Marzo 2003

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Quiero agradecer a todos los ponentes, en nombre propio y en el de todos los asistentes al Curso, el esfuerzo que ha supuesto el enviar los resúmenes para su publicación.

Un libro de resúmenes constituye el mejor recuerdo y, al mismo tiempo, el mejor elemento de trabajo para el aprovechamiento de las enseñanzas de tan valiosos expertos.

Aprovecho la ocasión para agradecer el apoyo recibido por la industria y dejar bien patente que a no ser por su generosidad, ni este curso ni muchas otras actividades de la educación médica postgraduada, podrían realizarse.

Antonio Navarro Quilis
Director del Curso

blanca

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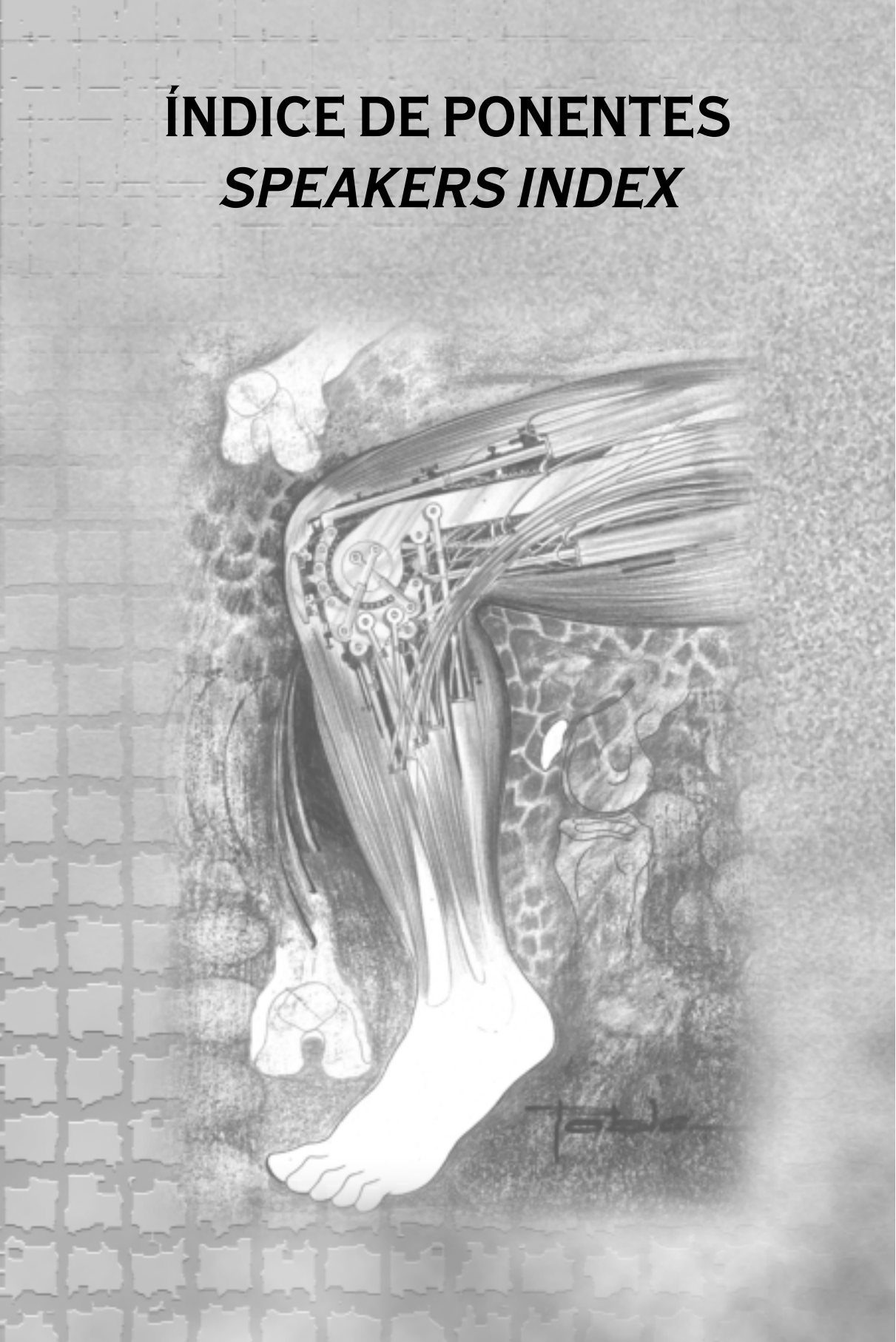




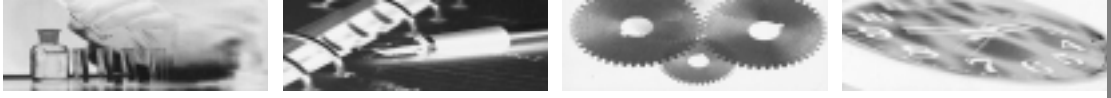




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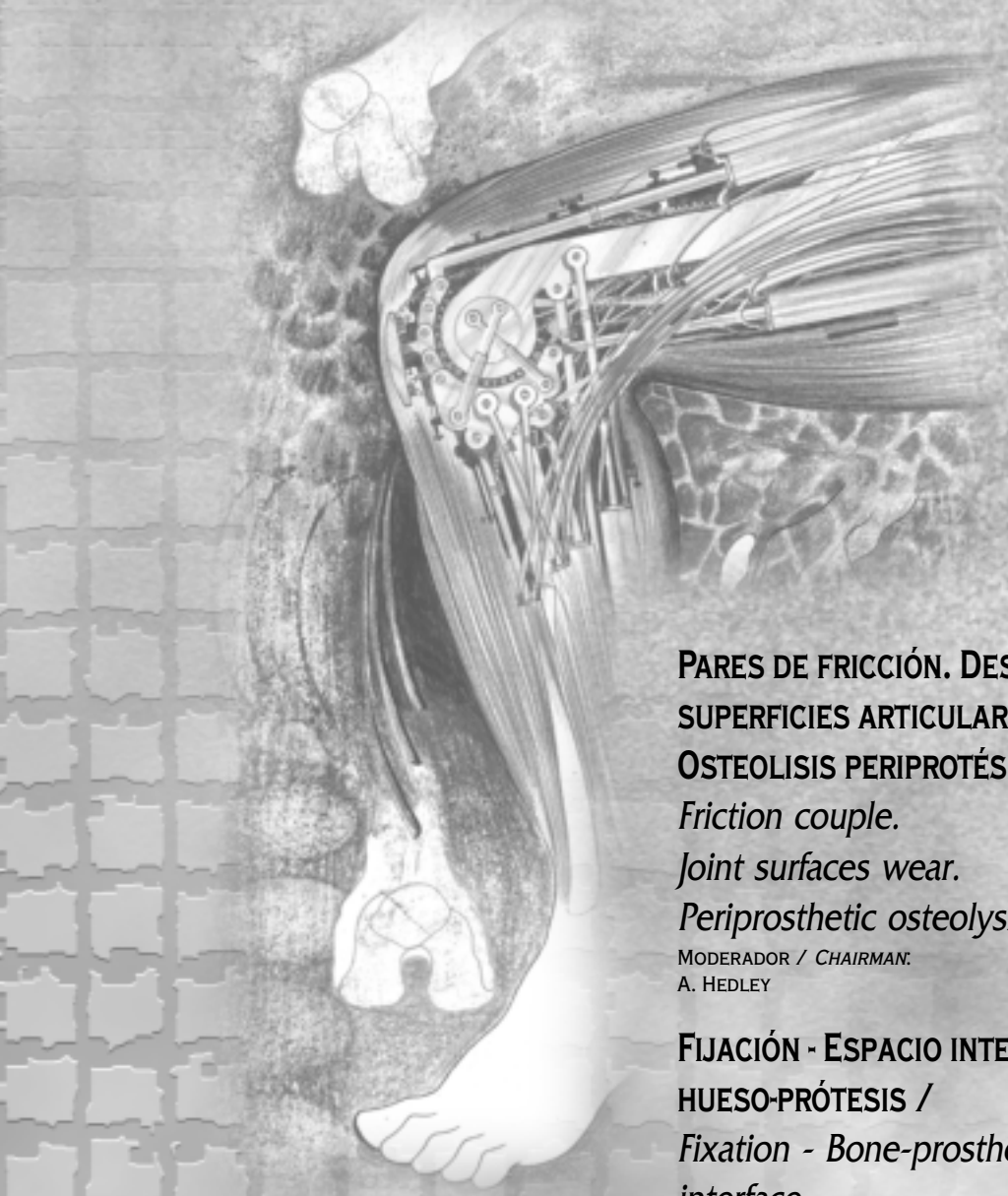

PARES DE FRICCIÓN. DESGASTE SUPERFICIES ARTICULARES. OSTEOLISIS PERIPROTÉSICA /
Friction couple.
Joint surfaces wear.
Periprosthetic osteolysis
MODERADOR / *CHAIRMAN*:
A. HEDLEY

FIJACIÓN - ESPACIO INTERSTICIAL HUESO-PRÓTESIS /
Fixation - Bone-prosthesis interface
MODERADORES / *CHAIRMEN*:
A. TONI - C. RORABECK

PARES DE FRICCIÓN. DESGASTE SUPERFICIES ARTICULARES. OSTEOLISIS PERIPROTÉSICA / *Friction couple. Joint surfaces wear. Periprosthetic osteolysis*

MODERADOR/CHAIRMAN: **A. HEDLEY**

13,45 - 15,45 H.

LOS PLÁSTICOS Y PARES DE FRICCIÓN, HOY

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ALTERNATIVE BEARING SURFACES IN THA

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While it is generally accepted that there is no operation in surgery which works better than a total hip replacement, nevertheless, there are some potential problems including osteolysis, wear of high density polyethylene, as well as aseptic loosening and dislocation. The potential solution to these problems has been directed towards improved bearing surfaces either through the use of cross linked high density polyethylene, ceramic on ceramic articulations, or metal on metal articulations. The issue therefore, relates to which technology should we use? Cross linked polyethylene is clearly very attractive and in all likelihood it will reduce wear leading to reduced incidence of osteolysis. There is considerable evidence for diminished wear (Oonishi, Wroblewski, Grobbelaar). Wear rates for cross linked polyethylene in a simulator are 0.015 mm/year and clinical studies would suggest they are in the range of 0.04 mm. Whether there will be long term consequences of wide spread use of cross linked polyethylene remains to be seen as the clinical data is lacking. As well, it is probably not suitable for knee replacement.
The literature has a number of papers suggesting

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that the long term results of metal on metal are durable and long lasting with minimal risk of osteolysis. The study at our Institution however, comparing metal/metal to metal on polyethylene articulation, has demonstrated a marked sustained increase in serum cobalt and chromium levels as well as urine cobalt and chromium levels. These data are out to 3 years now and suggest that ongoing elevation of serum cobalt and chromium is most likely sustained.

Is ceramic on ceramic the answer? The advantages of ceramic relate to its low wear rate secondary to diminished friction. As a result, there is a reduced incidence of osteolysis. The disadvantages are related to fracture and chipping. The wear rate of ceramic/ceramic has been reported at 0.016 mm/year which is approximately the same as cobalt chrome and cross linked polyethylene. Fracture however, is a problem unique to ceramic. Desmarquest has reported 204 fractured Zirconia ceramic heads and the FDA in the US issued a recall of Zirconia ceramic femoral heads. In addition, osteolysis is not completely eliminated with ceramic. Papers have been published indicating that osteolysis can be seen as a complication of ceramic on ceramic particles (Yoon et al).

The question, therefore, remains as to what the hard bearings of the future will be. In my opinion oxidized Zirconia coatings offer the advantages of ceramic without the risk of fracture. This material undoubtedly will lead to significant wear reduction and most likely less osteolysis. New bearings in joint replacement surgery will be introduced which will improve wear and diminish osteolysis. However, its important to remember that there may be consequences to these strategies. All new bearing surfaces need to be validated *in vivo* and the laboratory data corroborated in the patient.

CERAMIC ON CERAMIC VERSUS METAL ON POLYETHYLENE COUPLING: A LONG TERM SURVIVAL COMPARISON

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INTRODUCTION

Prosthetic-bearing coupling is still a debated topic[1]. Comparative studies are rare and results jeopardised by small data extent. Arthroplasty registers, collecting large quantities of data, allow statistically significant comparative analyses[2]. The aim of this study is comparatively analysing ceramic-ceramic (Cer-Cer) versus metal-polyethylene (Met-Pol) coupling. A long-term survival analysis comparison of the 2 cohorts was inferred from Rizzoli's Register of Orthopaedic Prosthetic Implants (RIPO) [3].

MATERIALS AND METHODS

Between Jan 1990 and Sept 2001 8177 primary hip arthroplasties were collected by RIPO; recording 3465 Met-Pol and 3018 Cer-Cer couplings. Threaded cup prostheses included only in the Cer-Cer cohort were excluded from the comparison. Leaving out cases with lack of proper follow-up, the survival of 3357 Met-Pol prostheses was compared with the survival of 1935 Cer-Cer prostheses. The cumulative probability of revision was estimated by Cox's proportional hazards regression. The Cox's proportional-hazards model selects the variables to include in the regression and estimates the hazard rate considering all the variables can influence the hazard rate. Definition of failure was revision for any cause for at least one prosthetic component. Log-rank and Wilcoxon tests were employed to compare the 2 cohorts[4].

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RESULTS

At 11 years a 94% survivorship for Cer-Cer and 88% survivorship for Met-Pol were calculated, the difference between the 2 cohorts being statistically significant ($p<0.05$). 26 Cer-Cer and 175 Met-Pol prostheses have been replaced.

Discussion

Prostheses with articular cer-cer coupling present lower percentage of removal than met-pol coupling. This is true also when adjusted curves are plotted for age, gender, and pathology, as suggested by Cox multivariate analysis (6% for cer-cer vs 12% for met-pol) at 11 years.

Causes for revision are mainly aseptic loosening, dislocation, septic loosening and prosthesis fracture or damage.

Aseptic loosening of one or both components affects 0.53% of implanted cer-cer prostheses and nearly 3.55% of met-pol. Major criticism against the use of Cer-Cer coupling is mainly based on its brittleness[5]. In this series 3 alumina head fractures have been recorded. Fractures occurred when a 28mm Biolox, head was employed. Despite no fractures occurring when 32mm Biolox, or 28mm Biolox Forte, were chosen. These results are comparable to those reported by Hamadouche et Al. at a minimum of 18.5 years follow up.[6] Another concern on alumina coupling is the higher rate of dislocations due to the lack of an antidislocation lip on the liner. In this series 10 Ceramic on Ceramic prostheses dislocated versus only 5 Metal on Polyethylene prostheses, the difference between the two being statistically significant ($p=0.03$). But in spite of 175 revisions with Metal on Polyethylene the alumina coupling account for only 26 replacements, enough to bear 5 more cases of dislocation. Finally we have compared the overcosts of alumina coupling versus Metal on Polyethylene coupling; if at the time of surgery alumina overcosts amount 590 Euro per prosthesis, at ten years, considering the higher revision rate of Metal on Polyethylene coupling, the savings drop to 26 Euro and the trend is negative. Balanced budget is therefore almost reached after 10 years for Metal on Polyethylene versus Alumina, even without taking into account other unquantifiable extra-cost such as human costs, related to avoidable revision surgery. Besides in revision surgery we have higher incidence of surgical complications, longer in-staying, a death risk of 0.3% and longer rehabilitation times. By this considerations, we are confident that alumina coupling is a valuable alternative to polyethylene.

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METAL/METAL COUPLE. SCIENTIFIC BASES

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ARE METAL/METAL BEARINGS IN TOTAL HIP ENDOPROSTHESES CAUSING HYPERSENSITIVITY

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ORTHOPÄEDISCHE KLINIK. UNIVERSITAT GÖTTINGEN (GERMANY)

Low articular wear was the reason to reintroduce the Co-Cr-metal-metal pairing for artificial hip joints. Midterm clinical results of this new generation of all-metal joints confirmed the expectation of a reduced wear rate and only a small number have to be revised. The estimated overall revision rate ranges between 0,15 and 0,20% per year, which may double by the number of unknown cases.

If metal/metal articulations causes problems, clinical symptoms, like hip – or thigh – pain at start up and weight bearing, or multiple subluxations, (re)appear mostly within the first 2 years after primary implantation, mostly increase in intensity and finally call for revision.

X-rays may show radiolucent lines and progressive osteolyses.

At revision surgery often massive serous and fibrin containing joint effusion, sometimes in connection with bursa – formation, are to be found, while the implants may be either loose or still fixed.

Histomorphologically, the periprosthetic tissues contain only very small amounts of metal debris. They show, however, aseptic inflammatory changes with extended lymphocytic infiltration, high endothelial venules, pronounced macrophage reaction and massive fibrin exudation.

Both, morphological findings and clinical course give reason to assume a hypersensitivity reaction as possible cause for implant failure.

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FIJACIÓN - ESPACIO INTERSTICIAL HUESO-PRÓTESIS / *Fixation - Bone-prosthesis interface*

MODERADORES/CHAIRMEN: **A. TONI - C. RORABECK**

16,15 - 19,00 H.

ACABADO DE LA SUPERFICIE METÁLICA Y/O RECUBRIMIENTO Y FIJACIÓN ÓSEA

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VALL D'HEBRON. BARCELONA

El instersticio hueso-implante es reconocido como el lugar en que se produce la fijación de los implantes protésicos al hueso. Históricamente, la manera más empleada para conseguir esta fijación ha sido el cemento protésico, material que rellena el espacio hueso-implante, creando dos intersticios: hueso-cemento y cemento-implante. La fijación sin cemento se desarrolló como alternativa a éste y, como describen diversos autores, por la alta frecuencia relativa de descementación de los componentes acetabulares fijados por ese método. Así, se desarrolló la denominada fijación biológica, por la que se entiende la creación de un intersticio vivo, estable y capaz de remodelarse, dependiendo de las solicitaciones fisiológicas.
Los tipos de superficie metálica protésica utilizados en la fijación biológica son:

- Superficie lisa, de metal pulido
- Superficie rugosa de metal de esas características, fijada por ongrowth del hueso endostal, o crecimiento en superficie.
- Superficie porosa, fijada por ingrowth o crecimiento del hueso en el interior del recubrimiento poroso.

La superficie lisa muestra push-out tests seis veces inferiores a la superficie rugosa de cualquier tipo. El intersticio, en estas superficies, muestra la formación de tejido fibroso interpuesto entre el hueso y el implante, ya a pocos aumentos[1].
Las superficies rugosas muestran, por tanto, valores 6 veces superiores a las superficies lisas en el push-out test. La microscopía muestra mejoría, respecto a la superficie lisa, del contacto entre el hueso y el implante[1].
El tercer tipo de superficie del implante usado en la fijación biológica es la superficie porosa. Esta se define como la que permite la penetración ósea más allá de la superficie del implante y, por tanto, su fijación. Existen diferentes maneras de conseguir la porosidad de la superficie del implante: "fiber mesh" (malla), "beads" o cuentas, spray de plasma, metal trabecular (tantalio), etc.
Las superficies porosas se caracterizan, también, por el tamaño del poro resultante, el porcentaje de espacio libre en el recubrimiento, o porosidad, el "bone ingrowth" o porcentaje de porosidad ocupada por hueso y por el "bone ongrowth" o crecimiento óseo en la superficie del implante[2].
La técnica histológica utilizada para obtener las

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imágenes que se cuantificarán define en gran manera los resultados del bone ingrowth. La microrradiografía y la histología convencional padecen el denominado error de proyección por el que, la técnica más apropiada para la cuantificación del bone ingrowth es la microscopía electrónica de barrido (BEI-SEM) que consigue una imagen de un espesor aproximado de 5 µ, frente a las 100 ì habituales en las otras tecnicas.
Al ser la sección estudiada de un grosor menor, disminuye la cantidad de hueso existente (bone ingrowth y bone ongrowth), así como la de metal, por lo que aumenta la porosidad del recubrimiento)[2].
Se ha estudiado los diferentes factores de los que depende el bone ingrowth, concluyéndose que depende de[3]:

Diseño protésico
Tipo de fijación del recubrimiento: sintering, fijación por difusión, spray de plasma
Tamaño del poro (100-400 ì)
Biocompatibilidad
Estabilidad inicial suficiente para que se produzca el bone ingrowth

En los especimenes estudiados en autopsias, se ha podido concluir que el bone ingrowth, en condiciones habituales, se produce en:

Acetábulos: 0 a 35%
Vástagos: 0 a 65%

El tipo de hueso que se observa es hueso membranoso, con áreas de cartílago (en presencia de movilidad) y tejido fibroso y el mecanismo potencial de fallo es la fractura del hueso adyacente al intersticio más que en éste.
Los resultados clínicos de las prótesis que utilizan el bone ingrowth como método de fijación son:
Acetábulos: ligeramente superiores, a corto plazo, a los acetábulos cementados[4].
Vástagos: ligeramente inferiores, a corto plazo, a los vástagos cementados[4].
Recambios: si se consigue la fijación de los componentes porosos al hueso, los resultados son mejores que los del cemento[5].

Diferentes situaciones clínicas pueden influir en la cantidad de bone ingrowth observado. Así, se dice que se puede estimular su formación por métodos eléctricos, prostaglandina F sub 2 y las cerámicas cálcicas Contrariamente, la inhibición de su formación se puede obtener mediante los mismos agentes que inhiben la formación de la osificación heterotópica y los anticancerígenos. La inestabilidad inicial es causa de disminución del bone ingrowth[3].
En cualquier caso, y tal como cita Callaghan[3], respecto de los trabajos de Bauer et al[6], …"Non-porous-coated stems coated with an enhancement agent (hydroxyapatite) have demonstrated excellent apposition of host bone to the coating".
La hidroxiapatita pues, es considerada como la manera de conseguir la mejor unión biológica entre el implante y el hueso del paciente. Es una cerámica con una composición similar a la del hueso ($Ca_{10}(PO_4)_6(OH)_2$) en la que la relación Ca/P es 1.67. Posee una característica capacidad osteoinductora por la que es denominada cerámica bioactiva. Exhibe poca resistencia mecánica a la tensión y la cizalladura y la manera de caracterizarla es por su cristalinidad, relación Ca/P, densidad, propiedades de disolución y resistencia mecánica[7].
Su uso como material de recubrimiento implica su fijación por spray de plasma en prótesis de titanio en las que se realiza la formación de óxi-

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dos de titanio que hacen que la unión sea estable.
El espesor de recubrimiento utilizado habitualmente en la clínica varía entre las 30 a 100 ì, aunque existe discusión sobre este particular. Muestra mayor fijación y contacto con el hueso que cuando se emplea los mismos metales sin el recubrimiento y disminuye el tiempo preciso para la fijación inicial de los componentes. Además posee una alta tolerancia a la falta de contacto directo con el hueso, observándose crecimiento cuando el espacio entre el recubrimiento y el hueso es de hasta 2 mm (jumping distance).

Sus usos clínicos son:
Material de relleno[8]
Recubrimiento de implantes dentales y PTR, PTC y RPTC[9]
Clavos de fijación externa[10]
Tolerancia cutánea de catéteres[11]

La hidroxiapatatita ha dado lugar a una nueva generación de prótesis que la utilizan como material de recubrimiento. Desde la primera implantación de una prótesis recubierta de hidroxiapatita por Furlong hasta la actualidad han pasado ya unos 17 años, a pesar de ello, todavía existen pocos artículos en los que se muestren sus resultados a más de 10 años. McNally et al[12] han referido, en una serie de prótesis Furlong en la que no se perdió ningún paciente en el seguimiento, unos resultados clínicos comparables a los de las prótesis de Charnley o Stanmore. Supervivencia a 10 años fue del 97% para la prótesis y 99% para el vástago femoral (acetábulo cementado). Sin embargo, observaron un aumento de fracturas relacionadas con la prótesis (11%), aunque también reconocen que tuvieron poca o ninguna repercusión en el resultado final.
El último material de recubrimiento que se está utilizando con éxito en la clínica es el metal trabecular de tantalio. Esta material combina las cualidades expuestas anteriormente y ofrece nuevas expectativas.
El tantalio es un metal puro, similar al titanio, que ocupa el lugar 73 en la tabla periódica de los elementos y se alinea con el niobio, zirconio y titanio en el grupo de los metales más biocompatibles, siendo el más biocompatible de los 4. Además, su óxido es el más inerte.
El metal trabecular de tantalio está compuesto en un 98% de tantalio y un 2% de carbón vítreo. El tantalio se fija a la malla de carbón vítreo por un proceso llamado de infiltración química de vapor en el que el tantalio precipita y se deposita de manera uniforme sobre un esqueleto de carbón vítreo.
Durante este proceso, el tantalio pasa de metal sólido a metal gaseoso y posteriormente al metal trabecular que es en la forma en la que tiene sus aplicaciones clínicas. El resultado es un material altamente poroso que se relaciona bien tanto con los tejidos blandos como con el hueso.
Los estudios experimentales sobre su utilización muestran un excelente ingrowth en el metal trabecular[13].
La aplicación clínica sobre la que se posee más experiencia es la utilización del metal trabecular como material con el que construir acetábulos porosos. Los primeros estudios a 3.5 años muestran unos excelentes resultados clínicos en su utilización.

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OSSEOINTEGRATION IN PRIMARY CEMENTLESS HIP FIXATION

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Osseointegration implies the formation of a "single" (i.e., integrated unit) between bone and, in the case of a joint replacement arthroplasty, a prosthetic component. Although it has not always been such in common usage, *osseointegration* and *fixation* are synonymous terms. Fixation, for total joint replacement, implies that a prosthesis is bonded to the bone in such a way that there is no relative motion at the interface between the prosthesis and the bone. *Osseointegration* is a term that describes the histological features by which this fixation is achieved and implies the mechanical features of a fixed implant.

Many total joint prostheses have been successful at the hip. There are numerous shapes and sizes of implants that have associated with successful clinical outcomes. The clinician is presented with a plethora of seemingly contradicting claims regarding the need for certain design features of implants in order to achieve a successful result. (E.g., "maximum fit and fill", porous coating, hydroxylapetite coating, "scratch fit" grit-blasting etc.)

This presentation suggests a unifying explanation for the success of implants. This explanation is based on dividing the time after implantation into four periods: primary stability, intermediate stability, secondary stability and long-term remodeling.

Primary stability: For a cementless implant this period would be during the operative intervention when the prosthesis is inserted into the bone. The interference of the implant in the bone leads to a "press-fit" that will hold the implant stable.

Intermediate stability: For a cementless implant this period begins after primary stability is achieved in the OR and ends when bone apposition to the implant leads to secondary stability and *osseointegration*.

Secondary stability: When bone apposition to the implant has progressed so that the implant has been "fixed" (i.e., no relative motion at the interface of the implant to the bone) secondary stability has occurred. The time required to achieve this is not certain but bone healing is generally thought to take between 6 and 12 weeks.

Long-term remodeling: The progressive change of bone at the interface to hypertrophy in areas of increased load and atrophy in areas of no load (i.e., the expression of Wolf's law of bone) leads to this long-term remodeling. Other conditions at the interface (e.g., fracture, infection, debris induced bone resorption etc.) can lead to

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dissolution of the bone and loosening of the implant.
In fact, this same concept can be applied to cemented arthroplasty as the ultimate fixation of a cemented joint must be against live bone and the term osseointegration is appropriate for the cemented joint as well.

PRIMARY TOTAL HIP REPLACEMENT: MY PHILOSOPHY

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The major complications related to total hip replacement today are those associated with osteolysis, polyethylene wear, aseptic loosening and dislocation. A number of solutions have been offered to reduce the incidence of osteolysis by improving the bearing surface with cross linked polyethylene, ceramic, or metal. The question facing us as orthopaedic surgeons is which technology should we use?. On the acetabular side, controversy consists of method of fixation (cement or cementless), the role of hydroxyapatite and the bearing surface (polyethylene, metal or ceramic). On the femoral side, the areas of controversy include cement or cementless, offset and head size as well as the bearing surface. Based on a large experience with tapered cementless implants as well as cylindrical and anatomic cementless implants, it is my feeling that at least 75% of patients with osteoarthritis of the hip can be treated by cementless tapered implants. The literature supports excellent results with this type of cementless fixation. The other 25%, mainly in the elderly, low demand or rheumatoid patient are probably best treated with cement fixation. On the acetabular side, I believe that fixation should be cementless using porous coated titanium shell with or without screws and cross-linked high density polyethylene as the bearing surface. Some controversy exists as to the role of hydroxyapatite. Our data would suggest that the results using porous coating alone, as opposed to porous coating and hydroxyapatite, are substantially the same. Thus, I do not believe there is a need for hydroxyapatite on the stem in routine primary, cementless total hip replacement.

PRIMARY CEMENTLESS FEMORAL RECONSTRUCTION

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Introduction:
The initial experience with cementless femoral fixation disclosed a number of problems. Distal femoral osteolysis became the major issue with first generation proximally fixed cementless femoral components. Some basic principles of design emerged from that experience. Circumferential porous coating is essential to seal the femoral canal and prevent distal migration of polyethylene particulates. Second generation cementless femoral components were designed to provide improved clinical results and limit distal osteolysis by incorporating circumferential proximal ingrowth surfaces. To maximize fixation more extensive areas of porous coating were provided and more canal filling geometries in the proximal region. This report examines the 8 to 11 year prospective results of a second generation anatomically designed, cementless femoral component.

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Method:
Ninety-two consecutive primary THAs were implanted using a circumferentially, proximally porous-coated femoral component (Anatomic, Zimmer) and were prospectively followed with clinical and radiographic evaluations. The mean age at arthroplasty was 51 years. Mean follow-up was 9 years (8-11years).

Results:
The mean pre-operative HHS of 51 pts. (24-71) improved to 94 pts. (52-100) at final follow-up; 91% had a good or excellent result. No femoral components were revised for any reason. One femoral component was radiographically unstable with subsidence into varus at 36 months. Using the endpoints of femoral revision or loosening, the survivorship at 10 years was 98.9% (95% CI 100.0 to 97.7%). Two hips underwent acetabular revision (1 for dislocations, 1 for loosening). With radiographic failure or revision of any component as the endpoint, 10 year survivorship was 95.2%.

No femoral radiolucencies greater than 2mm were seen. Proximal femoral osteolysis was noted in 11 hips (14%). Two of which underwent head and liner exchange. Ten year survivorship with any reoperation as the endpoint was 92.2%. No distal femoral osteolysis was identified.

Discussion:
This second generation cementless, anatomically designed stem provided excellent clinical and radiographic results with only a 1% failure rate. Circumferential porous coating of this implant prevented distal osteolysis.
The indications for use of cementless femoral implants have been extended today to cover most of our patients except those with very poor femoral bone stock. Although we prefer proximal femoral fixation, there are instances where the geometry of the femoral canal mandates distal fixation and a fully coated stem. The occurrence of proximal femoral osteolysis continues to be of concern in the young and active patient.

EVOLUTION OF THE CITATION HIP

A. Hedley
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A COMPARISON OF THE OUTCOME OF TECHNIQUES DESIGNED TO PRODUCE A "THICK" VERSUS A "THIN" CEMENT MANTLE AT THE FÉMUR

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In the cohort study, the 10 year old survival and radiological outcome of 2 different techniques of

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femoral canal preparation have been compared using the same prosthesis, with all patients performed by the same surgical team.
In Technique 1 the canal was over reamed by 2 mm and in Technique 2 the canal was reamed to the same size as the prosthesis. Technique 1 was performed on 92 patients and Technique 2 on 97 patients.
10 year survival for the 2 groups was Technique 1: 97.2% (90.6% - 99.2%) and for Technique 2: 98.8% (92.9% to 99.8%).
Vertical migration was greater in Technique 1 than in Technique 2 (1.8 mm versus 1.0 mm at 5 years, p=0.36). Radiographic review showed that there were significatly more lytic lesions and radiolucent lines at 5 years (p=0.0061) in Technique 1 than in Technique 2.
We conclude that Technique 2 is not worse and may even produce better long-term results than the current Anglo-American teaching on femoral canal preparation for cemented arthroplasty.

THE CLINICAL OUTCOME OF A COMPOSITE LOW ELASTICITY FEMORAL STEM

V. M. Goldberg, M.D.*,
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Roy Crowninshield, Ph.D., Peter Herberts, M.D.****, Russell Schenck, Ph.D.******

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Introduction: Porous coated femoral hip stems have a proven record in terms of establishing and maintaining fixation and providing favorable clinical results. An ongoing concern is stress mediated bone resorption in the proximal femur about the implant. Among the many factors influencing stress shielding, stem stiffness plays a dominant role. A novel total hip femoral component (The Epoch® stem, Zimmer, Warsaw, IN) was designed to simultaneously achieve stable skeletal fixation, structural durability, and reduced femoral stress shielding. The prosthesis combines a thin, forged, cobalt chrome core, surrounded by a polyaryletherketone material that is molded between the core and an extensive porous bone ingrowth surface comprised of titanium metal fibers. The resultant construct allows for proximal and distal canal filling, yet is significantly less rigid than all-metallic femoral stems crafted of either cobalt chrome or titanium alloy. Mechanical testing confirmed excellent fatigue strength and canine studies revealed favorable biological fixation and stability.

Materials and Methods: Clinical trials in the United States and 10 other countries were initiated in 1994. Follow-up is now approaching six years of duration, with a cohort of 366 patients (386 hips) treated at 21 institutions under a structured, multicenter clinical evaluation protocol. All patients received a cementless Trilogy® acetabular component (Zimmer, Warsaw, IN). Patients with inflammatory arthritis were excluded, resulting in a predominant preoperative diagnosis of osteoarthritis (81% in the U.S. study and 69% in the International Study). The study population was also relatively young, with mean ages in the two populations of 57.2 and 55.8 years respectively. All patients completed yearly self-assessment questionnaires. Harris Hip Scores were tabulated at six weeks, three and six months, and at yearly follow-up thereafter. An independent radiographic review assessed implant fixation and osteolysis. In addition, RSA

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studies were performed on 18 cases in Sweden and DEXA studies were conducted in several locations.

Results: Clinically, patients have shown excellent return to function. Harris Hip Scores at four-year follow-up average 97 for both study groups. Beyond three-year follow-up, no patients in the U.S. study and only 3% of patients in the international study admit to activity-related thigh pain.
Radiographically, the implants appear well fixed and exhibit no progressive radiolucencies or osteolysis. To date, no femoral implants have failed to achieve bone ingrowth fixation nor have any required revision, yielding a mechanical failure rate of 0%. Radiosterometric analysis (RSA) studies on one subset of patients showed strong initial fixation and minimal stem micromotion in direct comparison to other metallic porous and cemented control implants. Dual-energy x-ray absorptiometry (DEXA) analysis on another subset of patients revealed excellent periprosthetic bone mineral density retention, with significant reduction in stress shielding as compared to literature reports on other fully porous coated all-metallic implants.
The most common complications was perioperative femoral fracture which occurred in 7/171 hips (4.1%) in the U.S. study and 9/215 hips (4.2%) in the international study. This is attributable to the learning curve associated with the stem geometry which features a metaphyseal-filling proximal segment combined with a canal-filling, straight, distal segment.
In summary, the early results with a low-modulus hip stem appear quite favorable. Additional clinical and radiographic follow-up of this novel prosthesis is planned, in hopes that the long-term biological response to this implant may become better understood and appreciated.

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MODULAR PROSTHESIS WITH HYDROXIAPATITE

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The main difference between cemented and cementless fixation of the stems in hip prostheses, is the pressure distribution among the metal-bone

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interface. With the use of cement we try to obtain an even share of force transmission from the stem to the surrounding bone; in a cementless system exists zones that do not have any contact with bone, and therehence "the myth of the press-fit".

HA has been proved a very good material for the bone-metal interface and has shown several advantatges: the bone production is conducted quicker than without, the tolerance to the interface micromovements is greater and the jumping distance or healing gap (distance between the bone and the implant) is bigger than ever before. Perphaps the press-fit is not anymore a myth!.

Encouraged by the good results obtained with a stem totally covered with HA, but observing that there were cases of unatching size between the metaphyseal region and the diaphyseal one. We have designed a modular stem, that matches better the different morphological types.
From April 2000 till June 2002 we have used 100 stems in 92 patients; mean age 49.7 pm (range 23-72); the male-female ratio is 65:35.

The patients have been evaluated from the clinical point of view, as well as from the radiological one. In 43 patients a TC study (53 TC) has been performed, and formed jumping distance of more than 4 mm.
We shall also analyze the surgical technique, in order to avoid peroperative fractures (3 cases).

HIP REPLACEMENT: THREE STEPS TO HEAVEN

J. Richardson
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Hip replacement is one of the most effective operations in all of surgery. Unfortunately expecctations are also high – so it has become an art of trying to achieve perfection.

My main premise is that our aim is to maximise function – considered the area under the curve of a failing hip replacement.

My next premise is that all hip will fail – if the patient lives long enough. Therefore we must plan for revision. The best approach to this is firstly to get as much life out of the original hip, and then to use conservative surgery. Microfracture and cartilage resurfacing are the most conservative options. Then resurfacing or the Thrust Plate type of joint replacement. These allow the patient a high level of activity with a metal-metal bearing., but reduce the amount of bone loss at the time of surgery.

Once this type of hip fails it is possible to provide a 'standard' cemented hip replacement which should have an 80% chance of a 15 year life expectancy in the younger patient.

5000 cases of the BHR resurfacing hip have been studied at the Oswestry Outcome Centre in 8 countries over 5 years. The results are excellent with excellent restoration of function. The failures have been high in the first three months due to fracture of the neck. This is a particular problem in the women over 50 years of age. The rate is 1% although in some centres it is much higher and varies for reasons not yet known.

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Next consider the problems of revision surgery. Are they not principally related to bone loss? Can bone loss be charted? I have endeavoured to study this by two methods: weighing the amount of bone removed at surgery, and measuring the area of bone loss on the AP x-ray.

The effect of osteoarthritis only removes a small amount of the area of the bone, but total hip replacement removes a large amount, around $50cm^2$. Further loss is by osteolysis, and then bone can be replaced by impaction grafting.

If long-stemmed uncemented revision is undertaken, then even more bone is lost. If this is to be the last hip revision a person is to have, than that may be the most appropriate solution. Impaction grafting is not so successful in the over-70 year population.

In the acetabulum, the benefits of graft can be seen to be even greater. Hip resurfacing as the first operation greatly reduces the amount of bone loss.

In the diagram the resurfacing has been inserted as lasting 5 years. From the results I have it is likely that hip resurfacing will last about 15 years for an 80% survival.

This will prolong the time that bone stock is maintained.

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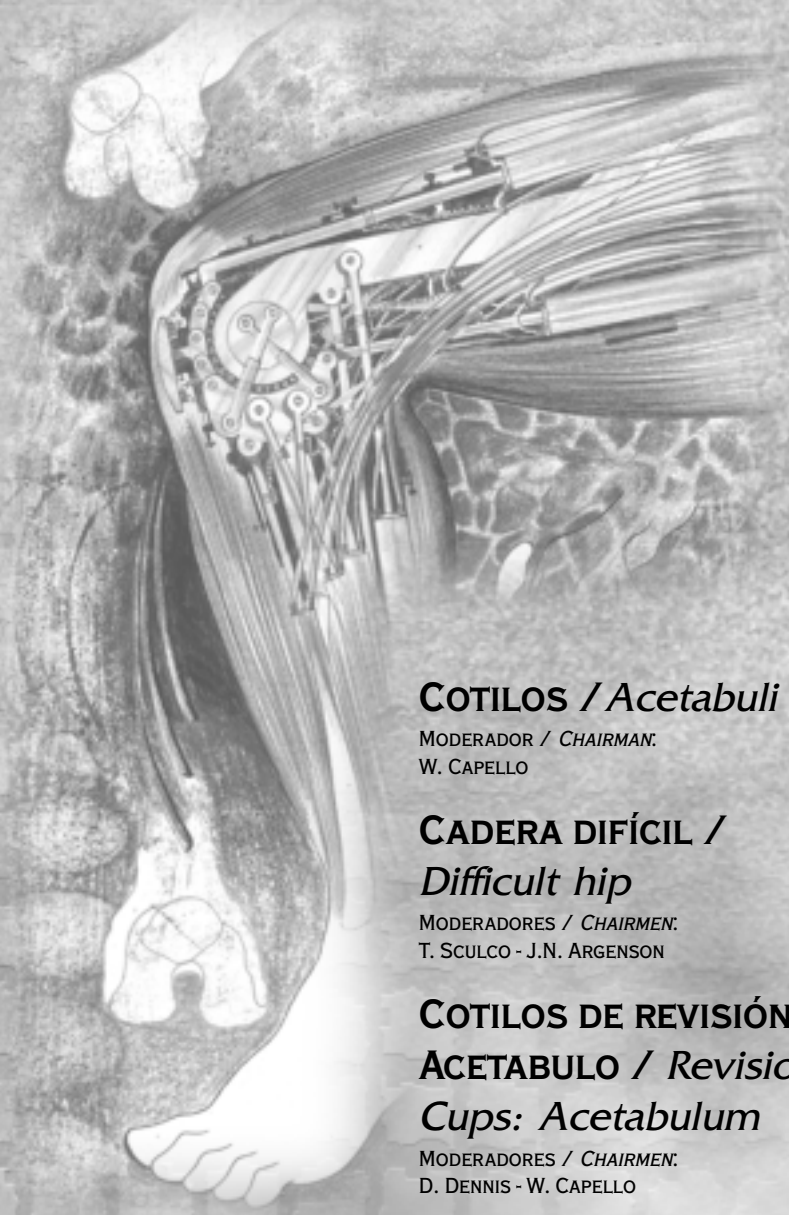

COTILOS / *Acetabuli*

MODERADOR / *CHAIRMAN*:
W. CAPELLO

CADERA DIFÍCIL / *Difficult hip*

MODERADORES / *CHAIRMEN*:
T. SCULCO - J.N. ARGENSON

COTILOS DE REVISIÓN: ACETABULO / *Revision Cups: Acetabulum*

MODERADORES / *CHAIRMEN*:
D. DENNIS - W. CAPELLO

COTILOS / *Acetabuli*

MODERADOR / CHAIRMAN: **W. CAPELLO**

8,30 - 10,15 H.

SPHERICAL OR CONICAL THREADED ACETABULAR IMPLANT ADVANTAGES AND RESULTS

N. Böehler
EFFORT PRESIDENT. ALLG.
KRANKENAHUS LINZ (AUSTRIA)

Spherical cups are widely used all over the world. Threaded conical cups had a bad image in former times resulting from problems with polyethylene wear and dissatisfying designs. Today they are mainly used in central Europe.
Both types of implants are offering several advantages:
Primary fixation is 2 + x higher at conical threaded cups.
Long-term fixation is depending on the macro- and microstructure of the implant. There is no difference between spherical and conical design.
The amount of bone loss is less after the implantation of a spherical cup.
In the severe dysplastic hip the conical threaded cups have mechanical advantages and give a better primary fixation.
Long-term results:
Survival rates of the implants are over 95% looking at the best implants in both groups. We found in our series with the Alloclassic conical threaded hip 97% survival rate after 14 years and with this spherical Allofit cup 100% survival rate after 6 years.
Summarizing it can be said that both types of implants are showing excellent results. The indications should depending on the primary anatomic situation and on the experience of the surgeon.

PRIMARY TOTAL HIP ARTHROPLASTY WITH A CEMENTLESS ACETABULAR COMPONENT:

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Introduction: Cementless acetabular reconstruction has become the standard for primary total hip arthroplasty. The principles include: reaming the acetabulum to a bleeding bone bed, a hemispherical modular porous coated acetabular component, impaction or screws for initial fixation. The effect of polyethylene wear and osteolysis on the long-term performance of these components remains a concern. We review our initial experience with primary cementless acetabular reconstruction at a minimum 15 years follow up.

Methods: Two hundred four consecutive primary total hip arthroplasties in 184 patients were performed with a hemispherical, porous coated acetabular component inserted with screws (HG-1, Zimmer). The cohort consisted of 102 females (55%) with a mean age of 52 years. At a minimum of 15 years, 52 patients had died (57 hips) and 5 patients were lost to follow-up (6 hips) leaving 141 hips in 127 patients.

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Results: At a mean of 194 months, the mean preoperative Harris hip score of 52 improved to 89. Five well-fixed cups were revised (2 for osteolysis, 2 for instability following femoral revision and 1 at the time of femoral revision) and 1 cup was revised for aseptic loosening. An additional 9 hips required reoperation for wear of the polyethylene liner and/or osteolysis. Three cups were radiographically unstable. The rate of failure of the component for aseptic loosening was thus 2% and the reoperation rate for a problem related to the acetabular component was 6.9%. Survivorship for the cup at 15 years was 98.7% with aseptic loosening as an endpoint, 97.5% for acetabular revision (for any reason) and 92.6% for a reoperation related to the acetabular component.

Discussion: Cementless acetabular reconstruction provides excellent component survivorship at 15 years. Most problems are encountered in the young and active patient, but aseptic loosening is not a cause for failure. With increasing follow-up, polyethylene wear and osteolysis become the major long-term problem. The introduction of wear resistant articular surfaces will definitely improve long-term outcomes especially for the young an active patient population. At our institution, highly cross-linked polyethylene is currently the material of choice for the patients at risk.

PREDICTING FACTORS OF MIGRATION OF POROUS COATED METAL SOCKETS IN PRIMARY TOTAL HIP REPLACEMENTS

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Cementless acetabular components are commonly used for primary total hip replacement, but the radiographic criteria to identify loosening are not well established. Hodgkinson et al. [16] have defined the correlation between the radiographic appearance of cemented cups and intraoperative findings of loosening. The purpose of this study was to correlate the radiographic appearance of a hemispheric porous coated cementless cup fixed with screws with the intraoperative findings of its fixation. The criteria for loosening thereby established was then corroborated by measurement of sequential radiographs of one hundred hips followed and average of 121 months (ten years).

Fifty-two hips which required reoperation for reasons other than infection at average 89.9 months (range, 33.8 –150.1 months) after primary surgery had the cup fixation evaluated at the reoperation. All hips were implanted primarily with a hemispheric porous coated cementless socket with screws. Thirty-two were patched porous coated and twenty were circumferentially porous coated. Sequential anteroposterior and lateral radiographs were measured to correlate the findings to the fixation status of the sockets tested at revision surgery. Sequential radiographs of an additional one hundred total hip replacements with average followup of 121 months (plus or minus 18.1 months) which did not require reoperation were also measured.

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Fixation was correlated to postoperative gaps, subsequent radiolucent lines, osteolysis, wear, and migration by two observers and on two occasions. A total of 152 radiographs were reviewed.
At reoperation, seventeen sockets were found to be loose although only ten sockets were preoperatively diagnosed as loose. Loose sockets could be radiographically identified by radiolucent lines which initially appeared after two years; progressive radiolucent lines after two years; radiolucencies in all three zones; radiolucencies wider than two millimetres in any zone; and migration. Both anteroposterior and lateral radiographs are necessary for this accurate determination of loose hemispheric porous coated cups. None of the well-fixed sockets had these findings and none have subsequently loosened at average follow-up of 137 months (range 102 to 165 months). In additional, no sockets in one hundred total hip replacements which did not have revision, and were functioning well, had any of these finding. Postoperative gaps were seen in fourteen of thirty-five sockets (40 per cent) that were well fixed and seven of seventeen sockets (41 per cent) that were loose. The majority of these gaps disappeared in both groups at an average of three years and did not correlate to loosening. The level of agreement of radiographic findings between two observers was 93 per cent with a Kappa coefficient of 0.76 and between two reviews of the same observer at a one year interval was 97 per cent with a Kappa coefficient of 0.89. Once we understood the criteria of loose cups, we could retrospectively diagnose sixteen of seventeen cups as loose without any false positives and one false negative. The sensitivity of these criteria was 94 per cent with 100 per cent specificity. The criteria had a positive predictive value of 100 per cent and a negative predictive value of 97 per cent.

The most critical radiographic findings for early diagnosis of loosening of a hemispheric porous coated cup were progressive radiolucent lines after two years postoperative, and any new radiolucent line of one millimetre or greater which appeared after two years postoperative. These findings are predictive that the loosening process has commenced. Sequential radiographs are important for assessment of the time of onset and progression of radiolucent lines.

Criteria for loosening of a cementless hemispheric porous coated cups have two differences from the criteria for cemented cups. Firstly, postoperative gaps were not predictive of loosening whereas with cemented cups postoperative demarcation was directly related to cup loosening within ten years, secondly, Hodgkinson et al [16] found that the fate of cemented cups can be identified at one year postoperative whereas findings with these non-cemented cups were important only after two years postoperative. Radiographic criteria for loosening are important when trying to diagnose the cause of a painful total hip replacement or when assessing the necessity of a revision of the acetabular component when an operation for wear and osteolysis needs to be performed. It would be of benefit to both the surgeon and the patient to be able to perform the revision operation prior to migration of the socket which causes destruction of bone.

A MONOBLOCK ACETABULAR ALTERNATIVE

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The major failure mode of cemented or non-cemented acetabular fixation is osteolysis

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produced by polyethylene debris and biologic reaction to this material. A monoblock acetabular non-cemented component offers advantages in reducing the failure mechanism of acetabular cups. First, because the polyethylene is fixed to the metal shell there is no motion between the shell and the liner as is seen with modular components. Therefore, extra-articular polyethylene wear debris is not generated. Secondly, there is no need for a locking mechanism which may fail and from which metallic debris may be produced. Thirdly, no screw holes are present on the back of the monoblock cup increasing the surface area for ingrowth and eliminating an entrance point for wear debris to access the floor of the acetabulum. Avoidance of the use of screws also prevents the possibility of neurovascular injury during screw insertion. Fourthly, by adding an elliptical configuration to a monoblock cup the dome of the shell is the same dimension as the reamed diameter allowing for improved coaptation of shell to acetabular floor. By increasing the diameter at the rim secure press fit is achieved without sacrificing contact at the dome.

In a radiologic review of 661 acetabular components 5.1% of cups were noted to have a polar dome acetabular gap of greater than 1.5 mm on the immediate postoperative radiograph. These patients were followed for a minimus of two years and there was noted shift in implant position in only one patient. Gaps tended to lessen in degree and fill in with bone in almost all cases. The clinical result was not compromised by the presence of a dome gap.

In a mid-term follow-up of 7.5 years 2634 elliptical monoblock acetabular cups have been inserted with greater than two year follow-up in 1323 hips. There have no mechanical failures requiring revision. Four patients have been revised for instability and one for infection. The need to convert to a cup with screw fixation because of poor press fit is less than one percent.

MUSCLE FUNCTION IN MINIMALLY INVASIVE OPERATIONS OF THE HIP

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NOTAS / *NOTES*

CADERA DIFÍCIL / *Difficult hip*

MODERADORES / CHAIRMEN: **T. SCULCO - J.N. ARGENSON**

10,45 - 14,15 H.

THE THREE-DIMENSIONAL ANATOMY OF THE HIP IN CONGENITAL HIP DYSPLASIA AND THE EFFECT ON TOTAL HIP ARTHROPLASTY. RELOCATION OF THE CENTER OF ROTATION

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Introduction: Total hip arthroplasty for osteoarthritis following congenital hip dysplasia or dislocation is always challanging due to the modified anatomy of the hip. The purpose of this study was to evaluate by X-rays and CT-Scan the three-dimensional anatomy of 312 hips in 262 patients and the potential difficulties for performing hip arthroplasty.

Materials and Methods: For each patient the same protocol was performed including full view of the limbs, frontal view of the pelvis and the hip, horizontal CT views of the upper femur, the acetabulum, and the knee. On the frontal view of the hip were measured the position of the femoral head, the level of the lesser trochanter, the medial offset, the CCD angle and the isthmus. A dedicated software was used to extract the internal contour of the femur and measure femoral dimensions. On the CT were also calculated the anteroposterior diameter of the true acetabulum and the anteversion angles.

Results: According to the classification of Crowe et al, 195 were dysplasia and 123 dislocations. On the CT the mean mediolateral and anteroposterior dimensions of the femoral canal at the isthmus level ranged from 9.3 to 9.8 mm in mediolateral and from 12.6 to 13.6 mm in anteroposterior. The canal flare index ranged from 1.9 to 8.7 . The proximal femur anteversion ranged from 1° to 86°. On the full limb view the neck / shaft angle ranged from 127° to 137° and the largest leg length discrepancy ranged from 45 mm to 82 mm.

Discussion: The center of rotation should be relocated at the level of the true acetabulum both for restoring abductor function and also for optimizing loading forces on the components. This requires acetabular components including smaller sizes according to the CT-scan results of the acetabular anatomy. When using cementless fixation for young patients the use of a titanium HA covered reinforcement ring is usefull for optimal cup positioning provided by the hook in the obturator foramen, and for primary stability provided both by the press-fit effect and the roof expansion for bone grafting screw fixation. The dysplasic or dislocated femur has a straighter and narrower canal than the normal femur but large variations arise either in canal flare index, neck / shaft angle, and anteversion. The importance of anteversion was not correlated with the severity of the dislocation. This may require not only an intramedullary stem able to match such anatomy but also an adaptation of the neck offset to restore the appropriate geometry. The solutions for neck

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offset adaptation may include: associated subtrochanteric osteotomy; modulars necks able to correct length, lever arm, and ante- or retroversion; or three-dimensional custom necks. The mean leg length discrepancy gradually changes with the severity of the subluxation requiring either preoperative extension or large tenotomies to restore leg length and avoid neurological complications.

PRIMARY THR IN HIP DYSLASIA

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THE MANAGEMENT OF HIGH RIDING DDH

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Introduction:
Developmental dysplasia of the hip (DDH) associated with high dislocation (Crowe grade three and four) is frequently accompanied by limited acetabular bone stock, excessive femoral rotational abnormalities, contracted soft tissues, and concerns of neurologic injury with restoration of leg length.

Methods:
Twenty-three (23) primary hip replacements were performed in patients with Crowe grade three or four hip dysplasia utilizing a subtrochanteric shortening / derotational osteotomy to restore the anatomic hip center and trochanter position. Average follow-up was 5.3 years.

Results:
Average age of patients was 47.5 years.. Femoral component fixation was cemented in nine patients and uncemented in fourteen patients. Femoral strut allograft was utilized in nine patients (39%) at the site of femoral osteotomy. All acetabular components were uncemented. Structural grafts were utilized in 30% of acetabular reconstructions. No reinforcement or reconstruction rings were used. The average acetabular component size was forty-four (44) millimeters. 92% of femoral osteotomies healed without complication. Two osteotomy site non-unions required revision surgery (one cemented, and one uncemented). Two acetabular component revisions were performed (one for polyethylene fracture at twenty-three months, and

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one for recurrent posterior dislocation requiring component version adjustment). Three patients had post-operative dislocations. One cemented femoral component was revised for loosening. No neurologic deficiencies were noted post-operatively. Mean Harris hip score improved from 38.7 to 73.4. Limp improved 0.96 grades and dependence on assistive walking device was improved in 30% of patients.

Conclusions:
Subtrochanteric shortening osteotomy is a safe and predictable method of restoring the anatomic hip center and correcting trochanteric alignment for patients with high developmental hip dislocation.

ARTHROPLASTY IN THE CONGENITAL DISLOCATED HIP

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REVISION SURGERY IN THR, FEMORAL ASPECT

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PATHOPHYSIOLOGY OF OSTEOLYSIS

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Osteolysis has become the major problem associated with the failure of both cemented and cementless total joint replacements. Although mechanical factors play an important role in aseptic loosening of implants, the underlying cause appears directly related to the biological response to particles. Although metal and/or

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polymethylmethacrylate particles may initiate the process, polyethylene wear particles recently have been shown to be the major problem. The granulomatous reaction associated with particle induced osteolysis is initiated by macrophages which are the primary directors of the cell and soluble factors cascade. This granulomatous membrane surrounding implants consists of a mixture of macrophages, fibroblasts and to a lesser degree lymphocytes. The soluble factors released as a result of the cell-particle interaction include: 1L-1B, 1L-6, TNF-µ (cytokines), PGE2 (prostaglandin) and collagenase (proteinases). These soluble factors affect directly or indirectly osteoclast precursors and/or osteoblasts accelerating bone resorption. Fibroblast proliferation also may occur to enhance the formation of a fibrous membrane around the implant which in itself may act as a transporter of wear debris from the articulating surface.

BIPHOSPHONATES AND THE PREVENTION OF BONE LOSS AFTER TOTAL HIP ARTHROPLASTY

B.E. Scammell

QUEEN'S MEDICAL CENTRE. NOTTINGHAM. (GREAT BRITAIN)

Periprosthetic bone loss is the main factor in limiting the longevity of total hip arthroplasty. The bone loss arises through two principle mechanisms; acutely in the first six months after surgery, due to stress shielding, and at a later time point due to wear particle-induced osteolysis.
Acute periprosthetic bone loss may contribute to long-term prosthetic failure, and at present, there is no established prophylaxis for this process. This paper presents the results of four prospective, randomised trials, three with alendronate and one with pamidronate therapy, that resulted in a significant reduction in bone loss compared with placebo.
To date, there is no treatment that halts the progression of the later periprosthetic bone loss due to osteolysis. This paper presents the results of a pilot study of alendronate therapy in the treatment of osteolysis in total hip arthroplasty.
These studies provide the basis for establishing large-scale trials for evaluating the efficacy of bisphosphonates in preventing aseptic loosening in total hip arthroplasties.

ALOINJERTO COMPACTADO EN PTC DE REVISIÓN

A. Murcia

FACULTAD DE MEDICINA. HOSPITAL DE CABUEÑES. GIJÓN

Introducción

De las 20.000 artroplastias totales de cadera que se implantan anualmente en España, unas 300, se realizan en Cabueñes. Al ir aumentando el número de implantes primarios también lo ha hecho paralelamente el número de cirugías de revisión. El porcentaje de revisiones es muy variable pero suele estar por debajo del 10% de las implantaciones primarias.

El aflojamiento de los componentes protésicos es la principal causa de fracaso de las artroplastias totales de cadera. Es la complicación más frecuente y constituye la principal indicación de su revisión quirúrgica y se presenta como consecuencia de la osteolisis periprotésica.

Se considera fallo clínico a la necesidad de realizar cirugía de revisión de cualquier componente por cualquier motivo, mientras que el fracaso radiográfico se define a nivel acetabular como la

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movilización de más de 5mm en cualquier dirección. El fracaso femoral viene expresado por el hundimiento y/o la movilización del vástago, generalmente en varo.

Clínicamente el fracaso acetabular se manifiesta por dolor en la ingle y disminución de la actividad que tenía el paciente. El fracaso femoral tiene una expresión clínica inmediata. Los dos síntomas principales son el dolor en el muslo que antes no tenía y la cojera, debida al hundimiento del vástago, que le obliga a coger el bastón que ya había abandonado.

El objetivo de la cirugía de revisión es triple: 1) reconstruir la anatomía y restablecer la longitud de los miembros inferiores; 2) recuperar o por lo menos preservar el soporte óseo; y 3) implantar unos componentes estables. Estos objetivos deben conseguirse con técnica e implantes que sean fiables y reproducibles con una tasa aceptable de complicaciones.

Componente acetabular
La técnica quirúrgica y modelo de implante viene determinado por el tipo de defecto óseo. Se admite generalmente que cuando el defecto está entre el 30-40% se puede utilizar con buenos resultados, los cotilos hemisféricos porosos con tornillos, recubiertos o no con hidroxiapatita. Si el defecto es mayor del 40% preferimos la técnica de Slooff con la que se obtienen buenos resultados y mantenidos en el tiempo. Cuando la destrucción afecta a ambas columnas y la pérdida ósea es masiva, o si se trata de una discontinuidad pélvica utilizamos los anillos de refuerzo o antiprotrusión junto con los injertos compactados.

Componente femoral
Para la reconstrucción femoral se dispone de tres posibilidades: 1) vástagos cementados, 2) no cementados y 3) con injertos triturados y compactados (Ling-Gie). El conducto femoral que ha estado con cemento, después de su extracción no es el mejor lecho para una nueva cementación. En los defectos segmentarios y fracturas femorales periprotésicas, añadimos placas óseas corticales de refuerzo que se solidarizan al resto con cables de Dall-Miles.

Las reconstrucciones femorales con injertos óseos triturados y compactados significan el 70% de nuestra casuística. En el restante 30% utilizamos vástagos modulares, que consiguen una buena fijación diafisaria primaria y estabilidad rotacional.

Técnica quirúrgica
Se aborda la articulación por vía posterior exponiendo circunferencialmente ambos extremos articulares. Con abordajes escasos pueden aparecer fracturas periprotésicas que son la principal complicación.

Resultados
Aunque la serie es más corta tanto en número como en años de seguimiento, que la de los descriptores de la técnica, los buenos resultados son del 79,8% y se mantienen con el paso del tiempo (entre 1 y 9 años).

Complicaciones
La más frecuente es la luxación, que aunque no es específica de la técnica sí lo es por la vía; al principio llegó al 7,5%. El hundimiento del vástago cementado, es superponible al de la cirugía primaria, de 2-3 mm y se ha presentado durante el primer año. Hundimientos superiores a 10 mm, se han presentados acompañando a otras complicaciones como la in-

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fección, y a otras complicaciones mecánicas. Hay dos complicaciones nerviosas en la serie, recuperadas aunque una de ellas tardó 14 meses. Las fracturas periprotésicas femorales pueden presentarse durante la cirugía o posteriormente.

Indicaciones

Acetábulo

Si el defecto es menor del 30% se puede implantar cualquier cotilo hemiesférico, poroso, con o sin hidroxiapatita. También se puede utilizar la técnica de Slooff sobre todo si el paciente es joven con el fin de aumentar su reserva ósea.

Si el defecto es mayor del 40% utilizamos la técnica de los injertos triturados y compactados con cotilo cementado. Si se trata de una discontinuidad pélvica o el defecto es excesivamente grande, es preferible los anillos antiprotrusión, asociados a la técnica de Slooff. También se puede utilizar los cotilos de tantalio con sus aumentos correspondientes.

Fémur

En pacientes jóvenes con expectativas de vida amplia, independiente del tipo de defectos, cavitario o segmentario, utilizamos la técnica de los injertos triturados y compactados. Si la diáfisis medular es amplia (+ de 20 mm) utilizamos la misma técnica de Exeter.

En pacientes mayores, poco activos y/o si se utiliza en el abordaje una osteotomía trocantérea ampliada, preferimos los vástagos modulares de anclaje diafisario.

Conclusiones

Utilizando la reconstrucción acetabular (Slooff) y femoral (Ling-Gie) con injertos triturados y compactados se consigue una disminución del dolor; mejoría de la función; y aumento del soporte óseo permitiendo una futura cirugía en mejores condiciones, si fuera necesaria.

UPDATED RESULTS OF THE MODULAR PROFEMUR STEM SYSTEM USED IN REVISIONS OF FEMORAL COMPONENTS

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When a total hip replacement fails, loosening of cemented and non – cemented femoral components often causes considerable bone defects preferably in the proximal portion of the femur. If larger defects are present, a safe anchorage of standard stems might be no longer possible. In order to find an alternative solution avoiding additional bone loss and the use of bone grafts, we designed a titanium – made modular revision stem for non – cemented fixation, which is adaptable to the individual shape and the femur as well as to existing bone defects. It consists of five interchangeable components: The distal stem, available in different lengths and sizes, allows to bridge the defect and to find an anchorage in the diaphysis by lengthwise cutting ribs. With a curved shape of the longer stems an adaptation to the antecurvature of the femur becomes possible. A proximal trochanter part, also available in different sizes, fills the metaphyseal defects, allows additional anchorage in the still existing proximal bone stock and an adjustment of the antetorsion even after the distal part is already fixed. Changeable necks, varying in lengths and

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orientation (varus, valgus, retroversion, anteversion, medialisation and lateralisation) and heads with three different lengths enable the surgeon to adjust length (up to 1,7 cm) and stability even the stem has been implanted.

97 revision-systems of this type have been implanted between 1992 and 1997 in 94 patients. Out of these, 73 patients with 76 implants could be evaluated between 3 and 9 years (mean 5,2 years) postoperatively. The indication for revision surgery derived from aseptic loosening of a cemented stem in 49 cases and a non – cemented one in 20; further revisions became necessary 3 times because of a periprosthetic fracture and 4 times because of septic loosening. According to the Endoclinic Classification, the femoral showed defects of grade 1 in 17%, grade 2 in 38%, grade 3 in 36% and grade 4 in 9%.

At follow up, very satisfying results had been obtained in 90,8% of the patients who reported a clear improvement of their situation while in 5,3% the complaints remained unchanged and got even worse in 3,9%. The average Harris hip score increased from 38 to 73. The radiographic analysis showed new bone formation in most of the cases, filling postoperative persisting defects completely in 62% and at least partially in 38%. Subsidence of stems could be measured in 14,6% of the cases. In 5,3% it measured less than 0,5%, was non progressive after 1 year and the patients remained asymptomatic. In another 5,3% the subsidence measured between 0,5 – 1,5 cm but was also non progressive after 1 year and asymptomatic. In 4% (3 patients) the stem subsited more than 1,5 cm, in 2 patients due to traumatic trochanteric fractures, caused clinical symptoms and had to be revised. Zonal sclerotic lines were seen in 45% of the cases only proximal, in 8% also distal. There were only 5 cases showing radiolucent lines, 3 (4%) located proximal, 1 (1,3%) distal. All of them were not progressive and already visible on the postoperative x-ray. None of these radiological phenomena was combined with clinical symptoms.

Basing on the clinical results, the use of the modular PROFEMUR system can be recommended for revisions of femoral components with osteolyses and bone defects.

VASTAGO ENCERROJADO

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Los defectos femorales proximales severos representan un problema importante en la cirugía de revisión del vástago femoral. **(7, 12)**

La utilización de vástagos cementados en la cirugía de revisión presenta peores resultados que en la cirugía primaria cuando no incluye restauración biológica del déficit óseo. Los porcentajes de rerevisión oscilan desde el 9 % **(10, 28)** al 49 % **(8, 19).**

La restauración del déficit óseo es necesaria para mejorar los resultados. Existen distintas técnicas quirúrgicas.

- Técnica de Exeter. **(11)**. La utilización de aloinjerto triturado permite la reconstrucción ósea cuando el fémur proximal es sufucientemente estable en defectos cavitarios puros o combinados que pueden convertirse en continentes. Presenta un elevado índice de complicaciones, hundimientos y fracturas periprotésicas, por lo que sus indicaciones son muy restringidas. **(22, 25, 27).**
- Los vástagos largos de anclaje distal y superfi-

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cie porosa presentan resultados difíciles de valorar debido a la gran variabilidad en su diseño y en la extensión de la superficie porosa. El dolor en la cara anterior del muslo y el stress-shielding, que disminuye la capacidad de restauración ósea proximal, hacen que no recomendemos su utilización de forma sistemática. **(17, 23, 29). (9, 20)**.

- Vástagos recubiertos de hidroxiapatita. Las características biológicas de la hidroxiapatita favorecen la formación ósea, reconstrucción del defecto óseo y osteointegración del implante. **(2, 5, 6).**
- Los vástagos modulares de anclaje metafisario (S-ROM) presentan resultados esperanzadores a corto plazo con un 6 % de fracasos a los 6 años. La fijación metafisaria favorece la hipertrofia endostal y cortical reconstruyéndose el defecto óseo femoral proximal. No tenemos experiencia en su utilización.**(4)**
- Aloinjertos masivos combinados con vástagos no cementados. Head, McLaughlin y Gross presentan resultados aceptables. Es una técnica a valorar en casos de grandes defectos óseos que exijan la utilización de aloinjertos estructurales masivos. **(12, 16, 24).**
- En 1987, Wagner presentó una técnica de revisión con un vástago largo de anclaje diafisario distal con excelente regeneración ósea proximal espontánea. El anclaje del vástago se consigue por implantación en la diáfisis femoral tras el fresado cónico de la misma. Wagner recomienda su utilización en presencia de defectos femorales proximales utilizando la via transfemoral. Basándose en la fijación diafisaria distal del vástago cónico, se busca una fijación primaria perfecta que favorezca la ulterior osteointegración por aposición ósea entre los surcos protésicos. **(31)**.

Las publicaciones de Hartwing, Kolstad, Grüning y Michelinakis están de acuerdo en tres hechos importantes:

a) Reconstrucción biológica del fémur proximal en la mayoría de los casos, incluso sin aporte de injerto óseo.
b) Hundimiento del vástago
c) Luxabilidad del implante. **(13,15,21,26).**

Böhm y Bischel tras revisar 129 vástagos con un seguimiento medio de 4.8 años mostraban un hundimiento medio de 5.9 mm y 7 casos de luxación. **(3)**. Gutierrez y Garcia Cimbrelo en una reciente revisión de 55 vástagos con un seguimiento medio de 6 años presenta hundimientos mayores a 3 mm en 11 caderas y 7 luxaciones. **(14).**
En una reciente revisión realizada en nuestro centro, 88 casos con un seguimiento medio de 6.5 años hemos podido observar:

- Hundimiento en el 45 % de los casos con una media de 13.7 mm. . Fracturas femorales periprotésicas, per y postoperatorias en el 16 % de los casos.
- Luxación en el 6.8 % de los casos.
- Regeneración ósea proximal en el 65 % de los casos.
- Contacto metal-hueso 27.57 mm.

Creemos que el vástago de Wagner es una buena opción para el tratamiento de los aflojamientos protésicos con importantes defectos óseos femorales proximales, aunque presenta un índice de hundimiento importante y una elevada tasa de luxabilidad que exige un encamamiento postoperatorio largo.
La planificación preoperatoria es compleja para determinar la longitud y el grosor del implante. Presenta poco off-set lo que facilita la luxación.

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Es dificil ajustar la longitud y la anteversión, ya que una vez impactada es imposible la vuelta atrás.
Para intentar mejorar algunos de los problemas que presenta la prótesis de Wagner, se ha desarrollado un vástago de revisión cuyas características detallamos a continuación.
Vástago de diseño cilíndrico con unos surcos longirudinales que aumentan en profundidad a medida que nos acercamos a la punta, por lo que el comportamiento biomecánico es cónico provocando un gradiente elástico progresivo.
El diseño cilíndrico permite aumentar las zonas de contacto óseo.
Presenta una angulación de 135º y por lo tanto un mayor off-set lo que disminuye el riesgo de luxación.
Existe la posibilidad de bloqueo inicial con los pernos distales con lo que se consigue estabilización primaria hasta que se osteointegra definitivamente gracias a la cobertura de hidroxiapatita (estabilización secundaria). El encerrojado distal permite el ajuste longitudinal y de la anteversión, permitiendo tantas pruebas de estabilidad articular como sean necesarias antes del bloqueo definitivo.
El bloqueo proximal y la aleta dorsal permiten el cierre de la osteotomía y con ello la reinserción correcta y estable de los pelvitrocantéreos.
Desde Noviembre de 1998 hasta Enero del 2002 se ha utilizado en 110 revisiones de vástago. Presentamos los resultados de los 60 primeros casos. La indicación de la revisión ha sido por aflojamiento aséptico en todos los casos. Dos luxaciones. Un hundimiento por migración de los pernos distales. Ninguna rotura de pernos. Disminución de la estancia hospitalaria. Media superponible a las prótesis primarias (10 días) .
Complicaciones: una fractura periprotésica, un encerrojado distal fallido con migración de los pernos y hundimiento del vástago. Una migración del tornillo proximal. Una rotura del vástago a nivel del agujero de bloqueo distal por desproporción entre el diámetro y el peso del paciente.
Al inicio utilizabamos el vástago IRH solo en casos de grandes defectos óseos femorales o fracturas periprotésicas. Sin embargo, los excelentes resultados obtenidos hasta la fecha han hecho que se halla convertido en la técnica de elección para la mayoría de los recambios de vástago femoral.

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COTILOS DE REVISIÓN: ACETÁBULO / *Revision Cups: Acetabulum*

MODERADORES / CHAIRMEN: **D. DENNIS - W. CAPELLO**

15,15 - 18,15 H.

CIRUGÍA DE REVISIÓN DE CADERA. VERTIENTE ACETABULAR

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La cirugía de revisión de cadera, cada vez más frecuente, supone uno de los mayores desafíos para el cirujano ortopédico. Son numerosos los métodos y sistemas que se han utilizado en este tipo de cirugía sin que se haya llegado a resultados concluyentes. El defecto óseo, entre otros factores, determina la conducta a seguir por el cirujano, tanto en el acetábulo como en el fémur. Diferentes clasificaciones han sido propuestas sin que exista un acuerdo general en relación con su validez. La clasificación propuesta por la AAOS, fácil de utilizar, no introduce la extensión del defecto como sucede con la clasificación de Paprosky. Los Grados 1 y 2 de Paprosky muestran un defecto del lecho acetabular menor del 30%. El grado 3 un defecto que oscila entre el 30 y el 50% , y el Grado 3B un defecto mayor del 50%. A diferencia de la clasificación de la AAOS no tiene en cuenta la discontinuidad pélvica. La técnica quirúrgica es exigente y aunque se debe planificar cuidadosamente, el defecto óseo se determina intraoperatoriamente, siendo generalmente mayor de lo previsto. El daño que el cirujano produce en el momento de la extracción de la cúpula revisada es generalmente un factor importante en el grado de defecto acetabular.

La prótesis cementada constituía en los años setenta el único recurso disponible para poder solucionar este difícil problema. En el momento actual conocemos los resultados tardíos de aquellas técnicas iniciales que tantas dificultades y complicaciones intraoperatorias producían. El empleo de prótesis cementadas aisladas en cirugía de revisión, sólo ha producido resultados favorable cuando no existía un defecto óseo significativo. En nuestras manos, los defectos tipo III y IV (Endoklinik) contraindican su empleo tanto en el acetábulo como en el fémur. Por el contrario, los resultados tardíos de las prótesis cementadas en los defectos tipo I y II fueron satisfactorios. En el momento actual, el empleo de estos implantes puede estar justificado en pacientes mayores, poco activos y sin defecto óseo.

Los anillos metálicos del tipo Müller, Burch-Schneider, o Ganz se utilizaron inicialmente asociados a cúpulas cementadas cuando existía un defecto acetabular del tipo II o III. Si bien los resultados tardíos de aquellos anillos implantados hace 20 años no fueron totalmente favorables, estarían indicados en el momento actual en pacientes poco activos y de cierta edad. La utilización de aloinjertos en conjunto con este tipo de anillo ha ampliado su uso, siendo de gran utilidad en grandes defectos del acetábulo en los que se asocia una inestabilidad de la pelvis.

En los años ochenta, el empleo de **cúpulas poro-**

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sas no cementadas, suplementadas con tornillos, y generalmente de gran tamaño (tipo Jumbo), ha sido generalizado y diferentes series refieren excelentes resultados, especialmente en EEUU. Sin embargo, otros estudios también refieren malos resultados cuando el defecto óseo afecta a más del 50% del lecho óseo. En nuestro centro se utiliza la cúpula porosa no cementada suplementada con tornillos, y con aloinjertos en caso de defecto óseo. Nuestros resultados mostraban una supervivencia de 94% a los 8 años para los acetábulos con defectos tipo I y II de Paprosky (menor del 30% del lecho óseo), 57% para los defectos tipo 3A (entre 30-50%), y 40% para los defectos de tipo 3B (mayor del 50%).. Nuestros resultados concluyen que se puede esperar buenos resultados con este tipo de cúpulas cuando existe un defecto óseo menor del 30%, pero que no se puede esperar una fijación directa entre el hueso y el poro de la cúpula cuando hay un defecto óseo mayor del 50%, donde el lecho óseo es tan delgado que es cuestionable una fijación estable de la cúpula, incluso con ayuda de aloinjertos. Un defecto óseo importante raramente puede ser rellenado mediante el empleo de una cúpula no cementada. Por el contrario, cuando el defecto óseo es menor y el implante está rodeado de hueso original bien vascularizado, la estabilidad de la cúpula es comparable a la que se puede obtener en cirugía primaria.

Injerto impactado con cúpula cementada. Como consecuencia de los buenos resultados observados con el empleo del autoinjerto tomado de cabeza femoral para reconstruir el acetábulo en protrusiones, Slooff y cols extendieron su uso a la cirugía de revisión. Contrariamente a lo que ocurre en el injerto estructural, la estructura abierta del hueso esponjoso, asociado con cemento (técnica de Slooff), permite una buena revascularización, donde la aposición de hueso neoformado precede a su reabsorción, con lo que la sustitución ósea tiene lugar sin que se produzca el aflojamiento mecánico del implante. Diferentes series refieren una completa sustitución del aloinjerto por hueso neoformado. Otra ventaja del hueso impactado unido a cemento es la facilidad de llenar las irregularidades del defecto óseo. Estudios con animales han mostrado la eficacia de esta técnica. En nuestro centro la técnica de Slooff se utiliza corrientemente en acetábulos con defectos tipo 3A y 3B, donde estaría contraindicado el empleo de cúpulas no cementadas y sin discontinuidad pélvica. En una serie de 90 casos con un seguimiento medio de 7.5 años (rango 5-11 años) se observaron dos casos de rerevisión por reabsorción del injerto y aflojamiento de la cúpula en un paciente con artritis reumatoide y en otro con luxación congénita de cadera, y 4 aflojamientos radiográficos probables, resultados incluso más favorables que los observados en pacientes con defecto grado I en los que se utilizó una cúpula porosa. El empleo de injerto impactado y cemento en el acetábulo estaría indicado especialmente en pacientes jóvenes en los que probablemente será necesaria una nueva revisión. El uso de nuevas mallas (X-change, Howmedica) facilita la técnica quirúrgica de la reconstrucción acetabular.

El defecto óseo determina por tanto la técnica que se debe utilizar en la revisión acetabular. **Grandes defectos con discontinuidad de la pelvis** requieren de reconstrucciones más complejas donde es necesario sintetizar la hemipelvis proximal con la hemipelvis distal mediante el empleo de placas y tornillos que fijen la columna posterior del acetábulo, o bien una jaula de Burch-Schneider cuando el defecto es tan grande que es difícil de resolver. Sólo una vez estabilizada la anatomía de

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la pelvis es posible implantar una cúpula, con o sin cemento dependiendo del defecto óseo existente. Las nuevas cúpulas de **tantalio** (Implex, Zimmer) que favorecen la osteointegración pueden utilizarse en grandes defectos sin tener que recurrir a al empleo de grandes anillos con cemento con resultados dudosos.

Conclusiones

-**Sin defecto óseo**, como en cirugía primaria dependiendo de factores generales, como edad del paciente, estructura ósea, etc. Se utiliza generalmente la cúpula hemiesférica porosas no cementada suplementadas con tornillos.

-**Defectos acetabulares menores del 30%**, cúpula no cementada hemiesférica porosa suplementada con tornillos y asociada a aloinjerto triturado para rellenar los pequeños defectos óseos.

-**Defectos acetabulares mayores del 30%** injerto impactado y cemento (técnica de Slooff).

-**Defectos acetabulares con discontinuidad de la pelvis**. Osteosíntesis de las columnas acetabulares con placa y tornillos o con jaula de Burch-Schneider en casos con grave afectación acetabular, antes de implantar la cúpula, cementada o no cementada dependiendo del defecto óseo existente. El empleo de cúpulas de tantalio que se integran con gran facilidad al hueso podría representar una alternativa a los anillos metálicos en grandes defectos.

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ACETABULAR OSTEOLYSIS: MANAGEMENT AND PRINCIPLES

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Preoperative Planning

It is important to identify the nature and severity of the acetabular bone defect prior to the operative procedure. One should have the understanding of a classification system of acetabular bone defects which will allow the surgeon to anticipate those patients requiring extensive acetabular reconstruction from those where a more simple reconstruction may suffice. Depending upon the size and location of the lesion, several options may be considered including impaction grafting, structural grafting, "double bubble" cups, deep profile sockets and any protrusio devices (cages). The use of cages, in conjunction with impaction grafting has been highly successful in our institution. There are a large number of technical

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variables which one needs to consider in the use of impaction grafting with cages. Specifically, this includes the quality of the allograft and the particle size and density. I prefer grafts of larger particle size and density. The technique of compaction of the graft into the defect and the stability obtained by compaction is important. Its not enough to simply rest the cage on an area of compaction. Rather, the cage needs to rest on host bone at some point. For a cage to work effectively, it must go from host bone to host bone (proximal-distal). In the presence of a pelvic discontinuity, a cage alone is not sufficient to deal with the problem and the addition of the addition of a structural acetabular allograft will almost certainly be required. Nevertheless, if one could achieve continuity with host bone proximally and distally, the results of cages combined with compaction grafting are extremely good.

A number of different cages can be used. The most versatile one, however, is the Contour cage which allows the surgeon to span the defect in the acetabulum. This cage comes in three diameters, making it ideally suited for large and small defects. Other cages such as the Contour reinforcement rings can also be considered. The surgeon should identify the take off of the ischium from the interior of the acetabulum and using a small osteotome, open a canal into the ischium to receive the inferior aspect of the cage. It is helpful to bend the tip of the inferior aspect of the Contour ring slightly anteriorly at the time of insertion into the ischium. It is important that it be inserted into rather than onto the ischium (except in cases of pelvic disassociation where distal screw fixation would be advantageous). Once the cage has been placed, it should be screwed firmly into position on host bone. An appropriate sized, all polyethylene cup is then cemented directly into the cage.

REVISION AND OSTEOLYSIS WITH METASUL UP TO 10 YEARS

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REVISION OF THE ACETABULAR COMPONENT WITHOUT CEMENT

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Introduction

Cementless acetabular reconstruction is an excellent option in the revision setting. Prerequisites for a successful reconstruction include an intact posterior column, some superior and inferior medial support. A large hemispherical porous coated implant is fixed to the pelvis with screws. Non-contained bony

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defects can be successfully managed with particulate bone graft.

Methods
One hundred and thirty-eight consecutive acetabular revisions were performed for aseptic loosening in 132 patients and were reviewed at an average ten year follow-up. The revision prosthesis was a cementless hemispherical component (Harris-Galante) and was secured to the pelvis with supplemental screws. There were 75 (57%) women and 57 (43%) men, with a mean age of 52 years (20-79 years). Due to defects in the acetabulum, 80% of the hips required bone grafts, usually a mixture of local autogenous graft and freeze-dried allograft.

Results
All hips which underwent re-revision of the acetabular component and all hips with a minimum of 84 months follow-up were included in this review. Seventeen patients with 17 hips died and 7 patients with 8 hips were lost to follow-up prior to 84 month follow-up leaving 107 patients with 113 hips for review. Re-revision of the acetabular component was performed in 15 hips (10.9%): 6 for recurrent dislocation (4.3%); 6 for deep infection (4.3%); and, 3 (2.2%) during femoral component revision. No acetabular component was revised for aseptic loosening.
103 patients with 109 hips had complete radiographic evaluation at average 124 month (84 - 166 months) follow-up. One hundred and seven acetabular components (92.7%) were stable. Two (1.8%) were unstable (migrated at least two degrees). One of these migrated in the presence of infection and has been revised. The second unstable component was noted to have a poor implant bone interface at 6 wks and migrated by 24 months. This acetabular component has not been re-revised. In addition, one deceased patient had shown migration of the acetabular component at 66 months. The total rate of aseptic loosening was therefore 1.5%.

Discussion and Conclusions
The results of this series of acetabular revisions using cementless hemispherical components were superior to the reported results of revisions of acetabular components with the use of cement. The principles include: a hemispherical porous coated acetabulum, screws for initial stability, support provided by the pelvic bone and morcelized grafts for contained defects. This approach lends itself to the solution of very difficult problems in revision surgery.

REVISION SURGERY IN THR. ACETABULAR CONSIDERATIONS

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BONE GRAFTS IN ACETABULAR REVISIONS

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Long-term reports of the outcomes of cemented acetabular components indicated an increased failure during the second decade (40-60% failure). There have been reports of unacceptably high loosening rates with cemented acetabulum revisions ranging from 10-30% at short follow-up. The use of uncemented acetabular components with porous coatings and supplemental screw fixation has improved the success rate of revision surgery with bone loss.

The assessment of the bone loss accompanying failed acetabular components is important, as it will determine the surgical technique. Radiographic evaluation is part of the pre-operative assessment and usually includes obtaining AP, lateral and special views of the pelvis which may include a 3-D CT scan. Defects may be classified simply as cavitary or segmental. The classification of the acetabulum deficiencies as reported by the American Academy of Orthopaedic Surgery is helpful in planning surgery and assessing the outcomes. Type I deficiency consists of segmental deficiencies, Type II cavitary deficiencies, Type III combined deficiency and Type IV pelvic discontinuities. Another classification as described by Paprosky also may be helpful in planning surgery. Type I acetabulum have small contained defects. Type II is a minimally migrated acetabulum, medial or superior; but with both columns intact. Type IIIA consists of superior migration of more than 3cm and the columns being partially compromised. Type IIIB is a severe defect with compromise of both the medial wall and the anterior and posterior columns.

The current management of patients with severe acetabulum bone deficiency has been modified to avoid structural bone grafts as much as possible. The use of uncemented hemispherical acetabular components with screw fixation makes it possible to manage most revisions and still obtain at least 60% coverage with viable, bleeding bone. Large defects can be managed appropriately with jumbo components, stabilized to the host acetabulum with multiple screws. Absence of the anterior column does not compromise the fixation of cementless components as the implant can be successfully stabilized to the posterior column and dome of the acetabulum. Bone grafting to enhance existing stock is carried out using non-structural morselized frozen allograft, however, the use of structural segmental grafts can be used to augment bone stock, but should not be utilized to support the prosthesis. Type IV pelvic discontinuities with massive loss of the dome of the acetabulum is a general contra-indication to the use of hemispherical cementless cups and usually requires reconstruction rings with or without cement.

The surgical technique requires excellent visualization of the acetabulum and if adequate exposure of the entire periphery of the acetabulum is not obtained without detaching the greater trochanter, a trochanteric osteotomy should be performed. Host bone should be preserved. Maximum contact between the remaining host bone and the porous coating is important and it is critical to preserve, if possible, both the posterior and anterior columns. However, in certain circumstances the anterior column may be sacrificed in order to provide component stability. Rigid fixation should be accomplished by the use of multiple screws avoiding placement in the anterior-superior quadrant. Recent intermediate results of cementless acetabular components for

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revision surgery have been excellent. Tanzer et al reported on 140 uncemented acetabular revisions in 124 patients with definite loosening demonstrated in only two hips. Silverton reported on 138 acetabular revisions with a cementless hemispherical acetabular component and at a mean follow-up of 100 months, none had been revised for aseptic loosening and 92% of the acetabular components were stable radiographically. The results from our institution confirm these excellent outcomes.

The results of the use of uncemented acetabular components for revision surgery suggest excellent outcomes with superior fixation when compared to cemented components at intermediate follow-up times. Use of large components that rely on the posterior column and acetabular dome for fixation appear to function satisfactorily, even in a significantly bone deficient acetabulum.

STANDARD PRESS-FIT CUP AND HOMOLOGOUS BONE-GRAFT FOR ACETABULAR PROSTHETIC REVISION

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Introduction

Cup revision surgery should correct bone deficiency, provide long term stability of the implant and restore the anatomy, if possible. These targets are hardly achievable when the loss of bone involves the major acetabular columns denying an effective mechanical support to the prosthetic cup.

Structural bone allograft with cementless cup has been considered; the allograft was employed to re-establish leg length and to maintain a sufficient off-set. Restoring biologically the pelvic anatomy, bulk allograft could be also suitable in anticipation of a further surgery. Different revision surgical strategies have been suggested but none able to biologically restore the bone stock employing a cementless pres fit cup[1,2].

The aim of this study is evaluate the intermediate survival of acetabular reconstructions with a not weight bearing structural bone allograft and a hemispherical press fit cup.

Materials and Methods

Between October 1992 and December 1996, twenty-four patients had an acetabular revision for aseptic loosening with a severe acetabular loss of bone stock. All the acetabular defects were type III-IV according to Gross[3] classification.

Of the twenty-four patients three were lost to follow-up evaluation before five years. All the remaining patients have an average follow-up of six years. There were seventeen women (80.9 percent) and four men (9.1 percent). The average age at surgery was 64.5 years (range, twenty-seven to eighty-three).

The bulk allografts, fresh-frozen femoral heads stored at – 80°C, were shaped to have the larger diameter widest than the larger dimension of the bone defect. When the defect was too big for a single graft two big halves were suitably shaped. The bone grafts were thereafter impacted in the defect. Then the reconstructed acetabula were reamed to hold primary hemispherical press fit cups. Afterwards the cups were impacted attempting to achieve direct contact with the host bone in the acetabular weight bearing area; the contact with the allografts being only in region of interest (ROI) II or III of DeLee and Charnley.

Cups were considered definitely unstable when tilt more than four degrees on anteroposterior view

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or migrate more than four millimeters medially or superiorly.
The incorporation of the grafts was estimated on postoperative x-rays; integration, resorption, remodeling and substitution with host bone were recorded.
Cups survival was estimated by Kaplan-Meier's product-limit method to estimate the cumulative probability of revision.

Results
Of the twenty-one patients, two required a revision surgery. In the first case twenty-two months after surgery the prosthesis was completely removed with Gilderstone's procedure because of septic loosening. In the second revised case, signs of aseptic loosening were present on x-ray; the bone graft was remodeled and osteointegrated. Eight months later the cup implanted was removed. At revision the bone stock was already recovered; a primary press fit cup was implanted; no further grafting was needed. The cup reimplanted at 5 years follow-up is osteointegrated and stable, and the graft is still integrated.
The average Merle d'Aubigné hip score improved from 10.9 points before surgery to 16.3 at the latest follow-up. Of the nineteen hips not revised, four hips were rated as excellent, seven hips as very good, four hips as good, two hips as fair, and two as poor.
All the cups under observation were stable at the latest follow-up. The graft was reabsorbed only in the case revised due to septic loosening. In all the other cases (95.8%) the graft was integrated and the anatomy restored.
The Kaplan-Meier cumulative probability of not having revision for loosening at 8 years predicted a survival rate of 88.7% (95% CI 100 to 73.6).

Discussion
The management of severe bone stock deficiency at cup revision surgery is a very demanding problem. Structural bone grafts are needed to biologically restore the anatomy and to assure an effective mechanical support to the prosthetic cup. The intermediate survival of acetabular reconstructions with a not weight bearing structural bone allograft and a hemispherical press fit cup seems to be valuable; anyway, in the literature, the employment of structural allografts is controversial. Some authors, reporting on severe acetabular deficiencies restored with bulk grafting alone, advise against a further employment of this technique[4,5,6].
In contrast with these studies, the 88.7% survival rate at eight years of our serie is very good. The only significant and remarkable difference in comparison with other series is that in our series the structural allografts were placed in the non-weight-bearing area of the acetabulum, spared from highest mechanical stresses.
Notwithstanding this there are some limits and concerns related to the bulk graft impacting technique. An efficient bone banking is required; and even if low, the infection risk related to allografts employment is present. Furthermore the influence of a displaced center of rotation on the long-term survival of the implant could be a major concern with the proposed technique. In this series we have recorded an average lateral displacement from the estimate center of rotation of nine millimeters and an average proximal displacement of 5.4 millimeters. This cup's displacement does not seem to influence the cup survival rate. At minimum time of 5 years. Finally, more conclusive results for our surgical technique probably need a longer follow-up. Notwithstanding we believe that these results have to be considered very successful for a very

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demanding surgery, and that the bulk graft impacting technique is a viable alternative to reconstruct severe bone stock deficiencies.

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USE OF CUSTOM TRIFLANGED ACETABULAR COMPONENTS FOR MASSIVE PERIACETABULAR DEFECTS

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Cavity Filling Components

Numerous surgical treatment methods have been utilized for treatment of massive peri-acetabular bone loss in revision total hip arthroplasty. Management options include structural allografting, impaction allografting, noncustom anti-protrusio cages, and custom, triflanged acetabular components (CTAC). CTAC are designed from a thin-cut CT scan and subsequent three dimensional reconstruction of the pelvis. Metal substraction software programs are utilized to minimize metal-induced distortion. These type of components are utilized when little to no osseous support remains in the acetabulum. Fixation is obtained by creation of a triflanged prosthetic component which is anchored to the ilium, ishium, and pubis with multiple fixation screws. Acetabular defects are grafted with large amounts of cancellous allograft. Modular polyethylene liners are then locked into the CTAC. CTAC have presently been utilized in fifteen cases of complex revision total hip arthroplasty. Massive periacetabular bone loss was present in each case. (Paprosky 3B). Fourteen of 15 cases (93%) are considered clinically successful at short term follow-up (average 24 months; maximum 48 months) with stable fixation and reconstruction of periacetabular bone. One failure occurred due to loss of fixation in a patient with a preoperative dissociation of the hemipelvis and severe

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osteopenia. CTAC provide the surgeon with another alternative to treat patients with massive periacetabular bone loss. Longer follow-up is needed to assess the durability of this treatment method. Presently, these should be utilized with caution in cases with a preoperative dissociation of the hemi-pelvis.

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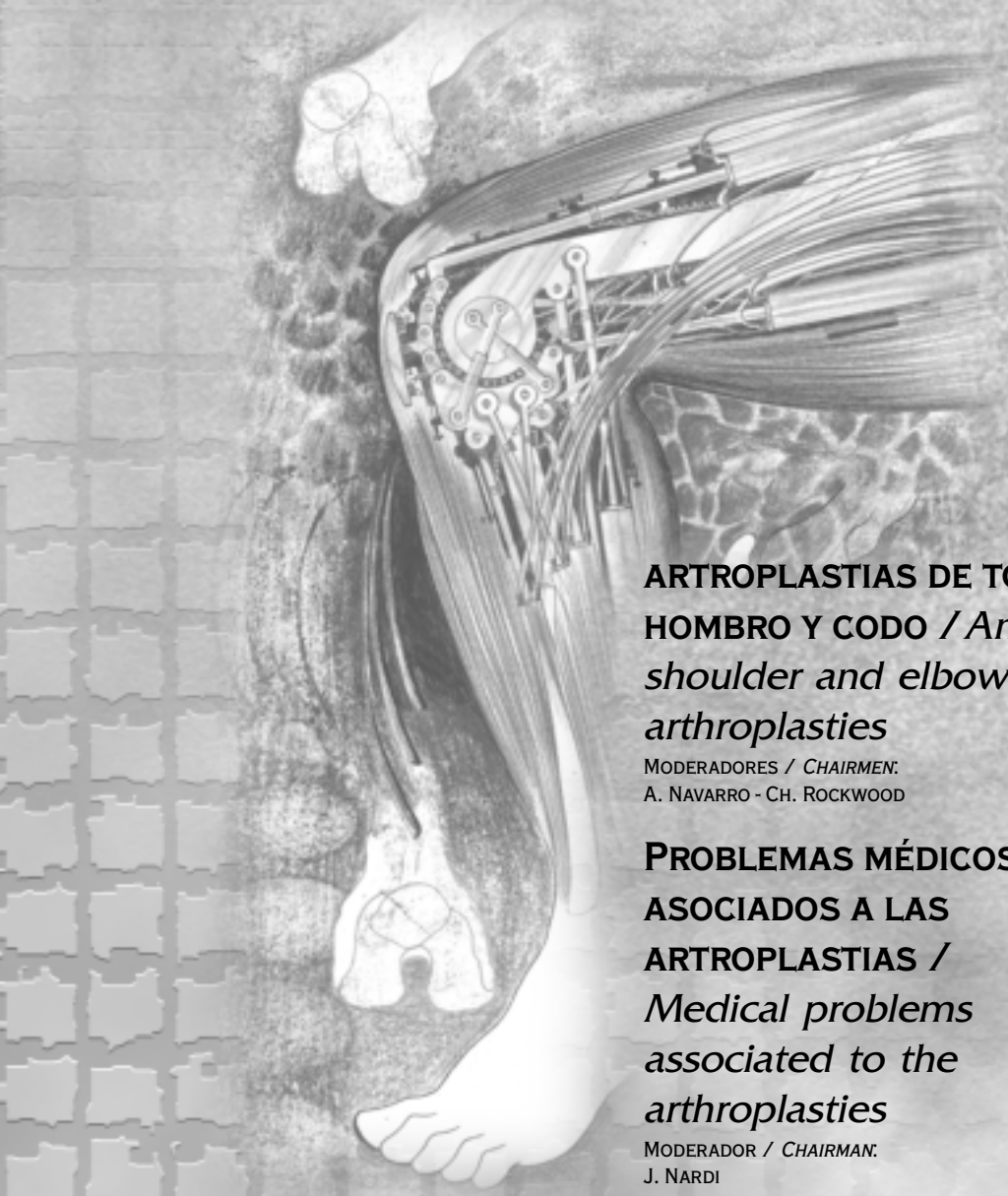
MIÉRCOLES, 26 MARZO
WEDNESDAY, 26TH MARCH



ARTROPLASTIAS DE TOBILLO, HOMBRO Y CODO */ Ankle, shoulder and elbow arthroplasties*

MODERADORES / *CHAIRMEN*:
A. NAVARRO - CH. ROCKWOOD

PROBLEMAS MÉDICOS ASOCIADOS A LAS ARTROPLASTIAS */ Medical problems associated to the arthroplasties*

MODERADOR / *CHAIRMAN*:
J. NARDI

RODILLA */ Knee*

MODERADORES / *CHAIRMEN*:
J. GALANTE - M. FREEMAN

ARTROPLASTIAS DE TOBILLO, HOMBRO Y CODO / *Ankle, shoulder and elbow arthroplasties*

MODERADORES / CHAIRMEN: **A. NAVARRO - CH. ROCKWOOD**

9,00 - 12,15 H.

ARTROPLASTIA DE TOBILLO

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La mayoría de autores coinciden en que los resultados a medio-largo plazo de la primera generación de prótesis de tobillo han sido poco gratificantes, con un 60 % de malos resultados. Esto ha ocurrido tanto con prótesis no constreñidas como la Smith o Bath implantadas por nosotros, como con las prótesis semiconstreñidas o constreñidas.
Actualmente, en un intento de encontrar solución a la problemática de la prótesis total de tobillo, estamos utilizando la prótesis de nueva generación RAMSES que presenta para nosotros una serie de ventajas sobre las anteriores:

1) Incorpora un menisco móvil de polietileno que:
   - Aumenta la superficie de contacto entre los componentes tibial y astragalino, lo cual facilita la transmisión de cargas.
   - Los diferentes grosores de polietileno permiten una adecuada tensión ligamentosa, incrementando por tanto la estabilidad de la prótesis.
   - Permite una movilidad triplanar entre los tres componentes del implante.
   - Amortigua las fuerzas en el punto de anclaje de la prótesis con el hueso, lo cual evita el aflojamiento del implante.
2) El anclaje del componente tibial respeta la cortical anterior de la tibia la cual esta muy solicitada mecánicamente durante la marcha, cuando el tobillo se encuentra en dorsiflexión.
3) El componente tibial incorpora unos topes laterales que estabilizan la prótesis en el plano transversal, evitando un conflicto mecánico entre los maleolos y el implant .
4) La forma esférica del componente astragalino permite un movimiento de prono – supinación el cual puede por un lado sustituir mecánicamente una posible anquilosis de la subastragalina y por otra parte disminuye tensiones en el punto de anclaje óseo .
5) Para la implantación del componente astragalino se realiza una resección plana de la troclea la cual facilita la técnica quirúrgica a la vez que extirpa una zona de hueso que frecuentemente se encuentra necrosada. Esto permite por tanto un mejor anclaje protésico.

Nuestra experiencia personal con este tipo de prótesis es todavía limitada: doce pacientes intervenidos con un seguimiento máximo de 69 meses y mínimo de 6 meses. Los resultados hasta el momento son alentadores, estando todos los pacientes satisfechos excepto uno al que ha habido que realizarle una artrodesis.

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ANKLE ARTHROPLASTIES

N. Böehler
EFFORT PRESIDENT. ALLG. KRANKENAHUS LINZ
(AUSTRIA)

Long-term results of total ankle arthroplasty systems in the early days were dissatisfying. Reason was a high loosening rate due to non-optimal biomechanics situations and due to large bone resections.

The results changed with the introduction of a sliding core giving freedom of movement and neutralizing the forces adversely to the anchoring of the components.

The longest results published are for the star prostheses with 15 years results, published by Prof. Kofoed.

Our personal experience started in 1993 using the star endoprostheses having implanted 36 until the end of 2002.

Indications were severe symptomatic osteoarthritis, posttraumatic osteoarthritis and rheumatoid arthritis. Due to the good results we are using this implant also for young patients. Following the AOFAS-Score we found 70 % excellent results, 15% good results, 8% fair results and 8% with a poore result. We had one septic loosening, requiring reoperation and arthrodesis. Two patients had an interoperative fracture of the medial malleolus requiring an immediate intraoperativ ostesynthesis. Two patients had delayed heeling due to skin necrosis; one patient required reoperation due to inlay-luxation. Summarizing can be said that total ankle arthroplasty is a promising alternative to Arthrodesis. Due to immediate pain reduction there is a good satisfaction of patients. The preserved mobility is protecting the other foot joints.

TREATMENT OF FRACTURES OF THE PROXIMAL HUMERUS WITH A PROSTHESIS HOW I JUDGE HEIGHT AND VERSION WHEN TREATING FRACTURES OF THE PROXIMAL HUMERUS

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There are four key steps in managing three and four-part fractures of the proximal humerus. Probably the hardest parts are to regain the proper length of the humerus and the second is to put the prosthesis in the proper retroversion. It is easy to say and do this but it is very difficult to do a trial reduction with the prosthesis in what you THINK is the proper position. The final two steps are secure fixation of the tuberosities to the upper shaft of the humerus once the prosthesis has been secured with cement and finally, it is important to remember that early rehabilitation is critical in obtaining a reasonable functional range of motion. Following a long deltopectoral incision and removal of the avascular head of the humerus, the greater tuberosity must be freed up and then mobilized so that they can be properly repaired back to the UPPER SHAFT of the humerus. With the stem of a small trial prosthesis down into the medullary canal, the height of the prosthesis and the retroversion can be measured. What I like to do is have my surgical assistant flex the elbow 90 degrees, hold the arm in zero degrees of rotation and then gently apply traction to the arm. This restores normal muscle length of the arm. I then lift the prosthesis up and out of the humerus with an instrument so that the head is at the same level as the glenoid fossa. You can then precisely measure the distance between the top of the shaft of the humerus and the bottom of the collar of

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the prosthesis. The Global "Fx" prosthesis has laser marks on the shaft so that you can see exactly how proud the prosthesis is up and out of the humerus. With the assistant still maintaining the gentle traction and with the arm still in zero degrees of rotation, I internally rotate the prosthesis to where the head is pointing directly into the glenoid fossa. This varies between 20 and 40 degrees of retroversion. If the prosthesis you are using has an anterior fin then it will usually line up with the bicipital groove. Once these measurements have been made, it would be nice to hold the prosthesis in the proper position and then do a trial range of motion to be sure that the head of the humerus maintains itself lined up with the glenoid fossa but this is almost impossible to do. The Global System of DePuy has a Fracture Jig that can be clamped onto the upper part of the shaft. The Jig is then clamped to the anterior fin of the prosthesis. The trial prosthesis is then positioned in the ideal predetermined position and a trial reduction can be performed. Mild correction can be made by increasing or decreasing the height and increasing or decreasing the retroversion by adjusting the clamp. The surgeon then has two methods for cementing in the final prosthesis:

a) With the jig removed and the cement and sutures for tuberosity fixation in place, the final prosthesis is inserted into the predetermined site i.e. height is determined by using the laser marks on the stems and the version is determined by the relationship of the anterior fin with the bicipital groove.

b) In this second option the clamp can be removed from the trial prosthesis. Then after cement and sutures are in place, the final prosthesis is inserted and the clamp is applied to the same hole in the anterior fin. When the cement has set up the Jig is removed.

When the cement is set up, the tuberosities are then secured back to the upper shaft through the drill holes using the heavy nonabsorbable sutures. Because there are holes in the anterior fin, additional stability can be achieved by passing the heavy nonabsorbable sutures through the tuberosities and through the holes in the anterior fin. The medial fin of the "Fx" prosthesis also has a hole in it so that a non-absorbable heavy suture can be placed through it and then around the two tuberosities for additional fixation.

SHOULDER ARTHROPLASTY IN THE CUFF DEFICIENT SHOULDER

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Management of these patients has been a dilemma for many orthopaedic surgeons for many years. As the cuff fails and the head migrates superiorly, the humeral head begins to articulate with the bottom of the acromion and the acromioclavicular joint. This causes a great deal of pain and as a result, the patient doesn't move the shoulder. With loss of motion and joint nutrition, the joint begins to fail, collapsing into a state known as cuff tear arthropathy. This condition is painful and extremely debilitating to the patient. Multiple operative procedures have been attempted and probably the one that has been known to consistently fail is total shoulder arthroplasty.

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With total shoulder arthroplasty, the proximal humerus is continued to be pulled upward by the deltoid muscle which puts pressure on the upper border of the glenoid prosthesis causing it to be displaced and, hence, a loose glenoid and a painful situation.

Several authors have reported on using hemiarthroplasty in cuff deficient arthritic shoulders. It is a great alternative to performing a fusion because at least it will allow some relief of pain and sometimes pretty good motion. Between 1979 and 1989 we performed hemiarthroplasty in 21 patients. [1] The procedure was performed through a long deltopectoral incision without detaching the origin or insertion of the deltoid. The coracoacromial ligament was preserved as a static restraint against anterior escape of the humeral head. The head of the humerus was resected in the usual fashion and replaced with a standard sized humeral head prosthesis. I believe it is a mistake to replace the humeral head with a very large humeral prosthesis because you must maintain soft tissue balance about the shoulder i.e. 60 to 75% of internal and external rotation, easy overhead elevation and the all important ability of the shoulder to be subluxed posteriorly at least 50%. This technique is particularly advisable when the head has not migrated superiorly all the way up and articulating with the bottom of the acromion. On occasion the greater tuberosity is quite prominent and in order to keep it from impinging into the acromion during abduction, the greater tuberosity can be resected. Postoperatively, 87% of our patients had mild or no pain; were able to sleep okay and were able to perform daily living activities. The average active flexion increased from 70 degrees to over 100 degrees.

In cases of severe displacement of the humeral head, for example as seen in patients with cuff tear arthropathy, another type of prosthesis can be used. In 1999 the Cuff Tear Arthropathy (CTA) humeral head prosthesis was developed. In this surgical procedure a standard humeral head is used to balance the soft tissues and then a special CTA head is inserted. The value of this CTA head is that it has a lateral extension of the articular surface, which allows smooth articulation from the glenoid and under the acromion process. This prosthesis has allowed pain relief and restoration of function for these debilitated patients.

The BiPolar prosthesis has also been introduced in the treatment of patients with cuff tear arthropathy. In this system a small ball of the humeral component articulates into the large polyethylene ball that sits inside of a large metallic component. Theoretically, there is supposed to be motion between the small ball and the polyethylene and the large ball and the glenoid fossa. Unfortunately, the size of the component is three times greater than any of the other prostheses on the market. There is concern for the generation of polyethylene particle and concern for the fact that in many instances scarring prohibits bipolar motion, which is then followed by the head becoming locked into a vertical position. The continued pull of the deltoid forces the prosthesis up into the acromion process, occasionally producing anterior/superior escape of the prosthesis.

A successful reverse shoulder prosthesis was developed by Dr. Gramont of France. This system has been used for approximately 20 years in treating severe cases of patients with cuff tear arthropathy. The Reverse Shoulder Prosthesis is not currently approved by the FDA for use in the United States. I believe that it will be a very useful prosthesis in the management of patients with cuff tear arthropathy.

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MIDDLE-TERM RESULTS AFTER SHOULDER ARTHROPLASTY – EVALUATION OF SHOULDER FUNCTION WITH A NEW ASSESSMENT SET

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Introduction

In the evaluation of the major joints, self-assessment tools have become wide spread aiming at a more precise quantification of joint function. For the shoulder joint, different such tools have been developed. However, there are only few data on the relationship between subjective self-assessment of joint function and objective measures. Therefore, we developed a comprehensive assessment set for the evaluation of shoulder function including both general health questionnaires, self assessment questionnaires of shoulder function and objective clinical investigations. In a first study, we used this set for the assessment of middle-term results after implantation of shoulder arthroplasties.

Material and Methods

In this study, we included 43 patients (10 male, 33 female, mean age 66 years) who were consecutively treated with shoulder arthroplasties between 1996 and 1997 for primary or secondary osteoarthritis of the shoulder. In 36 patients implantation was performed unilaterally, and in 7 patients arthroplasties were implanted in both shoulders, resulting in a total of 50 shoulder joints included in this study. The minimum follow-up time was 5 years. For the assessment of shoulder function, we used a newly developed evaluation set including the SF-36, the DASH, the SPADI, the ASES (patients assessment part and clinical examination part), the Constant-Score (CS) and a radiological evaluation form. All scores were fitted to a range of 0 – 100. The questionnaires were completed by the patients prior to the clinical examination. In addition, in all patients both radiological examinations and ultrasonographies of the operated shoulders were performed.

Results

In the SF –36 score, the mean physical component scale (PCS) was 37 (17 – 58 points), the mean mental component scale (MCS) was 54 (20 – 68 points). Subjective assessment of the shoulder function by the SPADI questionnaire revealed a mean of 69.9 (22 – 99 points), patients assessment ASES (pASES) yielded a mean score of 68 (15 – 100 points). Clinical examination resulted in a mean Constant- Score of 62 (18 – 93 points), and a mean clinical ASES – Score (cASES) of 82 (54 – 97 points).

Comparison between the patients self assessment and the objective scores revealed a significant correlation between the PCS of SF-36 and the CS ($r = 0.454$, $p = 0.002$) but not with the pASES. Also, the CS showed a strong correlation ($p < 0.001$) with both the SPADI ($r = 0.823$) and the pASES ($r = 0.705$). The pASES significantly correlated with the SPADI and the pASES ($p <$

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0.001), this correlation, however, was weaker than for the CS (SPADI: r = 0.566; pASES: r = 0.483). In contrast, no correlation was found between the MCS of the SF-36 and the clinical scores.
At radiological examination, radiolucent lines of more then 1mm were seen around the glenoid - component in 1 case and around the humeral - component in 2 cases.

Conclusion
Assessment of middle term results after shoulder arthroplasties yielded favorable clinical and radiological results. Hereby, the newly developed assessment set proved to be a feasible tool for a comprehensive assessment of shoulder function. In addition to clinical outcome assessment, with this set it is possible to gain important and new insights on the relationship between objective measures and subjective patients-assessment of shoulder disorders and postoperative conditions. For this, however, further studies will have to be conducted.

HEMIARTHROPLASTY VS TOTAL SHOULDER ARTHROPLASTY

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I believe that it is fair to state that there is no place for using a hemiarthroplasty or a total shoulder arthroplasty for the management of all patients with arthritic problems of their shoulder. Some patient problems require the use of the HA and others require the use of a TSA. I believe that most shoulder problems can be successfully managed with an HA i.e. three and four-part fractures of the proximal humerus, AVN of the head of the humerus, most cases of osteoarthritis, rheumatoid arthritis and all of the patients that have degenerative glenoid humeral joint arthritis and no cuff or severe cuff deficiency.

For me there are limited indications for using a glenoid prosthesis i.e. specifically for a nonconcentric glenoid especially when the glenoid has 15 degrees or more of either anterior or posterior glenoid erosion. I will also use a glenoid prosthesis after the glenoid has been reamed and I cannot obtain a stable joint with balanced soft tissue which allows proper joint rotation and elevation. While glenoid prosthesis are available, I have not used a posterior or anterior augmented glenoid or a metal backed glenoid. The metal backed glenoids seem to "overstuff" the joint, have loosening of the polyethelene from the metal backed tray and have a tendency for loosening in the bone structure.
One of the concerns that I have in using a total shoulder arthroplasty for all cases has to do with the wearing of the glenoid ultra high molecular weight polyethelene (UHMWPE) component. The literature dealing with total hip and knee arthroplasty reports that the greatest cause for failure is the wearing of the UHMWPE prosthesis. The longer the prosthesis is in place, the greater the odds are for failure of the plastic component. Failure comes from the wear of the metal head on the UHMWPE which constantly generates submicron particle debris (less than one micron to 150 microns) that overwhelm the body's ability to remove that material. In the hip the particular load is in the order of 40 billion particles per year or greater. Production of the submicron particles of UHMWPE stimulates the production of cytokines which produces an increase production of osteoclasts, a decrease production of osteoblasts and hence the osteolysis. The wear on UHMWPE is unavoidable, continuous and

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ultimately is the most common cause of failure of total hip and knee arthroplasty. Of course patients with total shoulder arthroplasties do not have the same stresses on the plastic glenoid prosthesis as those seen in the hip and knee. The question is, will the same fate occur in patients treated with total shoulder arthroplasty? It will probably take much longer for the process to occur but the answer is yes, we have already treated patients that have had a failed total shoulder arthroplasty secondary to the degeneration and wearing of the UHMWPE. The x-ray and gross findings are the same as those seen with hip and knee failures and arthroscopic examinations have revealed macrophages loaded with UHMWPE particles.

A review of the literature dealing with the treatment of arthritis of the shoulder presents variable results when using a hemiarthroplasty or the total shoulder arthroplasty:

Literature Dealing With Osteoarthritis

Neer[1] in 1974 reported the six-year follow-up I(10-year in some patients) n 48 shoulders with osteoarthritis treated with an HA. He noted satisfactory results in 83 percent of the patients. He did not alter the smooth glenoid surface and he noted no resorption or intrusion by the prosthesis into the glenoid. Clayton[2] compared HA over TSA in osteoarthritis and noted no difference in the relief of pain or function. Boyd[3] in 1990 compared 64 patients with osteoarthritis that were treated with an HA compared to 146 patients that were treated with a TSA. They reported that the patients had the same functional improvement. The pain, range of motion and patient satisfaction seemed better in the patients treated with TSA but the difference was not statistically significant. In 1996[4] we reported on 45 patients with osteoarthritis treated with HA vs TSA and noted no statistically significant difference in pain relief, range of motion, patient satisfaction or in the improvements of 15 functions of everyday living activities.

A prospective outcome study in 173 patients treated the first time with osteoarthritis with either HA or TSA was reported in 1996[5]. The conclusion with a minimum follow up of two years was that both HA and TSA were successful in improving the quality of life, improving range of motion and decreasing pain. Patients treated with TSA had somewhat better relief of pain and range of motion . However, the improvements in pain and range of motion in the patients treated with TSA over those treated with HA was minimal. It is important to remember that patients treated with HA had a procedure that was easier to perform, had less time on the operating table, no cement in their shoulders, no worry about later development of polyethelene disease, no future problems of glenoid loosening, and no problems with glenoid loosening secondary to late cuff failure and proximal migration of the humeral prosthesis. In 1996 Bigliani et al[6] treated 31 shoulders with osteoarthritis and intact cuff with a hemiarthroplasty procedure. The patients were evaluated by the American Shoulder and Elbow Surgeons, Neer and constant end result scoring methods. They reported that the outcome varied with the amount of glenoid wear. However, in their patients with a smooth concentric glenoid, they reported that 86 percent had excellent results and 7 percent and good results.

Management of Patients with Rheumatoid Arthritis

Some patients have a functioning rotator cuff at the time of arthroplasty and are treated with a TSA. However, I am concerned about using a

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glenoid prosthesis in rheumatoid patients because of the future progression of the disease process which may destroy the cuff and allow superior migration of the humeral prosthesis which will produce abnormal, superior glenoid rim pressure and subsequent loosening and displacement. In 1993[7] we reported on 45 shoulders treated with hemiarthroplasty and total shoulder arthroplasty. The end results grading the range of motion, patient satisfaction, function and pain relief favored patients treated with hemiarthroplasty. Cofield et al[8] in 1995 reported on 35 shoulders treated with osteoarthritis and 32 patients that were treated with rheumatoid arthritis that were treated with a hemiarthroplasty procedure. Their average follow-up was nine years and concluded that the HA should only be used sparingly when used to treat rheumatoid arthritis and osteoarthritis. They reported that 18 of 35 patients treated with HA had unsatisfactory results and 12 patients required revision of HA to TSA because of pain. However, 18 of their patients had severe erosion of the glenoid on preoperative x-rays and 22 of their patients had posterior subluxation of the humeral head on preoperative x-rays and so many patients had erosion and posterior subluxation. It would appear that many of those patients would have been better treated with the elimination of the posterior erosion, elimination of the posterior subluxation and then managed with a total shoulder arthroplasty. I believe their report supports the theory that you cannot treat all shoulder problems the same way i.e. some patients need a hemiarthroplasty and some are best treated with a total shoulder arthroplasty.

Sneppen et al[9] reported a prospective study of 62 shoulders with grade IV and V Larsen rheumatoid arthritis who were treated with a Neer total shoulder arthroplasty. He reported that at an average of 92 months that proximal migration had occurred in 55 percent of the patients and 40 percent showed radiographic loosening, translation or displacement of the glenoid prosthesis . However, despite the glenoid loosening and displacement and loosening of the press fit humeral components, 89 percent of the patients had good pain relief. The loosening did not influence range of motion or function. He concluded that a cemented HA may be the better treatment in end stages of rheumatoid arthritis of the shoulder.

Glenohumeral Arthritis and Absent Cuff

In 1991 Cofield et al[10] reported on treating 22 patients with arthritis of the glenohumeral joint and no cuff with HA or TSA. Patients treated with HA had the poorest pain relief but they reported problems with glenoid loosening in patients treated with TSA. Glenoid loosening in patients with deficient cuff treated with TSA has also been reported by Matsen et al[11] and Brems et al[12] . In 1992 Bigliani et al[13] reported on 30 patients with osteoarthritis and cuff deficient shoulders treated with HA and TSA and concluded that at 40 months follow-up that HA gave pain relief in 95 percent of the patients treated with a HA. In 1996 Williams and Rockwood[14] reported on treating 21 shoulders in 20 patients with glenohumeral arthritis rotator cuff deficient shoulders. After an average of four years follow-up using the limited goal criteria of Neer, 86 percent of the patients had achieved a satisfactory result i.e. pain was improved, deflection improved from an average of 70 degrees pre-op to a 120 degrees post-op. External rotation improved from a pre-op of 27 degrees average to a post-operative average of 45 degrees. None of the patients developed post-operative instability of their shoulder.

The primary issue in treating patients with arthritis

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of the glenohumeral joint and loss of the rotator cuff is that you only have three options i.e. do nothing; treat the patient with an arthrodesis or manage the patient with only a humeral component prosthesis. As this problem primarily affects older patients, I believe that treating these patients with a humeral replacement prosthesis which allows the use of their shoulder without pain is a far better procedure than managing the patients with an arthrodesis.

In summary arthroplasty of the shoulder is indeed a complicated procedure. The final selection of hemiarthroplasty or total shoulder arthroplasty is dependent upon the specific problem to be addressed. While most patients with shoulder problems can be successfully treated with a hemiarthroplasty some patients will require the use of a total shoulder arthroplasty.

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COMPLICATIONS OF SHOULDER ARTHROPLASTY

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Because more and more shoulder arthroplasties are being performed around the world, it is certain that we will see more and more patients with complications secondary to the procedure. Because long term follow up has been only scantily reported, we can't say at this point which are the most common long term complications. Certainly, loosening of the glenoid prosthesis, malalignment of the component, component instability, problems with the rotator cuff, loosening of the humeral component, nerve injuries, muscle dysfunction, fractures of the humerus, and infection are some of the more common short and midterm complications.

When faced with a patient who has a painful shoulder as a result of an arthroplasty procedure, I believe there are several important points to remember. I prefer to review all of the previous notes, operative reports, and the pre and post-operative x-rays. I don't believe you can second-guess what happened unless you have these reports to review. Obviously, a very careful history and physical examination are two of the key steps in making the proper plan for management. Ordinarily, routine A/P and axillary lateral x-rays will suffice, but on occasion it will be necessary to obtain a C T scan and even perhaps an MRI to determine what is going on with the anatomy about the shoulder. If the patient has received a constrained total shoulder arthroplasty, it is likely that the prosthesis failed at the glenoid because of the inability to maintain fixation at that point. Today, constrained arthroplasty is rarely indicated except perhaps as a salvage procedure. A painful constrained arthroplasty procedure will usually require a revision usually to a hemiarthroplasty but occasionally it can be converted to a total shoulder arthroplasty.

1. LOOSENING OF THE GLENOID COMPONENT:
This is probably the most common problem we see in total shoulder arthroplasties. Some of the more common reasons for glenoid loosening are related to poor cement technique, polyethylene slipping out of the metal tray, or actual loosening of the porous coated metal tray with or without fracturing of the screws. Neer has reported a very low incidence of glenoid loosening whereas

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Brostrom has reported radiolucent lines about the glenoid prosthesis in 25 of 26 shoulders at an average of four years after surgery. The development of the radiographic findings was associated with a decrease in function and a mild increase in pain. Torchia and Cofield reported an increase in lucent lines and loosening of the prosthesis in long-term follow up. At 12 years follow up, radiolucent lines were noted in 84% of their cases and 44% of those cases had definite loosening. As with the Brostrom's series, the loosening of the glenoid component was associated with pain. The question then becomes, are lucent lines after surgery important? Are they normal? And will they progress over time? Currently, there is a lot of work being done by orthopedists to prevent glenoid loosening by using better cement techniques; using a cementless press-fit metal backed prosthesis with screws; and in some situations, using metal-backed prosthesis with cement; plasma spray on the implant, or using press-fit of an all poly prosthesis. Polyethylene wear debris can indeed be a problem in aseptic loosening. Certainly, the Hylamer glenoid prostheses that were sterilized by gamma irradiation in air have been found to become brittle, eroded, and extensively worn, which sets up the osteolysis and loosening. It should be remembered that all polyethylene can produce wear particles that, just as it does in the hip and knee prostheses, can produce osteolysis and subsequent loosening of the glenoid prosthesis. Usually this osteolysis loosening is associated with long-term follow up cases.

The management of a loose glenoid component requires a major revision procedure. The old glenoid component will need to be removed along with all the cement, scar tissue, and all of the fibrous tissue from around the defect in the glenoid itself. The glenoid may need to be reamed back to a normal version position. Rarely will the glenoid have enough remaining bone for fixation of another prosthesis; so the most likely scenario is to impact autogenous or allograft cancellous bone into the defect, thus converting a total shoulder arthroplasty into a hemiarthroplasty.

2. LOOSENING OF THE HUMERAL COMPONENT:

It is rare to see loosening of the humeral component that has been cemented into place. Some of the new modular humeral components and their instrumentation are designed so that a very secure press-fit of the humeral component can be achieved. I think the surgeon has several options if the humeral prosthesis is loose and these would include using a porus coated prosthesis, using cement, or employing autogenous bone graft down into the proximal humerus as an impaction grafting technique (preferred technique).

3. GLENOHUMERAL INSTABILITY MALALIGNMENT OF COMPONENTS:

Glenohumeral component instability/ malalignment is the most common problem in hemiarthroplasty and is the second most common problem in total shoulder arthroplasty. Anterior instability is usually secondary to excessive anteversion of the humeral component, excessive posterior capsular tightness or as a result of subscapularis tendon rupture. Normally, the humeral component is placed in approximately 25 degrees of retroversion.

Posterior instability is the result of excessive retroversion of the humeral component. A very common cause of posterior instability is the fact

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that excessive posterior glenoid wearing has not been recognized. If the glenoid version is not corrected and the glenoid prosthesis is placed facing posteriorly then the head of the humeral prosthesis will sublux or dislocate posteriorly. Even if the humeral component is placed in the right version and the glenoid erosion is recognized, posterior subluxation is usually the rule. For this reason if the patient has limited external rotation preoperatively or has posterior subluxation of the humeral head from the glenoid as seen on the axillary view, then a C T scan must be obtained comparing the involved shoulder to the normal shoulder to see how much glenoid erosion there is. It is critical that glenoid version be corrected back to normal prior to inserting the glenoid component. Another cause of posterior instability following arthroplasty is excessive tightness of the anterior capsule and subscapularis tissue. It is important to remember that at the time of the arthroplasty procedure, you must achieve approximately 45 degrees of external rotation on the table. You cannot rely on physical therapy to gain external rotation.

Superior instability is usually secondary to insufficiency of the rotator cuff and the superior displacement of the head against the lip of the glenoid can cause the glenoid to be kicked loose. It is important to remember that if the rotator cuff is insufficient, then a hemiarthroplasty is preferable to a total shoulder arthroplasty.

Patients with glenohumeral instability will require a major revision to obtain a functional shoulder. This means realignment of the humeral component and adjustment of the glenoid version. It is difficult to remove a cemented humeral component and it is almost impossible to remove a cemented porus coated humeral component without severely fracturing the upper humerus. Finally, the soft tissue balance must be corrected so that the patient has at least 30 to 45 degrees of external rotation and full internal rotation. The shoulder should have a degree of laxity when you've completed the case – never put it up tight!

4. MANAGEMENT OF PATIENTS WITH A PAINFUL HEMIARTHROPLASTY:

First of all it is important to determine if the hemiarthroplasty is in the proper version and to determine whether or not a proper size head was used. If the shoulder is extremely tight and the op report indicates that a large head was used, then that may be the cause of the painful shoulder. If special x-rays reveal that the glenoid is eroded posteriorly and the head is subluxing out posteriorly, then it will require a revision procedure whereby the normal glenoid version can be reestablished. If a modular humeral component has been used, the simplest thing to do would be to remove the head, change the version of the glenoid component, and put in a glenoid prosthesis. In some situations patients have good function of the shoulder but just have discomfort with shoulder activity. If the humeral component is in a normal position and is facing directly into the glenoid, then I prefer to inject local anesthesia into the joint to see if pain can be relieved. If that is the case, then the glenoid prosthesis should be used. Of course, one of the real questions for the surgeon to resolve is what is the best form of treatment for a patient with a painful degenerative arthritis of the shoulder? Many believe that a total shoulder arthroplasty is practically always indicated whereas others feel that if you have a concentric glenoid without erosion that a hemiarthroplasty works quite successfully.

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5. MANAGEMENT OF FRACTURES OF THE HUMERUS:

In treating patients who have severe osteopenia i.e. in patients with rheumatoid arthritis or severe degenerative changes about the joint and very tight shoulders with loss of motion, it is possible to fracture the humerus during the reaming and insertion of the humeral component. Usually this is a spiral type fracture and can be successfully managed by distal extension of the deltopectoral incision to expose the fracture site, reduce it and hold it in place with cerclage wire and then insert a long stem revision prosthesis which extends distally to the fracture site by 2 to 3 cortical diameters. Postoperatively, we do not change the early rehabilitation program. Fractures that occur sometime following the arthroplasty procedure usually occur distal to the tip of the prosthesis. Some surgeons have recommended open reduction, plate and screw fixation, bone grafting, and immobilization. We have successfully managed these fractures with an orthoplast sleeve and functional bracing with very satisfactory results.

6. MANAGEMENT OF INFECTIONS:

This is an uncommon problem and perhaps this is secondary to the fact that the shoulder is so vascular. If the infection is recognized within the first few days of the surgery, the patient can be taken back to surgery, the wound thoroughly explored, cleaned out, and irrigated, and the prosthesis can be left in place. Appropriate antibiotics should be utilized and perhaps even the wound can be closed over closed suction irrigation with careful observation of the patient post-operatively. If the infection occurs beyond a week or two, then it is usually going to require removal of the prosthesis and the cement, leaving the wound open until several more débridements have been accomplished and the wound is cleaned. If the patient has a gram-positive organism, a spacer of bone cement can be used to maintain shoulder alignment so that at four to six weeks another prosthesis can be reinserted. If a gram-negative organism is the culprit, then resectional arthroplasty is probably the best method of treatment.

7. MANAGEMENT OF NEUROMUSCULAR INJURIES:

Thankfully, most nerve injuries that occur at the time of arthroplasty involve neuropraxia. If the patient indeed has a neurotmesis of the axillary nerve, this will lead to a severe disability and dysfunction of the shoulder. In certain situations if the injury is recognized early, a nerve repair or grafting could be accomplished. Injury to the axillary nerve of course will lead to severe dysfunction of motion and paralysis of the deltoid muscle. If it is recognized that the patient has lost the attachment of the anterior deltoid from the clavicle, then an immediate re-repair is indicated. If it is recognized late, the only fall back position would be a transfer of the lateral and posterior deltoid around to replace the anterior deltoid. This will give only minimal to moderate ability for forward elevation of the arm.

In summary, management of complications of the shoulder is usually multifactorial in nature. It requires a very careful review of the preoperative and postoperative x-rays of the arthroplasty procedure, careful review of the operative report, complete history and physical examination, and a thorough review of all of the x-rays prior to determining how you will manage the complication.

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SHOULDER ARTHROPLASTIES

M. Mason
BOSTON UNIVERSITY MEDICAL CENTER. BOSTON, MASSACHUSETTS. (U.S.A.)

LONG TERM RESULTS WITH ELBOW ARTHROPLASTY IN RHEUMATOID ARTHRITIS AND POSTTRAUMATIC CASES

H.K. Schwyzer, N. Gschwend, B.R. Simmen
SCHULTHESS KLINIK. ZÜRICH (SUIZA)

For elbow arthroplasty, artificial joints are most commonly used today. Of the linked prostheses, sloppy hinges are at the more, due to their more reliable long-term results compared to fully

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constrained linked prostheses. The spectrum of indication is wider for sloppy hinges than for non-linked resurfacing prostheses, as sloppy hinges have to rely less on good ligaments than non-linked prostheses. Rheumatoid arthritis has been the most frequent indication for artificial joint replacement so far. Sloppy hinges, and particularly those with flanges on the humeral condyles (like the GSB III elbow joint) or on the anterior wall of the humerus (Coonrad Morrey prosthesis), are also increasingly used for post-traumatic osteoarthritis, as well as for nonunion or malunion of intra-articular fractures in the distal humerus. The hinge mechanism facilitates mobilisation and compensates for an insufficient ligamentous apparatus. Precision instruments allow increasingly accurate placement of the prosthesis, corresponding to the physiological centre of rotation, and hence better long-term results (similar to those obtained in knee arthroplasty). The preservation of the continuity of the extensor mechanism is another factor for good and durable function. The most important complications are instability or disassembling, aseptic loosening and infection, as well as ulnar nerve lesions. However, a clear reduction of the complication rate has been achieved with some of the most frequently used elbow prostheses Ewald, Gschwend, HSS, Morrey, Souter compared to earlier reports.

Between 1978 and 1986, 59 patients received a GSB III elbow prosthesis, six of them in both elbows. Rheumatoid arthritis (RA) was the underlying cause in 51 of the patients and post-traumatic osteoarthritis (PTOA) in eight. Of these, 24 patients (28 prostheses) have since died; two, both operated on bilaterally, had had their implants for more than ten years and had already been assessed for inclusion in the long-termfollow-up. Two patients, each with elbow prosthesis have been lost to follow-up and three males who are still living (two with PTOA, one with juvenile RA) had their prosthesis removed before ten years had elapsed.

The remaining 32 patients (28 RA, 4 PTOA) with 36 GSB III elbows were examined clinically and radiologically after a mean period of 13.5 years. Pain was considerably reduced in 91.6%. Mobility was increased by 37° in those with RA and by 67° in those with PTOA.

There were three cases of aseptic loosening and three of deep infection. The main complication was disassembly of the prosthetic component in nine elbows (13.8%). This last group included two patients with postoperative fractures unrelated to the operative technique and one with neuropathic arthritis. Ulnar neuritis occurred in two patients. Since 87.7% of all the GSB III prostheses implanted in this period remained in situ, our results are comparable with those for hip and knee arthroplasty.

ELBOW ARTHROPLASTIES

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PROBLEMAS MÉDICOS ASOCIADOS A LAS ARTROPLASTIAS / *Medical problems associated to the arthroplasties*

MODERADOR / CHAIRMAN: **J. NARDI**

12,45 - 13,30 H.

PERIOPERATIVE MORBIDITY IN ONE STAGE BILATERAL TOTAL HIP REPLACEMENT

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HOSPITAL FOR SPECIAL SURGERY. NEW YORK (U.S.A.)

A. Advantages

1. One operative intervention
2. Shorter rehabilitation
3. Reduced cost
4. Patient preference
5. Increased Morbidity

B. Study Design

1. Hospital Chart Review of Perioperative Complications
2. Demographics
3. Study Period 1986-2000
4. 971 Patients
5. 479 Females - 492 Males
6. Average Age 56.3 (8-84)
7. 6.6% of 18,395 THR
8. Diagnosis
   - a .Osteoarthritis 644 (66.3%)
   - b .Avascular Necrosis 123 (12.7%)
   - c. Hip Dysplasia 65 (6.7%)
   - d. Rheumatoid Arthritis 59 (6.1%)
   - e. JRA 27 (2.8%)
   - f. Other 53 (5.5%)
9. ASA Classification
   - a. Grade 1 171 (17.6%)
   - b. Grade 2 1,640 (65.9%)
   - c. Grade 3 160 (16.5%)
   - d. Grade 4, 5 0
10. Regional Anesthesia
    - a. 96.2% of Patients
11. Posterolateral Approach
    - a. 99.6% of Patients
12. Intensive Care Unit
    - a. Minimum 24 Hours

C. Technique

* Acetabulum
  - a. Cemented: 182 (9.4%)
  - b. Non-Cemented: 1,760 (90.6%)
* Femoral Component
  - a. Cemented: 1,606 (82.7%)
  - b. Non-Cemented 336 (17.3%)
* Transfusion
  - a. Mean 2.25 units (0-11u)
* Length of Stay
  - a. 1986-1994: 12.3 days (4-120)
  - b. 1994-2000: 7.0 days (3-26)
* Discharge
  - a. Home: 69.6%
  - b. Rehabilitation Facility: 30.1%

D. Major Complications

1. Potentially Life Threatening and Prolonged Hospital Stay
2. Major Complications
   - a. 156 in 94 patients (9.6%)

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b. No Deaths
3. Cardiac: 32 (3.2%)
   a. Cardiac arrest 3 (0.3%)
   b. Myocardial Infarction 3 (0.3%)
   c. Atrial Fibrillation 15 (1.5%)
   d.CHF 11 (1.1%)
4. Pulmonary: 23 (2.3%)
   a. Pulmonary embolism: 9 (0.9%)
   b. Pneumonia: 7 (0.7%)
   c. Respiratory Distress 7 (0.7%)
5. Proximal DVT: 16 (1.65%)
6. Fat Embolism
   a. 29 Patients (2.9%)
   b. 20/22: Confusion and hypoxia resolved within 7 days
   c. 7 Patients with cerebral infarcts
1. 5/7 recovered

E. Minor Complications
1. 534 complications in 334 patients (34%)
   a. Electrolyte Abnormality 113 (11.6%)
   b. UTI 88 (9%)
   c. Ileus 22 (2.2%)
   d. Rash 46 (4.7%)

F. Major Complications
1. Positive Correlation
2. ASA Grade (p=.0003)
3. Age (p=.007)
4. Total transfusions (p<.001)

G. Summary
1. Acceptable Morbidity in Bilateral THR
2. No Deaths
3. Fat Emboli is Significant Complication
4. Increased Morbidity with Age, ASA
5. Limitation: Selection Bias

DVT PROPHYLAXIS IN THR AND TKR

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HOSPITAL FOR SPECIAL SURGERY. NEW YORK (U.S.A.)

Pneumatic Devices and Intraoperative Intervention

Inciting events leading to deep vein thrombosis occur primarily intraoperatively. Therefore, if at all possible, intervention should be performed at the time of the operative procedure. It has been demonstrated in hip replacement surgery that DVT is significantly reduced with epidural hypotensive anesthesia which may or not be augmented with intraoperative small doses of heparin (500-1000 units). Reduction of extreme limb position with occlusion of the femoral vein during hip replacement surgery reduces the stasis effect which promotes clotting. In the hip, overall DVT rates have been reduced to 7% and proximal DVT rates to 2 % using these intraoperative techniques. Mechanical devices work by a myriad of mechanisms: (1) venous turbulence is created in valve pocket areas and this reduces clot formation; (2) there is an increase release of endothelial relaxing factor (EDRF) which inhibits platelet aggregation; (3) intermittent compression stimulates fibrinolysis by inducing release of urokinase and tissue plasminogen from the venous endothelium. Randomized trials have demonstrated a reduction in DVT to levels similar to pharmocologic agents (20-27 %) without the risk of postoperative haemorrhage. However, compliance with use of these devices is crucial, as a positive relationship has been demonstrated between time of use and DVT rates. Although plantar pump devices tend to be well tolerated with occasional complaints of foot and skin irritation, calf compression devices with or

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without sequential foot compression applying at least 50mm Hg of external pressure at a frequency of at least once per minute and an inflation rate of less than 1 second tend to be the ideal device for DVT prophylaxis.

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RODILLA / *Knee*

MODERADORES / CHAIRMEN: **J. GALANTE - M. FREEMAN**

14,30 - 18,15 H.

ANATOMIA CONDILAR Y PROTESIS DE RODILLA

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La técnica quirúrgica utilizada en la implantación de los diseños protésicos actuales de rodilla consiste en cortar el platillo tibial a 90º respecto al eje de la diáfisis tibial, y a continuación el fémur es modelado con el objeto de obtener unos espacios rectangulares e iguales, tanto en extensión como en flexión de rodilla, que sean suficiente en tamaño para alojar de una manera estable los componentes protésicos.
Actuando así, efectuamos el corte femoral distal en menor grado de valgo del fisiológico (cortamos más cóndilo medial que lateral), y el corte femoral posterior con un cierto grado de rotación externa de la guía de corte (cortando, pues, más cóndilo medial que lateral, en su aspecto posterior).
Consecuencia de estas secciones óseas es la conversión de la morfología tronco-cónica de la epífisis distal del fémur en una cilíndrica.
Estamos de acuerdo en que el eje de movimiento de la articulación es a través del eje transepicondíleo, pero el movimiento se efectúa en una superficie troncocónica y no cilíndrica; ¡no nos ha de extrañar que la rótula no encuentre su mejor camino!. Como tampoco nos ha de extrañar que no consigamos mayor grado de flexión de rodilla.
Tras estudiar la geometría condilar, proponemos mantener la línea articular en ligero varo 2-3º y

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así conseguir los espacios en extensión y flexión simétricos y manteniendo la forma tronco-cónica. Discutiremos la conveniencia o no de una espacio rectangular o ligeramente trapezoidal en flexión.

Discutiremos como obviar la desventaja mecánica que la oblicuidad en varo del apoyo tibial significa para la fijación del componente protésico.

WHAT IS LIMITING ULTIMATE MAXIMAL FLEXION IN PCL-RETAINING TKA?

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CATHOLIC UNIVERSITY LEUVEN. BELGIUM

Introduction
The purpose of this study was to detect the limiting mechanism of maximal active flexion that can ultimately be obtained by patients after pcl-retaining TKA.

Methods
The study consisted of 2 parts. In the first part, 30 patients with well performing pcl-retaining TKA's were examined using video-fluorocopy. In deep flexion, observations were directed towards potentially determinant factors of maximal obtainable flexion.
Based upon these observations, a newly defined parameter, called the "posterior condylar offset", was found to be important. The exact influence of this parameter was investigated in part 2, in which 150 consecutive patients with pcl-retaining TKA were reviewed.

Results
Aberrant kinematics were observed in the majority of cases. In 27 patients (93 %) slide-forward of the femur was noted with flexion, with anterior translation of the medial and/or lateral femorotibial contact position. In deep squat, direct impingement of the posterior aspect of the tibial insert against the shaft of the femur was noted in 21 cases (72,4 %), blocking further flexion. In part 2 of the study, it was demonstrated that in knees with decreased postoperative "posterior condylar offset", such impingement occurred faster and lead to decreased maximal obtainable flexion ($p<0.001$).

Conclusion
Maximal obtainable flexion is in the majority of cases determined by posterior tibial insert impingement against the femoral bone, and this occurs as a consequence of aberrant kinematics with anterior sliding of the femur during flexion. Restoration of "posterior condylar offset" is important, since it allows greater degrees of flexion before impingement occurs.

CONDYLAR TOTAL KNEE ARTHROPLASTY AT THE LONDON HOSPITAL AND THE HOSPITAL FOR SPECIAL SURGERY WITH SPECIAL REFERENCE TO THE PERIOD 1970/1980

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This paper describes the development of condylar TKR over the period 1970 to 1980. Since the author (hereafter referred to as "MF") was involved in these events the description is inevitably to some extent autobiographical.

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In 1968 MF joined the consultant staff of the London Hospital. At that time Charnley's procedure for the total replacement of the hip had just been introduced at the London Hospital but no comparable operation existed (there or anywhere) for the knee. Moderately damaged osteoarthritic knees were treated by osteotomy, or if more severely damaged, by arthrodesis. The MacIntosh arthroplasty and synovectomy were used for rheumatoid arthritis with the former occasionally being used in OA. Because of the polyarthritic nature of rheumatoid, the severely damaged rheumatoid knee was rarely treated by arthrodesis and hinges were therefore occasionally used for this indication. The alternative was a wheel chair. Initially hinge arthroplasties had been attached to the skeleton without cement (as for example the Waldius) but with the advent of cement in the Charnley arthroplasty attempts were also made to fix hinge arthroplasties with cement. Unfortunately the incidence of loosening and sepsis were unacceptably high and revision in either of these circumstances proved difficult if not possible. The result was the occasional above-knee amputation, a disastrous outcome given the limited nature of the initial pathology. Appreciating the success of the Charnley total hip arthroplasty., MF and Professor (then Dr.) S.A.V. Swanson, a mechanical engineer, therefore set out to design an operation and a prosthesis which would enable the treatment of knees hitherto treated by arthrodesis or hinge arthroplasty to be replaced without surgical invasion for the bone beyond their surfaces.

One piece of personal background is relevant to this history. In 1950 MF came to Corpus Christi College, Cambridge to read Medicine. In the same year John Insall (thereafter "JNI") also started his medical studies at Corpus Chisti. JNI and MF remained students together until qualification in 1956 and continued to be close personal friends thereafter. JNI remained in Europe for some years, went to Canada, and finally to the Hospital for Special Surgery (HSS) in New York. During the late 60's and 70's he returned from time to time to the UK. Thus JNI and MF had periodic occasion to see each other and indeed to operate with each other in England. In 1968 MF visited New York as an ABC Travelling Fellow when JNI had just joined the staff of the Hospital for Special Surgery.

Imperial College and the London Hospital 1968-1974

In the early 1960's MF and Dr. S.A.V. Swanson founded the Biomechanics Unit in the Department of Mechanical Engineering at Imperial College.

In 1968 Swanson designed what was possibly the first knee simulator as a first step in the process of designing for the total replacement of the knee. In this machine, cobalt chrome hinges and polyethylene articulations were evaluated. It was found that the cobalt chrome devices produced large numbers of very small fragments of cobalt chrome wear debris which, when implanted into the rat were carcinogenic (1, 2). In contrast the polyethylene devices produced no detectable debris. (This was not to say that no debris was actually produced but merely that with the techniques available at the time, none could be detected). It was therefore decided to design a prosthesis using metal and polyehtylene.

In 1969 MF implanted 3 prosthesis composed of a Massachusetts General Hospital stemmed

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femoral shell and two specially made D-shaped polyethylene tibial components (i.e. 2 polyethylene MacIntosh prostheses). This experience demonstrated that it was not possible reliably to align such components in relation to each other and to the long axis of the femur and tibia without special instruments. Accordingly, while the definitive prosthesis was being made, special instruments were designed.

Because of concerns that polyethylene would not bear high contact stresses over long periods of time, Swanson designed the bearing surfaces as a single radius femoral "roller" working in a fully conforming concave tibial polyethylene "trough", the latter being shallow enough to slip in the face of a rotational overload. At the same time MF had decided that both cruciate ligaments would have to be resected as part of the arthroplasty: the joints which it was proposed to operate on frequently had damaged cruciate ligaments and their replacement required that the midline tissue should be resected to reverse midline impingment secondary to collapse of the condyles.Because at that time it was believed that the femur rolled backwards with flexion and forwards with extension under the influence of the cruciate ligaments, it was decided to resect the ligaments for the further reason that it permitted the replacement of he joint with a "roller-and-trough" design that kinematically would act as a hinge. Having resected the cruciate ligaments, the contact are between the metal and polyethylene was increased by making the femoral components a single roller without a midline gap (i.e. there was no intercondylar "notch" in the femoral component). This proved to be an unfortunate decision since it necessitated (for reasons explained below) the implantation of the femoral component first and the tibial component second.

In March 1970 the first prosthesis of this type, called the Freeman Swanson, was implanted at the London Hospital by MF and the principles of the operation have remained little changed from that day to this. The distal femur was transected just above the level of its distal surface at an angle chosen, in conjuction with the tibial resection, to align the hip, knee and ankle vertically above each other. The tibia was also similarly resected transversely, removing the condyles and the intercondylar tissues. The results of these 2 resections was a gap in the extended knee into which the prosthesis was to be implanted in such a way that it would "space open" the gap leaving the collateral ligaments tight and hence the joint stable (an expectation based on the work of MacIntosh). Rotationally it was expected that the capsule as a whole, combined with the shape of the prosthesis as a roller in a shallow trough, would produce stability. At the same time rotational overload was expected to result in slippage between the components of the prosthesis, so that the extra load would be taken by the soft tissues (not, as in hinges, by the bone-prothesis interface).

In flexion, the posterior surface of the femoral component was made to be of a thickness such that with suitable resection of the posterior femoral condyles, the same thickness of prosthesis as had "blocked open" the extension gap would also "block open" the flexion gap. The anterior lip of the polyehylene would then act as a posterior stabiliser stopping the tibia subluxing backwards whilst the posterior lip would have the reverse effect. After a few years of experience it was appreciated that anterior subluxation of the tibia did not occur and that the upwardly projecting posterior lip of the tibia interfered with flexion. The posterior lip was therefore reduced but the anterior lip has remained to this day.

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Thus in 1970 an operation had been introduced in which the cruciate ligaments were resected and the now familiar box cut of the distal femur and transverse cut of the tibia had been made. Ideally stability had been achieved by blocking open the flexion and extension gaps with the prosthesis whilst the correct alignment depended upon the appropriate angle of surgical resection of the femur and tibia. Special instruments were available to guide these steps.

One surgical problem remained, namely that in many knees, the valgus or varus malalignment could not be corrected simply by "blocking open" the knee. It appeared that in some way, the varus or valgus deformity had become fixed. At first it was not appreciated how this state of affairs came about, but with surgical experience, it was realised that had been a lax collateral ligament on the concave side of the deformity (produced by bone loss) had undergone a "contracture" resulting in fixation of the deformity. Initially it was that any form of release of this contracture might produce a totally unstable joint and accordingly (unsuccessful) attempts were made to reef the ligament on the convex side of the deformity.

The suggestion leading to a solution to this problem came from a South African surgeon, Jan Van Vuren, who worked with MF in 1971 and who had experience of lateral soft tissue release to correct the valgus deformity seen in polio, an operation proposed in South Africa by Ober (Campbell's operative Orthopaedics (1972) Vol. 2, p. 959). Since many of the severe deformities at the London Hospital were in a valgus direction, in rheumatoid arthritis, it seemed appropiate to attempt similar release procedures. The problem remained of how to know when to desist from the soft tissue release so as to correct the deformity without making the knee unstable in the opposite direction. This problem was resolved in 1974 when an instrument was developed by MF and Mr William Day at Imperial College called the Tensor (Fig. 4). With this it was possible to separate the condyles of the tibia and femur independently, in the two compartments whilst at the same time checking the alignment of the hip, knee and ankle. In this way, soft tissue releases could be carried out little by little until the correct alignment was obtained. Only when this had been done was the final bone resection of the distal femur carried out.

Thus by 1974 the final step in the procedure (controlled soft tissue release for fixed deformity) was in place. The operation now became relatively straightforward. Guided by a special instrument used in flexion, the femur was cut anteriorly and posteriorly to fit the femoral component. The cruciate ligaments were resected. The proximal tibia was resected perpendicular to its long axis. The knee was then extended, the Tensor was inserted and the knee aligned after suitable soft tissue release procedures if necessary. Finally, with the knee correctly aligned and the extension gap tensed open, the distal femur was resected parallel to the resected surface of the tibia and at a distance from it equal to the height of the flexion gap. The prosthesis (i.e. the Freeman Swanson) was then inserted so as to "block open" both the flexion and extension gaps, and by virtue of its shape, prevent anteroposterior motion.

Unfortunately it did not at first prove possible to obtain the manufacture of prostheses of various sizes. Thus the first Freeman Swanson prosthesis came only in one size, the smallest. This had 2 consequences. Firstly, the tibial component was

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often smaller than the tibia so that the stresses at the interface were high and tibial component sinkage and loosening followed. On the femoral side, the single small size of prosthesis made it impossible to provide a long, anterior flange to replace the patello-femoral joint. Thus only the distal and posterior surfaces of the femur were replaced with a very short anterior flange, designed to be recessed into the bone of any but the small femur.

This procedure was first described in 1971 at the Premier Symposium de Biomechanique at the Santé Interdisiplinaire Ossieuse (Belgium). A corresponding publication based on 18 knees, stating simply that replacement was possible, appeared in Acta Orthopaedica Belgica in 1972. In that year communications were also made to the Royal Society of Medicine and the British Orthopaedic Association. In 1973 the outcome of 69 replaced knees was reported in Clinical Orthopaedics and Related Research, volume 94. This volume is of some historical interest since it contained papers on 3 groups of prostheses:

1. Implants which did not depend upon the retention of any of the ligaments i.e. hinges and the Spherocentric.
2. Implants which depended on the retention of both the cruciate ligaments and the collateral ligaments i.e. the Polycentric, Geomedic and Duocondykar, the latter having been used in the Hospital for Special Surgery since 1971.
3. Implants which depended upon the collateral ligaments and the capsule but not upon the cruciate ligaments i.e. the Freeman Swanson, the only prosthesis of its kind at that time. In the same year (1973) the operative technique was described in more detail in Acta Orthopaedica Belgica and a patella polyethylene component together with a high anterior flanged femoral component was inserted. Finally, the operation was described to the AAOS by MF (as the President's Guest Lecturer).

The Hospital for Special Surgery 1971-1974

Between 1971 and 1974 the 2 surgeons who became responsible for knee replacement surgery at the HSS (Ranawat and JNI), working with a bioengineer (Peter Walker), designed and implanted the Duo-Condylar Prosthesis, an implant in some ways similar to the cruciate retaining "ad hoc" device used at the London Hospital in 1969. The experience at HSS was similar to that at the London Hospital: the implant was difficult to insert in significantly damaged knees (even, at HSS, with special instruments). During this time for reasons explained above, it happened that JNI, visiting the UK for domestic reasons, operated with MF and was thus aware of the London Hospital work. Indeed in an informal way JNI and MF worked together.

In late 1973 JNI, Ranawat and Walker (two of whom had graduated in the UK and one in India) designed a new implant, based upon the operation developed at the London Hospital, but which was a considerable improvement over the Freeman Swanson Prosthesis in respect of its mode of implantation and shape. With regard to the operation up to the moment of implantation of the prosthesis, Insall, Ranawat, Scott and Walker remarked that "the principle of the operation is similar to that of Freeman" and "we agree with Freeman that the absence of the cruciates does not prejudice stability". It was from this point onwards in the procedure that the HSS sequence

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and implant were clearly to be preferred to that at the London Hospital.

The problems with the Freeman Swanson device were two-fold. Firstly, in order to reduce the contact stresses on the polyethylene, the femoral component had been made with a single posterior femoral condyle stretching across the intercondylar notch. As an unforseen consequence of this, it was necessary to implant the femoral component first, so as to leave a gap in flexion between the resected tibia and the femoral component through which posterior femoral cement could be extracted. This in turn meant that the tibial component could not have a stem since it was believed that it had to be introduced into the flexion gap after the femoral component had been implanted in much the same way as a unicondylar tibial component is implanted today. This step was unsatisfactory since it led to very poor cement intrusion into the bone and often resulted in tibial cement being carried posteriorly to form a "cementophyte" posterior to the tibia. This in turn was an eventual cause of abrasive wear. Tibial loosening was the result not only of poor cement fixation but also, as mentioned above, of too small a tibial component. (Larger area tibial components were only introduced into the London Hospital procedure in 1975 following laboratory work on the strength of tibial component fixation but even though these improved the quality of fixation, a large area was not by itself sufficient to resolve the problem, see below). The second defect with the Freeman Swanson prosthesis was the absence of a mid-line groove on the femur to engage with a midline eminence on the tibia and with the patella (in the same way as the natural femur has a midline groove). The absence of a midline groove was a deliberate decision taken to reduce the shear stresses that might otherwise have developed at the bone/cement interfaces: it was hoped that the tendency to lateral tibial and patella subluxation might be controllable simply by soft tissue release procedures and alignment. In fact these proved to be unreliable ways of controlling medio-lateral alignement whereas a groove-and-eminence resolved the problem.

The Total Condylar prosthesis developed at HSS resolved all these matters: the essential surgical step which JNI and Ranawat demonstrated to be possible in condylar arthroplasty was one used in hinge arthroplasty, namely to sublux the tibia one diameter forwards before implanting the prosthesis. Once that had been done, the tibial component was provided with a stem adn was now cemented in a secure fashion by a "straight shot" downwards into the tibia. Posterior cement was then easy to remove. A femoral component with an intercondylar notch was then implanted second (not, as at the London, first): the intercondylar gap in the Total Condylar prosthesis was not there to permit cruciate resection but to permit the removal of posterior cement. These design and surgical modifications solved the problems of component fixation and residual posterior cement. At the same time the prosthesis was provided with a midline groove and eminence which controlled medial/lateral stability.

The Total Condylar prosthesis also had an extended anterior flange with patellar replacement similar to the anterior flange and patellar replacement introduced at the London Hospital in 1973. The Total Condylar patellar replacement was better than that at the London Hospital in so far as the flange had a groove (which the London Hospital component did not) but it was perhaps worse in that it did not have a single radius as

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seen from the side (as at the London Hospital): a single radius permits smoother patellar tracking and reproduces the normal geometry.

1974-1980

Preliminary results with the Total Condylar prosthesis were published in 1976 (10) followed in 1977 by the results of the Freeman Swanson prosthesis. From these results the conclusion could be drawn that a condylar prosthesis could be used as an alternative to a hinge. In 1978 the four major problems encountered in the first decade in the experience at the London Hospital (tibial loosening, the problem of abrasive wear due to posterior cement, the issue of patellar replacement and the management of fixed deformity by the use of soft tissue release and a Tensor) were described. It was 1979 however that the major paper of this period was published: a description of the 3 to 5 year results with the Total Condylar prosthesis by JNI, Scott and Ranawat. Excellent results were reported which clearly demonstrated that this prosthesis might well replicate the success of cemented hip replacement. As the authors remarked, prostheses of the kind represented by the Total Condylar (a category which had until then only represented by the Freeman Swanson) were "close to ideal".

Between 1976 and 1980 the Freeman Swanson prosthesis (latterly known as the ICLH) was modified by Freeman, Samuelson and Tuke to resemble the Total Condylar: the femoral component was provided with a midline notch and groove and the tibial component with a midline eminence. This prosthesis, the Freeman Samuelson, was first implanted in 1980. The early results were published in 1985.

Thus by 1980 after a decade of clinical development, the prostheses and the operative procedures used for their insertion were similar at the London Hospital and HSS, having been developed on the basis of unofficially combined work.

POSTCRIPT 1980-2000

In 1980, only short-to-medium term results were available at the London Hospital and HSS. In retrospect, it would been wise to have made no further modification until the long-term results were available since (at least in MF'sview) the only remaining "genuine" problems at HSS and the London Hospital in 1980 seemed to have been how best to obtain AP stability in flexion in the absence of the cruciate ligaments, wear and, in general, the unknown long-term future. Instead of letting time go by whilst these questions were addressed, if not solved, we and others, investigated a number of modified designs and techniques which MF now believes either addressed problems which were in reality non-existant or which were real but were not solved by the new proposal. Had we known the long-term outcome of the 1980 procedure, it might have been better to have left it unmodified.

A-P Stability in Flexion: In the original Freeman Swanson procedure AP stability had depended upon the surgeon's ability to obtain a flexion and extension gap of exactly the same height and then to insert a prosthesis that would be tight enough in both gaps to allow the anterior lip of the polyehtylene to act as a posterior stabiliser for the tibia. Doing this with a relatively low tibial lip (7 mm in the Freeman/Swanson and Freeman/Samuelson) proved to be technically difficult. This

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problem was addressed in different ways at HSS and at the London Hospital.

At HSS JNI with Burstein introduced a posterior stabiliser by a cross bar on the femur and a short upwardly protruding polyethylene peg on the tibia. (A longer peg had been previously designed by Walker). The fear initially with this mechanism was that it might unduly increase the stresses on the tibial interface and lead to tibial loosening. Experience has shown that this does not happen and therefore posterior stabilisers of the kind are a viable option.

A different solution was adopted at the London Hospital. This took the form of modifying the Tensor so that it could be used in flexion as well as in extension. The flexion gap was cut and the Tensor introduced. The bones were separated and the height of the gap measured. This determined the height of the extension gap and in turn the height of the prosthesis. The knee was then extended and the Tensor reinserted. After adjusting the soft tissue tension, the Tensor was used to mark the distal femur at a level and angle such that section in the marked position would ensure equal tension in flexion and extension, together with the correct alignment and stability in extension. This solution required that surgeons should understand how the Tensor worked and that tibial components of various thicknesses should be provided. The latter requirement was not a problem but it proved difficult to convey to surgeons the mode of use of the Tensor save by operative demonstrations on deformed knees: a thing which was not easy to arrange at the time. Over the last 5 years a modification of the Freeman Samuelson prosthesis has been used at the London Hospital with a medial anterior lip of increased height (11 mm) which provides stability throughout the range of movement, i.e. it is alternative form of posterior stabiliser.

These 2 procedures (stabilisers and/or the Tensor) would appear to have resolved the problem of the flexion gap and A-P stability. The third solution proposed early in the history of knee replacement was to retain the posterior cruciate ligament. In MF's view this has not proved as successful as a stabilizer or a Tensor: if the PCL is too tight, the posterior polyethylene may be damaged; if the PCL is too loose, AP stability is not provided. However the controversy as to whether or not to resect the PCL continues.

The Long-Term Outcome: Documentation of the long-term (10 year) results of cemented condylar arthroplasties has been a major contribution by JNI working both at HSS and in his own practice since 1980. The task is enormous, involving painstaking record-keeping, the tracing of patients and multiple careful re-examinations. A series of papers on the Total Condylar and IB prosthesis have shown that these prostheses are reliable implants for the treatment of the arthritic knee. The Freeman Samuelson cemented prosthesis as shown by the Swedish Knee Survey appears to be similarly reliable.

Wear: Throughout the 1980's and early 1990's the major perceived problem with knee replacement was wear. In general polyethylene wear may be due to adhesion, abrasion or delamination. The two former modes of wear are, relative to the hip, unimportant at the knee but delamination has been a major problem. It is now appreciated that delamination is due to the conjuction of 3 manufacturing factors of which the third is perhaps the most important. These are firstly, poor compaction of the polyethylene

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powder so that the implant comes to be manufactured from a polyethylene block which contains multiple fusion defects. Secondly the use of non-conforming prostheses which may result in cyclic sliding, substantial rotation and contact stresses in excess of 20 Mpa (absent form the conforming devices produced at HSS and the London Hospital). Thirdly and most importantly, delamination is due to sterilization by gamma irradiation in the presence of air (oxygen). When this is done the chains of ultra high molecular weight polyethylene may be split by the irradiation and then oxidized so that they do not recombine. This means that the implant is made of polyethylene of short chain length, not of ultra high molecular weight polyethylene at all. If these 3 factors are avoided, (as they can be) it is now thought that delamination will not occur. If this is true, the wear rate of a bearing such as the FS or the IB would in clinical practice appear to be negligible: in simulators adhesion and abrasion result in total volumetric wear of the F/S of about 1.5 mm3 106 cycles (one tenth the rate at the hip) and a similar rate has been reported on retrieved specimens for the F/S.

Modularity: Modularity was introduced into knee replacement in the early 1980's. Both the HSS and London Hospital prostheses followed suit for commercial reasons. The alleged advantages are the ability to change only the polyehtylene component leaving the tibial baseplate undisturbed and to allow the surgeon to make a last-minute decision with regard to the polyethylene thickness. The first eventually rarely arises in practice and the second would never arise if surgeons used a Tensor in flexion and extension and/or determined the component thickness with a trial. A more real advantage is the reduction in inventory and stock which modularity permits. The great disadvantage is back-side wear which is of couse absent in mono-block implants. Connecting (socalled "locking") mechanisms which can be reversed are almost certain to permit movement either initially or after a period of clinical use. Thus from the patients' point of view modularity may on balance be undesirable (and even metal backing may do little more than increase cost, especially in the elderly, see below).

Cementless Fixation: Cementless fixation has been of interest to orthopaedic surgeons since the erroneous attribution of osteoslysis to cement fragments ("cement disease"). It is by no means clear that the absence of cement improves the quality of fixation, indeed the opposite may be true: the long-term loosening rates for porous coating are not demonstrable better than are those with cemented fixation and although the addition of hydroxiapatite may improve the former it remains to be seen whether they will be better than those with cement. Indeed, with loosening rates of 96% or better at 10 years being reported for cemented condylar arthroplasties, it is difficult to see how a statistically significant improvement could be demonstrated in the long-term for practical and statistical reasons.

Poor fixation leading to loosening was a problem for all prostheses in the early days of knee replacement, particularly for the Freeman Swanson in which, as explained above, the prosthesis had only an inadequate underside stud, was too small in area and was poorly cemented. These problems were progressively resolved in the early 80's, at first in the context of cementless fixation in studies carried out with colleagues in Sweden using RSA. It was shown that a metal-back by itself made fixation worse but that the

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addition of a stem to the metal-back improved fixation. Finally adding cement to the under-surface of the metal-back fixation secure. Unfortunately these studies were not extended to include a comparison of a cemented UHMWPE component with a prosthesis having cement applied to the underside of a metal-back and stem. This has now been done using RSA in Sweden: the all-polyethylene component was found to be if anything slightly better. If this result can be confirmed, the all-polyethylene implant would be preferable: it would be cheaper, less invasive and would not be exposed to the risk of back-side wear (see Modularity).

Meniscal Prostheses: There is currently a major surgical enthusiasm for the use of a meniscal prostheses first introduced by Beuchel and Papas in the '70's. Space does not permit a review of meniscal prostheses here but one such (the MBK), introduced by JNI and colleagues in the 1990's, appears in a simulator to wear more, not less, rapidly than the Insall Burstein (or the Freeman Samuelson) due to under-surface adhesion and it is not clear that there are nay compensating clinical or fixation advantages. In a separate study, the Freeman Samuelson prosthesis has been compared with an identical prosthesis save that the tibial polyethylene component was allowed to rotate around a central peg i.e. the prosthesis was modified to be rotationally meniscal. No differences were found between the two groups of knees with respect to patient outcome nor, using RSA, to kinematics over the weight-bearing range 15º to 45º, roughly that used in the stance phase of gait. In another study of patients with a rotating meniscal prosthesis (the LCS) in one knee and a hinge in the other, no side-to-side differences were found with respect to symptoms, physical signs nor gait analysis. Thus although meniscal bearings have been in use since the 1970's, it still remains to be demonstrated that patients notice improved function with a meniscal bearings or that the loosening and wear rates are less than those of a cemented fixed bearing condylar device with a concave tibia.

If it is the case, as argued by implication in this paper, that knee replacement was effectively developed over the period 1970 to 1980 at HSS and the London Hospital, one might ask, why is it that a multitude of new prostheses have come into existence since then, accompanied by numerous instructional courses and discussions of this subject?. Doubtless these "innovations" have partly been due to a very proper attempt to improve the function of the replaced joint. Partly, however, it might be thought that they represent efforts to market a consumer durable, each of which has to have some introductory "talking point" and be accompanied by educational visits to attractive parts of the world.

SOFT TISSUE BALANCING IN TOTAL KNEE ARTHROPLASTY

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Knee motion after total knee arthroplasty is a complex interaction between the implant design parameters and the inherent stability of the soft tissues. Balancing the soft tissues during total knee arthroplasty in both flexion and extension is critical to the eventual function of the implant, and ultimately to patient satisfaction. Normal biomechanical function after knee replacement

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is dependent upon accurate reproduction of the size and shape of the articular surfaces, and demands that the prosthetic surfaces be precisely located relative to the ligaments. This is accomplished via measured resection technique. Intraoperative soft tissue balancing is best visualized as a series of reproducible steps that both elevate and reflect ligamentous structures. The surgeon must first identify which deformity or combination of deformities is present. These include varus, valgus, flexion, and extension. The most common deformities are varus or valgus deformities in combination with a flexion contracture. In general, release of contracted soft tissues is favored over reefing of lax tissues and structures.

Varus contractures are generally relieved by reflecting the capsular structures from the proximal tibia. This release should extend to the posteromedial corner of the tibia. Performing this step in a single sleeve promotes ease of closure and predictable healing.

Valgus deformities can often be more complex. There is no consensus regarding the sequence of soft tissues release to correct a fixed valgus knee deformity. Significant deformities frequentely require release of the popliteal tendon, the posterior cruciate ligament, and reflection of the femoral origin of the lateral collateral ligament. Resection of the posterior cruciate ligament for valgus deformity greater than 10º is recommended. Lengthening rather than transaction of the iliotibial band is important in preventing overcorrection and resultant lateral soft tissue laxity. The surgeon must be aware of the potential for peroneal nerve palsies associated with correction of fixed valgus deformities, especially when combined with a significant flexion contracture. A careful excision of posterior ostesphytes and release of the posterior capsule when necessary is the best way to addrres flexion contracture deformities.

Soft tissue balancing is critical to the long-term success of total knee arthroplasty. The surgeon must be adept at soft tissue releases to ensure proper biomechanical function and restraint of the chosen prosthesis.

POSTERIOR CRUCIATE LIGAMENT: SAVE VS. SUBSTITUTE

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Proposed advantages of PCL retention include assisting posterior femoral rollback, resulting in improved knee flexion, increased quadriceps lever arm, and improved quadriceps efficiency. The PCL serves as a secondary stabilizer to varus/valgus loads, resisting lateral condylar lift-off during the normal adduction moment of gait. This reportedly lessens medial compartment overload, and the risk of polyethylene wear and component loosening. Some reports have found superior stair-climbing ability in PCL-retaining TKA.

Are the above arguments for PCL retention true? Numerous in vivo kinematic analyses of PCL-retaining TKA demonstrate posterior femoral rollback often does not occur. A paradoxical anterior femoral slide of the femur on the tibia is not uncommonly observed (Dennis et al, Knee Society, 1995). Similar fluoroscopic analysis of PCL-retaining TKA demonstrates lateral condylar lift-off commonly occurs, suggesting the PCL is not functioning normally to resist lateral lift-off. Recent studies (Bolanos, Insall, et al, AAOS, 1996)

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demonstrate similar function in stair-walking for posterior cruciate substituting as compared with PCL-retaining prostheses.

The advantages of posterior cruciate substitution are many. Weight-bearing, in vivo knee kinematic analysis (Dennis, et al, CORR, 1996) has demonstrated more reproducible posterior femoral rollback with PCL substituting prostheses. Posterior femoral rollback is assured by the femoral cam-tibial post mechanism. PCL function following TKA is highly unpredictable. Kinematic analyses have demonstrated highly variable knee function following PCL-retaining TKA. Presently, no intraoperative testing methods are available to scientifically measure intraoperative PCL tension accurately. If laxity exists, this ligament is non-functional, risking instability and polyethylene wear. Excessive tension risks limited motion and increased posterior contact stresses. Microscopic analysis of the PCL in arthritic knees has demonstrated substantial histological abnormalities. Additional mechanical testing has demonstrated subnormal strength in the PCL of the arthritic knee. Clinical studies have shown superior results with posterior cruciate substituting TKA in various conditions, including fixed deformity greater than 20 degrees, previous high tibial osteotomy or patellectomy, and patients with rheumatoid arthritis (Laskin). The more conforming condylar geometry of posterior cruciate substituting prostheses lessen polyethylene contact stresses, as evidenced by the low wear rates observed in these designs over one decade of use. Increased loosening over nine to twelve years of use has not been found, as compared with PCL-retaining designs (Stern & Insall, JBJS, 1992). Lastly, weight-bearing, in vivo range of motion analysis has demonstrated superior flexion with posterior cruciate substitution vs. PCL-retaining TKA (Dennis, et al, AAOS, 1997).

POSTERIOR CRUCIATE RETENTION IN TOTAL KNEE ARTHROPLASTY

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Introduction

Why Keep The PCL? Some of the rationale include: improved kinematics, improved quadriceps strength, better stair climbing, improved stability and retention of propioception. Preservation of bone stock in CR designs is in addition possible in the Femur and in the Tibia.

The femoral rollback is one of the critical parameters of knee function, it is most important in stair climbing and other similar activities of daily living.

The critical issue is the tension in the posterior cruciate ligament. Appropriate ligament tension is a function of prosthetic design and surgical technique. We report our clinical experience with two cruciate retaining total knee prostheses.

Material and Methods

One hundred seventy-two consecutive cemented Miller-Galante I total knee arthroplasties in 155 patients were compared with 109 consecutive cemented Miller-Galante II total knee arthroplasties in 92 patients. The average follow up was 11 years (range, 8-15 years) and 9 years (range, 8-10 years), respectively.

Results

Of the 172 Miller-Galante I arthroplasties, there have been 21 revisions; 15 patellar revisions; two included femoral revisions attributable to abrasion. Six additional well-fixed femoral and tibial components were revised: two for early instability, one for pain, one for periprosthetic frac-

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ture, and two for infection. No component had aseptic loosening or osteolysis. Using revision or loosening of any components as the end point, the Kaplan-Meier 10-year survivorship was 84.1% + 4.1%.

Of the 109 Miller-Galante II arthroplasties, there have been no component revisions, no aseptic loosening, and no osteolysis. Using revision or loosening of any component as the end point, the Kaplan-Meier 10-year survivorship was 100%. This cruciate retaining design showed excellent fixation with no loosening and no osteolysis at as many as 15 years. Additionally, there have been no component revisions for late instability at as many as 15 years. The high prevalence of patellofemoral complications with the original design was obviated by changes in the shape of the patellofemoral articulation.

Discussion and Conclusions

Cruciate retaining designs can provide excellent long term function. The experience related above was obtained in an elderly patient population. In younger patients with higher functional demands the results might be different. We introduced recently a more contemporary design that offers some improved features, including a system concept, improved patellofemoral articulation, improved articular geometries and a choice of net molded or highly cross-linked polyethylene to minimize wear. We currently use PCL retaining TKR (NexGen CR) almost routinely; we release partially the PCL when tight and convert to PCL substituting prosthesis when the PCL is insufficient.

THE EVOLUTION OF THE POSTERIOR CRUCIATE SUBSTITUTING KNEE REPLACEMENT

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Total knee arthroplasty has evolved over the past thirty years to its present state of performance. At the Hospital for Special Surgery in New York City the original design of the total knee replacement encompassed two condylar surfaces connected by a thin metallic bridge articulating with two separate polyethylene tibial plateau surfaces. This implant was called the Duocondylar Knee Replacement and preserved both cruciate ligaments. This prosthesis was utilized from 1969-1974 and had significant limitations. The implant provided very little medial-lateral stability and subluxation occurred in moderate to severe deformities. Instrumentation and sizing were very limited. Subsidence of the tibial plateau was common.

In 1974 the Total Condylar implant was developed and implanted. This device had a single, dished tibial polyethylene component and resected both cruciate ligaments. Stability was maintained by soft tissue balancing and the conformity of the two components. Motion was limited with this prosthesis and often patients did not achieve greater than 90-100 degrees of flexion. Also instrumentation and sizing were limited. The implant has performed well and in a recent 20 year follow-up study over 85 % of these devices were still functioning satisfactorily.

In 1978 the Posterior Stabilized total knee replacement became available. This was a modification of the Total Condylar design and also was implanted by resecting both cruciate ligaments. This implant had a cam mechanism

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which substituted for the absent posterior cruciate ligament. The tibial component has an eminence on its upper surface which contacted a bridge in the posterior portion of the femoral component. This allowed excellent roll back, improved motion and stability. The 15 year results with this implant have been outstanding with good to excellent results in the range of 90-95 %. However, lateral release to improve patellar tracking has been noted to be a common occurrence in some posterior stabilized designs. Additionally peripatellar fibrosis with subsequent need for arthroscopic debridement has also been noted with increased frequency. Design changes to improve the patella tracking have been incorporated into new posterior stabilized designs to reduce both of these problems. 1187 total knee replacements were reviewed performed by the senior author (TPS) over the period 1993-98. 409 Insall Burstein II prostheses were used during this time period and 829 total knee replacments of the new 913 design (Optetrak). This latter design incorporated a more anatomic shape to the femoral component and a deepening of the trochlea groove. Demographic data for the groups were similar. A lateral patellar release was necessary in 164 of the 409 (40 %) Insall Burstein II knees and utilizing the same criteria for lateral patellar release 76 lateral releases were performed in the 829 (9.2%) new 913 design knees. Additionally 17 arthroscopic debridements were necessary for peripatellar fibrosis in the Insall-Burstein series and 4 (0.5%) patients in the 913 series have undergone arthroscopic debridement only 2 patients for peripatellar fibrosis.

This current design embodies all the benefits of its earlier generations. The longevity with the device has been demonstrated. By substituting for the posterior cruciate complex deformities can be managed. Patellar problems have been essentially eliminated with the new design modifications.

CRUCIATE RETAINING VERSUS POSTERIOR STABILIZED TKA: A PROSPECTIVE RANDOMIZED OUTCOME STUDY, INCLUDING FLUOROSCOPIC KINEMATIC ANALYSIS

J. Victor

PRESIDENT BVOT. ASSEBROEK-BRUGGE. (BELGIUM)

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IN VIVO KINEMATICS OF MOBILE BEARINGS KNEES

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POSTERIOR STABILIZATION IN TOTAL KNEE ARTHROPLASTY WITH THE USE OF AN ULTRACONGRUENT POLYETHYLENE INSERT

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Fifty-three primary and 47 revision posterior cruciate ligament (PCL)-substituting total knee arthroplasties (TKAs) using a highly conforming (ultracongruent) polyethylene insert were retrospectively reviewed over a 48 to 106 month (mean, 60+- 11 months) follow-up period.
These 100 knees were age and sex matched with another 100 TKAs performed using a PCL-sparing design. The ultracongruent design has an anterior buildup of 12.5 mm. and a more conforming articular surface to match better the radious of the femoral component. In primary and revision TKAs, the average Hospital for Special Surgery knee score (P=.3) and rage of motion (p=.43) were similar between the PCL-sparing and ultracongruent groups. In primary and revision TKAs there were no revisions resulting from instability for patients receiving an ultracongruent insert versus 5 knees in the PCL-sparing control group secondary to subsequent postoperative anterioposterior instability and PCL insufficiency. Certainly, no post is required for posterior stabilization.

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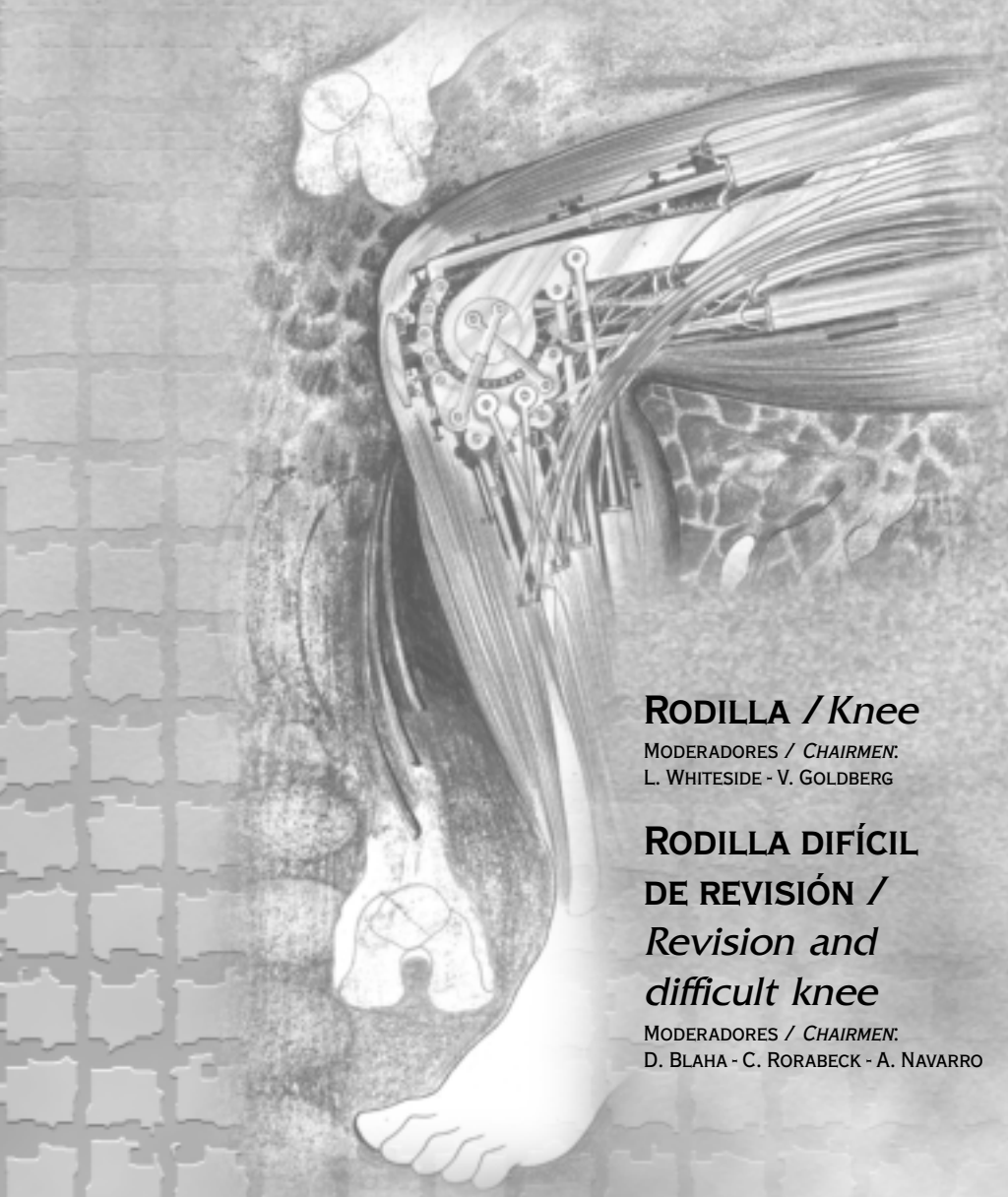

RODILLA / *Knee*

MODERADORES / *CHAIRMEN*:
L. WHITESIDE - V. GOLDBERG

RODILLA DIFÍCIL DE REVISIÓN / *Revision and difficult knee*

MODERADORES / *CHAIRMEN*:
D. BLAHA - C. RORABECK - A. NAVARRO

RODILLA / *Knee*

MODERADORES / CHAIRMEN: **L. WHITESIDE - V. GOLDBERG**

9,00 - 13,30 H.

IS THERE A DIFFERENCE IN KINEMATICS BETWEEN MOBILE BEARING AND FIXED BEARING TKA?

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Introduction
One of the advantages of mobile bearing TKA's is the assumption that these knees may be associated with more normal kinematics compared to fixed bearing knees, because they have little intrinsic constraint, and therefore leave maximal freedom to the joint to follow its own kinematical pattern. The purpose of this study was to investigate this hypothesis.

Methods
Knee kinematics were studied in 31 patients using video-fluoroscopy during stair climb activity. The same TKA system with identical femoral component design was used in all patients (Profix^{R}, Smith and Nephew). 4 Different tibial bearing configurations were investigated: standard fixed bearing, highly conforming fixed bearing, mobile bearing translation + rotation, and mobile bearing rotation only.

Results
All 4 bearing configurations performed similarly with regard to sagital kinematics, with anterior translation of the medial femorotibial contact point with increasing flexion, and to a lesser extent some anterior translation of the lateral contact point with flexion. The only significant difference that was noted amongst the 4 groups, was the location of the medial and lateral femorotibial contact positions in early extension (0°-30°), which was more posterior for the standard fixed and highly conforming fixed bearings, compared to the mobile bearing knees ($p>0.05$ – 2way ANOVA). All 4 configurations demonstrated similar degrees of tibial internal rotation during flexion.

Conclusion
No important differences could be noted with regard to sagital and rotational kinematics. Standard fixed bearing knees, highly conforming fixed, and mobile bearing knees performed similarly.

CEMENTED ALL POLY TIBIA SURVIVORSHIP SUPERIOR TO MOBILE BEARING

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MEDIAL PIVOT KNEE ARTHROPLASTY

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Design of total knee prostheses is predicated on knowledge of the kinematics of the normal knee. Designs that more closely mimic the normal might reasonably be expected to perform more normally for the patient. For many years the knee joint has been viewed as a "four-bar link" in which the ligaments (specifically the cruciate ligaments) guide the motion of the knee in such a way that "rollback" occurs. (Rollback is the progressive posterior movement of the contact point between the femur and the tibia with increasing flexion.) Proponents of the four-bar link model point to studies that have shown a decreasing radius of curvature of the femoral condyles from distal to posterior.

Several recent studies of knee joint kinematics have suggested that the knee can be modeled as having a single axis of flexion-extension. Similarly, the internal and external rotation of the tibia around the femur (i.e., the pivot) of the knee can be modeled by an axis roughly at the central part of the medial condyle. (van Dijk et al. 1983, Blankevoort et al. 1988, Hollister et al. 1993, Mancinelli et al. 1994, Blaha et al. 2003) These studies show that the normal knee does not roll-back, but rather remains remarkably constant in position on the medial side (like a ball in a socket) while varying in contact position on the lateral side to accommodate internal and external rotation of the tibia about the femur.

Kinematic studies of total knee prostheses designed respecting the concept of the "four-bar link" and providing for roll back have demonstrated paradoxical kinematics. Instead of rolling back, these knees demonstrate *sliding forward* of the femur on the tibia during *in vivo* fluoroscopic studies. A similar kinematic study done with a knee joint designed for medial pivot and medial ball-in-socket kinematics does not demonstrate paradoxical motion. (Banks et al. 1997, Dennis et al 1997, Blaha et al. 1998)

The Advance" Medial-Pivot (Wright Medical Technology, Arlington TN USA) total knee prosthesis has been in clinical use for 5 years (as of January, 2003). Based on the preliminary results available at the time of the writing of this abstract the medial ball-in-socket configuration of the implant appears to provide a clinical result characterized by enhanced anterior-posterior stability both to clinical examination and in functional use.

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THE UNRESURFACED PATELLA IN TOTAL KNEE REPLACEMENT

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FEMORAL PATELLAR ISSUES IS METAL BACKING A PROBLEM?

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Patellofemoral pain and failure of the patella can be strongly affected by implant position. Patellar component failure has been reported in 6-11% of reported series. These problems include mechanical problems such as extensor mechanism imbalance, malalignment, dislocation, loosening, polyethylene wear, metal-back failure and fracture of the patella. Many of these new problems are related to increased demand including polyethylene wear, delamination of the polyethylene, and failure of the metal-backed pegs. Patellofemoral joint considerations which have an effect on the failure of this joint include patient selection, knee function and kinematics, the design of the patella and technical concepts. Since the demand for total knee arthroplasty has increased, patellar failure has become more common. The patellar failure group, when separated from the non-failure group includes a significant number of patients who are younger, more active and have more motion, which resulted in more quadriceps activity and strain.

Patellofemoral failure related to design of the implant is critical. Three basic designs are: dome-shaped, fixed anatomic with increased congruity and rotating anatomic. Although the rotating anatomic encourage dynamic tracking, it is a difficult design to implant with satisfactory alignment. Dome components have been shown to fail frequently with cold flow of the polyethylene. Recent data from knee simulating machines suggest that a modified dome demonstrates improved performance compared to other designs. The modified dome provides an interface which has increased congruency with the femoral component and a large contact area which distributes stress over a greater area. This design significantly reduces shear loads seen at the high load ranges of 40-100∞ of flexion.

We compared the results of 168 MGI total knee arthroplasties with dome-shaped metal-backed patellas to 93 MG II total knee arthroplasties with a modified dome. The clinical history, risk factors, and operative findings were reviewed for all patients undergoing revision surgery. The cumulative survival rates at 3, 5, 7 and 9 years

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post-operatively were 99%, 92%, 81% and 73% respectively for MG I TKAs with MB patellar components. In contrast, 1 of 93 modified dome shaped MG II MB patellar components required revision for patellar wear. Severe, relatively symmetrical wear of the tibial polyethylene (PE) and patellar PE (without exposure of the metal backing and resultant femoral damage) was noted in this patient. Survival of the MG II MB patellar component was 98.7% at 5 years post-operatively. This study indicates that design changes incorporated into the modified dome shaped MG II patellar component have resulted in a dramatic reduction in MB component failure and highlight the importance of design on the survival of cementless MG patellar components.

Finally, careful consideration of patient selection, design and in particular the kinematics of the femoral patellar joint and technical aspects as outlined will provide the best chance for a successful patellar replacement. However, overall alignment and component position are truly a key to success of patellar replacement and prevention of patellar failure.

LIGAMENT BALANCING IN THE VALGUS KNEE

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Most ligament balancing problems in total knee arthroplasty can be solved by first resecting the distal femur at 5-7º valgus and the proximal tibia perpendicular to its long axis. The next step is to remove osteophytes and release adhesions, then insert the trial components and release tight structures. It rarely is necessary to tighten loose structures. The most prominent surface of the joint is used as a point of reference for resection, and bony defects on the deficient side of the knee are grafted with either morselized or block autograft.

Because ligament balancing in flexion is dependent upon rotational alignment of the femoral component, 3-4º of external rotation of the femoral component usually provides correct varus-valgus balance in flexion and also places the patellar groove laterally and helps to stabilize patellar tracking.

In knees with significant posterior deformity or erosion, the posterior femoral condyles are unreliable as rotational alignment landmarks, and an alternative reference is needed. The anteroposterior axis – a straight line connecting the deepest part of the patellar groove anteriorly with the center of the intercondylar notch posteriorly – provides a reliable landmark for rotational alignment of the femoral surface cuts.

Technique for Femoral Bone Resection

Intradedullary alignment instruments usually are used for the femoral resection. The distal femoral surfaces are resected at a valgus angle of 5-7º. A medialized entry point generally is advised because the distal femur curves toward valgus in the valgus knee. The current technique is to reference the resection from the distal medial femoral surface. The distal femoral cutting guide is seated on the distal surface of the medial femoral condyle, which is resected equal to the thickness of the distal condylar surface of the implant. If the distal lateral femoral condylar surface is deficient, considerably less is resected from the lateral surface than from the medial surface, and in many cases of a severe valgus angle, no bone is present to resect from the distal lateral surface. Seating on bone is necessary on

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the lateral distal side, but this can be accomplished with the anterior lateral bevel surface. In cases of severely deficient lateral femoral condylar bone stock, the anterior bevel surface is the only bony contact for the distal lateral surface of the femoral component. This leaves a gap that is filled with bone graft between the distal bone surface and the inner surface of the implant on the lateral side. When the posterior flange and the anterior bevel surfaces are seated on viable bone, the distal defect can be treated as a contained defect and needs no structural grafting. Rotational alignment of the distal femoral cutting guide is adjusted to resect the anterior and posterior surfaces perpendicular to the anteroposterior axis of the femur. The AP axis is drawn and the femoral cutting guides are aligned to make the cuts perpendicular to this line. In the valgus knee this almost always results in much greater posteromedial than posterolateral femoral condylar resection.

Technique for Tibial Bone Resection

Intramedullary alignment instruments are used to resect the proximal tibial surface perpendicular to its long axis. Like the femoral resection, resection of the proximal tibial surface is based on the height of the intact medial bone surface. A maximum thickness of 10 mm is removed from the medial tibial plateau, which often leaves the defect on the lateral side of the tibia that requires a bone graft. Use of a long-stem component and screws in the tibial tray securely fixes the tibial component, and obviates the use of fixed structural bone graft.

Ligament Release Technique and Differential Balancing

Stability is assessed first in flexion by holding the knee at 90º flexion and maximally internally rotating the extremity to stress the medial side of the knee, then maximally externally rotating the extremity to evaluate the lateral side of the knee. A medial opening greater than 4 mm, and a lateral opening greater than 5mm, is considered abnormally lax, whereas an opening less than 2 mm on either side is considered abnormally tight. The knee then is extended and stability is assessed in full extension by applying varus and valgus stress to the knees. A medial opening greater than 2 mm and a lateral opening greater than 3mm is considered abnormally lax, whereas an opening less than 1mm on either side is considered abnormally tight.

Tight laterally in flexion only

In knees that too tight laterally in flexion, but not in extension, the lateral collateral ligament is released in continuity with the periosteum and synovial attachments to the bone. When this lateral tightness is associated with internal rotational contracture, the popliteus tendon attachment to the femur also is released. The iliotibial band and lateral posterior capsule should not be released in this situation because they provide lateral stability only in extension.

Tight laterally in flexion and extension

The only structures that provide passive stability in flexion are the lateral collateral ligament and the popliteus tendon complex, so knees that are tight laterally in flexion and extension have popliteus tendon or lateral collateral ligament release (or both). Stability is tested after adjusting tibial thickness to restore ligament tightness on the lateral side of the knee.

Additional releases are done only as necessary to achieve ligament balance. Any remaining lateral ligament tightness usually occurs in the extended position only, and is addresses by releasing the

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iliotibial band first, then the lateral posterior capsule if needed. The iliotibial band is approached subcutaneously and released extrasynovially, leaving its proximal and distal ends attached to the synovial membrane.

Tight laterally in extension only
In knees that initially are too tight laterally in extension, but not in flexion, the lateral collateral ligament and popliteus tendon are left intact, and the iliotibial band is released. If this does not loosen the knee enough laterally, the lateral posterior capsule is released. That lateral collateral ligament and popliteus tendon rarely, if ever, are released in this type of knee.

Finally, the tibial component thickness is adjusted to achieve proper balance between the medial and lateral sides of the knee. Anteroposterior stability and femoral rollback are assessed, and posterior cruciate substitution is done if necessary to achieve acceptable posterior stability.

MANAGEMENT OF DEFORMITY IN TKA (VALGUS KNEE)

J. Victor
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LIGAMENT BALANCING IN THE VARUS KNEE

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The cornerstone to ligament balancing is correct alignment of the knee in flexion and extension. The long axis of the femur and tibia suffice as landmarks for varus-valgus alignment in extension, and the anteroposterior (AP) axis of the femur is best for varus-valgus (rotational) alignment of the femoral component in flexion. After correct sizing and alignment have been done, then the ligaments can be evaluated. The next step is to remove osteophytes and release adhesions, then insert the trial components and release tigh structures. It rarely is necessary to tighten loose structures.
Resection thickness is based on the intact (lateral) side of the knee, and ligament releases balance knee stability. The intramedullary alignment instrument aligns the surface at an angle of 5-7º valgus to the long axis of the femur. The reference point for resection is usually the distal surface of the lateral femoral condyle since the medial surface is worn, but this is not always the case since the distal femoral surface often is still in valgus alignment to the long axis of the femur.

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Rotational alignment of the femoral cuts is done to achieve neutral varus-valgus position in flexion and also to place the patellar groove in the plane of motion of the tibia through the flexion-extension arc. If minimal wear is present, 3º external rotation relative to the posterior femoral condyles can be used for alignment, but if significant medial posterior wear is present, the component should not be set in external rotaion. Instead, the AP axis should be used, and the cuts should be perpendicular to this AP axis. Tibial alignment also is best done with an intramedullary rod. Less is resected from the medial tibial plateau than from the lateral because of the normal posteromedial slope of the tibial surface and because of medial tibial surface wear.

Knees with tight medial structures will require medial collateral ligament (MCL) release. Much of the ligament is released by removing the osteophytes, but in severe, fixed varus deformity, extensive MCL release may be necessary. Once the bone surfaces are cut and the trials are inserted, the knee is assessed for stability in flexion and extension. Knees that are tight in flexion only should have release only of the anterior portion of the MCL because this portion of the ligament is effective primarily in flexion. If the knee is tight medially only in extension, then only the posterior portion of the MCL (posteromedial oblique ligament) should be released because this portion of the MCL is effective only in extension. In cases of persistent medial tightness in extension, the medial posterior capsule may need released.

When severe deformity is present, the pes anserine may require recession. If the entire medial cuff is evaluated, it may cause gross medial laxity. In those cases the medial ligamentous and tendinous structures can be reattached to the tibial surface in the corrected position with AO screws and soft-tissue washers.

Posterior Cruciate Ligament

In cases of severe varus deformity, the posterior cruciate ligament (PCL) often is contracted. Excessive rollback will almost always be present in these cases, and this mechanical abnormality will restrict flexion postoperatively. Partial release of the PCL will allow the tibia to seat normally under the femur in flexion, and will improve knee flexion. Release from the tibia, including the bony attachment point, is the most convenient way to handle this. The PCL should not be released to treat a flexion contracture because this loosens the knee only in flexion, not in extension, and it may make the problem worse.

Popliteus Tendon

Many knees with either varus or valgus deformity have an abnormally tight popliteus tendon complex after the trial components are inserted. This is often caused by excessive external rotation of the femoral component, which results in underresection of the posterolateral femoral condylar surface, and the femoral component adds too much structure to the posterolateral side of the knee. This is apparent by loss of rotational laxity of the knee, but can be corrected by releasing the popliteus tendon.

FEMORAL COMPONENT ROTATION IN TKA

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Placing total knee components in the proper position in all three planes (frontal, sagittal and transverse) is important for correct functioning of the arthroplasty. Until relatively recently little attention has been paid to positioning in the transverse plane – often referred to as the

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"rotational" position of components. There has been acceptance of the transepicondylar axis (TEA) is a landmark by which the surgeon can align the femoral component of a total knee replacement to achieve proper rotation. Surgeons have experienced problems, however, finding the epicondyles with certainty making this set of landmarks difficult to use, and there is some concern that the epicondyles do not always define a kinematically proper placement. A line down the trochlear groove (AP axis – most often attributed to Whiteside) has been suggested as another guide to proper rotational position.

In fact, the proper placement for a total knee prosthesis is such that the axis of flexion of the component (i.e., the flexion-extension axis) is collinear with a functionally appropriate flexion axis for the patient's knee. Kinematic work with cadaver limbs has been used to find a functionally appropriate flexion axis for the knee. The knee joint moves in a plane perpendicular to this flexion-extension axis. This *functional plane* is not coincident with either the anatomic axis (i.e., shafts of the bones) or the mechanical axis (i.e., femoral head – center knee – center ankle). Rather the plane intersects four critical *functional points*: the lateral border of the acetabulum (origin of the rectus femoris muscle), the trochlear groove, the tibial tubercle and the neck of the talus. These points now define a different axis for the knee joint: *the functional axis*. Finding the functional axis will appropriately position the components of a total knee replacement so that the axis of the replaced knee matches that of the native knee.

The AP clamp attaches to the femur at the most posterior-superior part of the intercondylar notch with an acutely curved portion and to the trochlear groove with a more gently curved portion. When used with an appropriately angled intramedullary rod the AP clamp establishes the plane perpendicular to which a total knee femoral prosthesis should be placed.

PRÓTESIS BISAGRADAS

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Las prótesis bisagradas se colocan desde hace ya algunas décadas. En realidad, fueron los primeros implantes que se colocaron. Años después de su primera implantación fueron progresivamente abandonados debido a los altos índices de complicaciones y aflojamiento. Paralelamente, los modelos protésicos de deslizamiento, con sus diferentes grados de constricción, fueron imponiéndose obteniendo muy buenos resultados clínicos.

Actualmente se han innovado los modelos bisagrados introduciendo el movimiento de rotación de la tibia respecto del fémur. De este modo, se reducen las fuerzas que causan el aflojamiento. Hemos revisado la casuística de nuestro centro – alrededor de un centenar de casos- para exponer nuestra experiencia en un tipo de prótesis bisagrada que permite el movimiento rotacional anteriormente mencionado. Hemos revisado aquéllas prótesis colocadas primariamente –no incluimos recambios en nuestra casuística-. Todos nuestros casos corresponden a patología severa de la articulación de la rodilla, fundamentalmente desviaciones axiales irreductibles.

Esta revisión pretende contribuir al debate de la indicación de este tipo de implantes en la actualidad. Nuestra indicación son las afectaciones

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degenerativas de la rodilla con inestabilidades ligamentosas laterales severas y las severas deformidades angulares en pacientes de edad avanzada.

TKA INCREASING MOTION + MINIMAZING FACTOR

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RODILLA DIFÍCIL Y DE REVISIÓN / *Revision and difficult knee*

MODERADORES / CHAIRMEN: **D. BLAHA - C. RORABECK - A. NAVARRO**

14,30 - 19,00 H.

TKA AFTER HTO

J. Victor
PRESIDENT BVOT. ASSEBROEK-BRUGGE. (BELGIUM)

SIMULTANEOUS OSTEOTOMY AND TOTAL KNEE REPLACEMENT OF JUXTA ARTICULAR DEFORMITITES, BOTH FEMORAL AND TIBIAL

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RESTORATION OF THE JOINT LINE BASED ON THE DISTAL FEMUR IN REVISION TOTAL KNEE ARTHROPLASTY

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A clinical and radiographic analysis was undertaken to evaluate joint line position in patients who underwent revision TKA and correlated to their clinical outcome. One hundred revision total knee arthroplasties using stemmed revision components in 93 patients implanted by a single surgeon using a single revision knee system were evaluated. Forty-eight females and 45 males were studied with an average age of 67 years. Radiographs of the opposite unoperated knee, the pre-revision knee and finally the postoperative revision knee were reviewed. The joint line was evaluated relative to a line drawn from the distal point of the slope of the medial distal femur at the adductor tubercle.

Clinical evaluations included flexion, extension, total ROM (flex, ext), HSS score and pain score and correlated to reproduction of the normal joint line. Average follow-up was 5.5 years. Thirty-nine cases were revised for aseptic loosening, 38 for infection and 33 for instability. Average preop HSS score was 60 with a postop improvement to 90. Average postop pain score was 34. Average ROM improved from 6-94 to 5-105.Better flexion was obtained with the joint line being closer to normal; as the joint line deviated from what was measured as normal on the preoperative knee, the flexion decreased ($p=0.001$). Extension was statistically correlated to normal position of the joint line ($p=0.004$) as was total ROM (flex-ext) ($p<0.001$), HSS score ($p<0.001$ and pain ($p=0.025$). If the joint line was elevated either 3mm proximal or distal from the "normal" joint line, all dependent variables (flex, ext, total ROM, HSS score, pain score) were compromised. Our patients were seen to do much better irrespective of age, sex, mechanism of failure, infection or length of follow-up if the joint line is accurately reproduced.

OPTIONS AND OUTCOMES IN MANAGING KNEE INSTABILITY

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At the time of revision surgery, where both the femoral and the tibial component are being changed, some degree of constraint (posterior stabilized, varus/valgus constraint, or hinge) will be required to restore stability to the knee. The amount of stability required and hence the degree of constraint, will depend upon each individual situation. *Generally*, however, it is advisable to use the *least* amount of constraint necessary rather than the most. As one increases the amount of constraint, the forces have to be dissipated somewhere and this will happen at the stem cement or stem bone interface, perhaps resulting in premature loosening particularly in an active patient.

At the time of revision, if the medial collateral ligament is present then it is generally possible to use minimal constraint consisting either of a constrained liner or a posterior stabilized polyethylene insert. *Rarely*, in this situation, is it necessary to use an implant with more constraint (VVC or CCK). On the other hand, if the medial

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collateral ligament is absent and non-reconstructable the surgeon should consider a hinge prosthesis. If however, the medial collateral ligament is reconstructable, then a non-linked hinge consisting of either a VVC or CCK implant will generally suffice. It is sometimes difficult to be certain as to the status of the medial collateral ligament prior to the revision. I would therefore recommend that the surgeon has, in addition to a posterior stabilized liner, a varus/valgus constrain (VVC or CCK) insert available intraoperatively. It is always a good practice to keep a hinge in the operating room for the occasional situation where ligamentous support is absent.

UNSTABLE TOTAL KNEE REPLACEMENTS

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REVISION TKA WITH A MODULAR STEM

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Revision total knee arthroplasty is technically more difficult with increased complications and in general the prognosis is poorer with a higher failure rate. Failure of total knee arthroplasty usually is related to either infection; mechanical problems such as loosening, wear or instability; or extensor soft tissue problems.

I. The important concepts of revision total knee arthroplasty include: 1) planning, 2) cause of failure, 3) consideration of prior incisions, 4) prosthetic options, 5) surgical planning, 6) exposure, 7) implant removal, 8) restoration of stability and kinematics which depends upon implant choice, 9) soft tissue repair and 10) post-operative rehabilitation.
II. Pre-operative planning includes a diagnosis and the appropriate determination of requirements of components.
III. Preparation includes knee exposure and removal of components.
IV. In order to rebuild the knee there are a number of approaches, however, my preference is to use the three-step reconstruction which approaches the tibia first. This includes re-establishment of the tibial platform, stabilization of the knee in flexion, femoral component rotation, size and restoration of the joint line. Additional steps include stabilization of the knee in extension. Clearly that requires balancing flexion and extension gaps. Finally, patellofemoral reconstruction.

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We have used these principles in performing revision for mechanical failure after total knee replacement using the constrained condylar knee system (CCK).
Finally, it is clear that the best results can be anticipated with the restoration of anatomy and selection of the best components for the individual knee with a supervised rehabilitation.

BONE RECONSTRUCTION AND IMPLANT FIXATION IN REVISION TOTAL KNEE REPLACEMENT

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Reconstitution of bone stock is a primary concern at revision surgery for failed total knee arthroplasty. Fixation often is difficult because the cancellous bone has been depleted, so it is tempting to cement the implant to diaphyseal cortical bone. However, revision with cement ultimately destroys more bone stock. Rather, techniques that use an uncemented stem to engage the isthmus and bone graft to fill the defects can provide adequate fixation as well as the opportunity to reconstruct the bone stock about the knee.
The major concerns with massive bone grafting – vascularization an incorporation- remain significant issues in the knee, and bone grafting with allograft still raises the question of immunocompatibility. Bone tissue itself is not highly immunogenic, but the marrow cells incite a vigorous immune response and can create and inflammatory process that blocks ossification and incorporation of the graft.
Early reports of allografts reconstruction in the tibia and cementless fixation of the tibial component have been encouraging, and reconstruction of the femur with cementless components has been well documented in the literature. Loss of bone in the distal femur is a major problem after a cemented total knee arthroplasty has failed, and revision surgery with a cemented stem can cause even more bone loss. An effort has been made since 1984 to reconstruct bone defects with morselized allograft bone and to fix the implants to the patient's remaining bone structure using osteointegration techniques. It was initially thought that cementless fixation of the components would be tenuous and that repeat revision would be necessary to achieve durable fixation with the improved bone stock. However, durability of the construct has been surprisingly reliable and repeat revision due to failure of fixation has not been necessary.
In cases of infected total knee arthroplasty, treatment regimens range from debridement and antibiotics to removal and fusion, but the standard treatment has been to remove the implants, treat with antibiotics for six weeks, and finally perform revision arthroplasty with antibiotic-impregnated cement. However, cementless reconstruction is attractive for these revision cases because further bone destruction is avoided and bone stock also can be restored.

SURGICAL TECHNIQUE

Alignment landmarks usually are deficient, but intramedullary instrumentation makes varus-valgus alignment relatively simple. The intramedullary rod is inserted into the distal femur, and the distal femur is prepared at a valgus angle of 5-7º. Despite severe bone destruction, the intramedullary rod gives a line of reference for preparation of the remaining distal bone at the

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proper valgus angle. The tibial rod provides a reliable line of reference for alignment of the surface perpendicular to the long axis of the bone.

BONE PREPARATION TECHNIQUE

Bone loss is one of the major problems in failed total knee artrhoplasty , so minimal bone should be resected during preparation to preserve the remaining bone stock. The amount of bone erosion makes complete seating of the component nearly impossible, so that augmented fixation with a stem almost always is necessary to achieve toggle control of the implant. This technique results in substantial, uncontained defects on both the femoral and the tibial sides. Seating the implant on the patient's own bone stock controls axial migration, and the stem prevents the implant from tilting into the defect. Screw and peg fixation can add stability to the construct, thereby allowing the cavitary deficiencies to be filled with morselized bone. This bone grafting technique promotes rapid healing and reconstituion of bone stock without the technical difficulty and late collapse associated with massive allograft replacement.

Femoral preparation

When bone destruction is assessed, the medial and lateral condyles usually are found to be at least partially intact. With intramedullary instrumentation as a guide, the distal surface of the femur should be resected just enough to achieve firm seating of the femoral component on one side of the bone. Both sides may be engaged by the implant in some cases, but often only one of the two condyles can afford firm seating for the femoral component without excessive resection of the distal femur. After all the cuts have been made with the saw and all the surfaces are prepared, the femoral component is partially inserted and the morselized allograft is packed into the deficient areas. The implant is then driven until it is fully seated, then more bone graft can be packed tightly into the distal and posterior cavitary defects. Prolonged protection from weight bearing allows healing of bone into the cavitary defects for mediolateral and anteroposterior support of the implant.

Tibial preparation

Reconstruction of massive tibial defects also relies upon rim support for axial loading and a stem to stabilize the implant. Screws can be used effectively in the tibial component to augment fixation, with non-structural allograft filling the central and peripheral defects. Massive block allografting is feasible for these defects, but with long-stem and augmented fixation, morselized cancellous allografting can reconstruct the proximal tibial bone with low failure and complication rates.

The lateral tibial cortex usually is relatively well preserved, and the fibular head is almost always present. The fibular head can be used for proximal seating of the tibial component if the rest of the tibial architecture is severely destroyed. In the worst cases, all cancellous bone is gone, leaving a large cavitary defect and substantial deficiency of the tibial rim. Long-stem fixation is advisable in these cases regardless of whether block allografting or morselized allografting technique is used. When morselized graft is used, the tibial tray should seat of the intact portion of the tibial rim, and the stem should engage the isthmus of the tibia. As with the femoral component, the tightly fit diaphyseal stem maintains stability and prevents tilting of the component, so that massive defects may be filled with allograft and protected until healing and bone formation occur in the grafted area.

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Patella

Patellar bone stock may be severely compromised, and the patella is not amenable to grafting techniques. If the femoral component is smooth on its anterior and distal surfaces, then leaving the patella unresurfaced is a reasonable option. Ligament balancing must be achieved in flexion and extension, and the quadriceps extensor mechanism must remain intact. In many cases the patella cannot be returned to its normal position relative to the new joint surface.

GRAFTING TECHNIQUE

Block allograft traditionally have been used for massive bone deficiencies, but their complication rates are high, and the destructive of allograft rejection can limit their long-term success. Large segments of allograft also heal slowly, are never replaced by new bone, and weaken as the ossification and vascularization front proceeds. In contrast, morselized allograft has proven structurally reliable for both small and large defects while supporting new bone formation. Morsels that are 1 cm in diameter maintain their integrity long enough to act as a substrate for new bone formation. Morsels less than 0.5 to 1 cm in diameter tend to be resorbed while those larger than 1 cm incorporate slowly, if ever, and tend to collapse.

Rejection can be a major problem with allograft because marrow is immunogenic. However, marrow elements can be thoroughly removed from morselized allograft to prevent the inflammatory response and loss of graft and to capitalize on the osteoconductive potential of the allograft. The allograft acts as a scaffolding for new bone growth, and although it is not osteoinductive, demineralised bone (mildly osteoinductive) and bone marrow aspirate (highly ostoinductive) can be added to the allograft to enhance bone formation. The surrounding bone structure supplies most of the ostoinductive activity because mataphyseal bone has a rich blood supply and maintains the capacity to heal even after repeated failed arthroplasty.

Grafting preparation and placement

Fresh-frozen cancellous allograft in morsels measuring 0.5 to 1 cm in diameter is soaked for five to ten minutes of normal saline solution that contains polymyxin 500.000 units, bacitracin 50.000 units, and cephazolin 1 g of of per liter. The fluid is removed and 10 cc of powdered demineralized cancellous bone is added to each 30 cc of the cancellous morsels. Bone fragments and diaphyseal reamings are added to improve the osteoinductice potential. This mixture is packed into the bone defects, then the implants are impacted so as to seat on the remnant of viable bone while compacting the morselized bone graft.

ALIGNMENT AND POSITIONING OF THE IMPLANTS

Positioning of the joint line is achieved by choosing the thickness of the distal portion of the femur. Tensioning of the knee ligaments is achieved by adjusting the thickness of the tibial component. A simple way to handle this ligament balance and joint position problem is to reconstruct the bone stock, saving as much bone as possible in the distal femur and proximal tibia, and then to insert the femoral trial component with the thickest available distal surface. A plastic tibial trial component with enough thickness to stabilize the knee at 90º flexion is inserted, and then the knee is straightened. If the knee extends fully and stops, the femoral component thickness is correct. If full extension cannot be achieved, less distal femoral thickness is required.

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If the knee is stable in flexion but unstable in extension or hyperextends, then a thicker tibial component should be used to stabilize the knee in extension, and the knee should be accepted as tight in flexion. This is a rare combination of events because distal femoral bone loss usually is adequately replaced by distal femoral buildup. The other alternative is to lower the joint line further by using massive block allografting techniques on the distal femur to replace lost bone stock. This creates a tenuous long-term situation and rarely is necessary.

Femoral positioning

Because of servere bone destruction, distal surfaces of the femur no longer are reliable for mediolateral and rotational alignment of the femoral component. Anteroposterior positioning, which in the primary knee is determined by the anterior cortex of the femur and the posterior femoral condyles, also must be determined by distant landmarks. Thus the medullary canal becomes the single most reliable locus from which the femoral implant can be aligned and positioned. The anterior cortex of the femur usually is available to position the femoral component relative to the anterior femoral surface. The position of the posterior femoral condyles can only be estimated, but it usually is correct to cover the mediolateral width of the distal femur with the implant. Therefore, an implant large enough to cover the mediolateral surfaces of the distal femur and positioned so that the anterior flange is resting on the anterior cortex of the femur places the posterior condyles in the approximately correct position for normal ligament balance. The distal surface of the femur must then be positioned correctly. In most cases of revision arthroplasty of the knee, the distal femoral surface has been severely damaged so that a femoral component of standard thickness, when placed against the remaining distal femoral bone stock, almost always inappropriately raises the joint line and makes the knee too loose in full extension. However, if the distal femoral surface is positioned so that ligament balance is similar in flexion and extension (i.e., by changing the thickness of the implant or adding bone stock to the distal femur), then clinically acceptable stability of the knee can be achieved.

Rotation alignment of the distal femoral component is especially difficult to achieve because of loss of the posterior femoral condylar surfaces. In the primary arthroplasty, the posterior femoral condyles usually are the most important rotational landmarks, but these seldom are intact in revision knee arthroplasty cases. A more reliable landmark is the anteroposterior axis of the knee. A line connecting the deepest part of the patellar groove to the center to the intercondylar notch posteriorly defines the anteroposterior axis of the knee. A line perpendicular to this line roughly defines the rotational position of the posterior femoral condyles. The implant should be rotationally aligned so that its patellar groove and its intercondylar notch align with the normal anatomic structures. The patellar groove usually is absent in the revision situation, so the mediolateral epicondylar line is the only remaining landmark for rotational alignment. Although less reliable than the posterior condylar and anteroposterior axes, this line is reasonably accurate. It almost always is present, since the epicondyles seldom are destroyed by the operating surgeon or by dissolution of bone associated with loosening of the implant.

After the diaphyseal cortex is reamed, an alignment rod that engages the diaphyseal cortex is inserted, and rotational alignment is performed using the best landmarks available. The cutting

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guide then should be firmly attached to the distal femur and the surface prepared. It is important to avoid extensive bone resection. Only enough bone is removed to achieved stable support on the distal femoral surface. Removal of bone from the anterior and posterior surfaces of the femur usually is not necessary because of previous resection. It often is impossible to achieve seating on more than one surface of the femur, so rigid fixation will depend on tight fit of the intramedullary rod of the implant. Likewise, rigid fixation of the alignment rod is dependent on tight fit within the canal of femur. This does not necessarily require tight fit of the rod in the isthmus, as alignment in the bone proximal to the isthmus of the femur gives more reliable varus-valgus and anteroposterior fixation and positioning of the alignment rod.

Tibial alignment

Varus-valgus alignment of the tibial component in revision cases also depends on the medullary canal of the tibia as the major landmark. Reaming with reamers of increasing size to engage the diaphysis of the tibia aligns the reamer parallel with the longitudinal axis of the bone and gives a reliable landmark for cutting the upper surface of the tibia perpendicular to its long axis. The upper tibial bone stock almost always is deficient centrally in revision cases, and often the tibia has major peripheral defects as well. It is acceptable to achieve seating on the upper portion of the tibial surface approximately one-fourth the circumference of the remaining cortical shell. The rest of the tibial metaphyseal bone stock can be reconstructed using allograft and autograft, so it is not necessary to sacrifice more bone stock to seat the implant. The fibular head occasionally is higher than the lowest surface of the tibia, and partial resection of the upper portion of the fibular head is necessary to achieve a flat upper surface for load bearing. When the fibular head has been prepared as part of the weight-bearing surface, the joint in between it and the tibia should be excised and packed with bone graft. Because of bone loss and damage to the collateral capsular sleeve, especially thick tibial components are necessary to achieve adequate stability of the knee.

Rotational alignment of the tibial component is best done by using the tibial tubercle as a landmark. The anterior center point of the tibial tray should be aimed at the medial third of the tibial tubercle.

Once the tibial component has been removed and careful debridement has been done, the remaining tibial shell often does not give satisfactory anchoring for tibial cutting guides. The intramedullary reamers that prepare the diaphyseal cortex of the tibia for the intramedullary stem can be used for attachment of the tibial cutting guides. This ensures that the upper tibial surface will be accurately positioned relative to the medullary canal so that the stem and tray, when inserted in the tibia, will both fit tightly to the bone. The tibial cone and remaining capsular sleeve provide excellent containment for the morselized bone graft. Once the tibial surface has been prepared so that adequate rim seating can be achieved, the reamer is removed and trial components are fixed to the diaphyseal inner surface and the upper tibial rim.

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REPLACING BONE LOSS IN REVISION TOTAL KNEE REPLACEMENT

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LA BISAGRA ROTACIONAL EN LA PTR DE REVISIÓN

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La cirugía de revisión de rodilla se ha incrementado en los últimos años a pesar de que los fracasos en cirugía primaria hallan disminuido. Esto es debido a que el número de artroplastias totales de rodilla aumenta año tras año. Actualmente, según la literatura publicada, entre el 5 y el 10% de las artroplastias de rodilla se revisan a los 10-15 años. Las causas de aflojamiento aséptico incluyen factores mecánicos tales como la incorrecta alineación de los implantes y la inestabilidad articular, y factores biológicos tales como el desgaste del polietileno.
Según el grado de inestabilidad articular y el tipo de defecto óseo, la artroplastia de revisión será más o menos constreñida, pudiendo necesitar en los casos más graves modelos bisagrados.

La utilización de prótesis bisagradas para revisiones de artroplastias de rodilla, está indicada en aquellos casos con inestabilidad articular grave sea por una insuficiencia o ausencia de uno o ambos ligamentos colaterales, o debido a una gran pérdida ósea.
Se ha realizado un estudio retrospectivo de aquellos pacientes que han requerido una prótesis de revisión bisagrada entre los años 1993 y 2002, excluyendo los aflojamientos protésicos sépticos. Se trata de una muestra de 82 pacientes, 16 varones y 66 mujeres, con una edad media en el momento de la revisión de 72 años, y con un seguimiento medio desde la colocación de la prótesis bisagrada de más de 7 años (7,52 años de media, rango de 5 a 144 meses).
Las indicaciones para la revisión fueron aflojamiento aséptico (por desgaste del polietileno o por mala alineación) en 48 rodillas, inestabilidad en 27 rodillas, disfunción del aparato extensor en 3 rodillas, y fractura periprotésica en 4 rodillas.

Veintiséis rodillas presentaron alguna complicación:
1- Persistencia del dolor sin causa aparente, en 6 casos.
2- Aflojamiento séptico en 3 casos que se resolvieron con la retirada del implante y la artrodesis de la rodilla.

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3- Luxación de la artroplastia en 3 casos, los cuales fueron sometidos a un nuevo recambio protésico.
4- Problemas del aparato extensor en 10 casos: una ruptura del tendón rotuliano, 5 luxaciones rotulianas asintomáticas, 2 casos de subluxación rotuliana y 2 casos de déficit de extensión activa.
5- Aflojamiento aséptico en 7 casos sin necesidad de recambio protésico.
6- Inestabilidad articular en 4 casos: 2 de ellos requirieron artrodesis y uno recambio protésico.

Las 56 rodillas restantes no presentaron ninguna complicación siendo el balance articular medio de –1,78º de extensión y 103º de flexión.

CASOS CLÍNICOS

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EMERGING TRENDS IN UNI TKA

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Background:
Unicompartmental knee arthroplasty is experiencing a resurgence in popularity worldwide. The purpose of this study was to report our experience with the Miller-Galante unicompartmental knee arthroplasty at a mean 10 year follow-up in order to determine if this procedure can provide durable long-term clinical results.

Methods:
The study group consisted of 109 consecutive Miller-Galante unicompartmental knee arthroplasties in 83 patients performed by two surgeons between 1989 and 1997. There were 107 medial and two lateral compartment arthroplasties performed. The mean age of the patients at the time of surgery was 67 years. Forty-four patients were male and 39 female. Nine patients died at a mean of 6.6 years after the index arthroplasty. No patients were lost to follow-up. The mean duration of follow-up of the surviving patients was 10.0 years.

Results:
At the time of the most recent follow-up, 11 medial compartment arthroplasties (10.3%) and both la-

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teral compartment arthroplasties (100%) had been revised at a mean of 4.2 years. Of the 13 revision procedures, three required use of revision components, and none required bone graft or augments. The mean Knee Society score for the surviving patients who had not had a revision improved from 100 points preoperatively to 172 points at the most recent evaluation. Kaplan-Meier survivorship analysis revealed a probability of survival free of revision or radiographic loosening of 93% at 5 years, and 86% at 10 years.

Conclusions:
The Miller-Galante unicompartmental knee arthroplasty can provide reliable pain relief and restoration of function in selected patients. Our experience has shown that the survivorship of this implant approaches that of tricompartmental knee arthroplasty, and suggests that it may offer the advantage of ease of revision.

UNICOMPARTIMENTAL KNEE PROSTHESIS

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From 1996 to 2002 we implanted 350 LCS Uni prosthesis of the knee. All prosthesis had been non cemented. 80% had been placed on the medial side, 20% on the lateral side. Nearly 50% of all knee arthroplasty had been unicompartimental. Our indications for the Uni are: full extension of the knee; varus not more than 0° (anatomical); valgus must not be fixed; patella joint is not involved; osteoarthritis only in one compartment; no rheumatory osteoarthritis; the age is no matter; the indication was performed clinically and by X-ray with wheight-bearing;

Up till now 3 patients needed a revision ending in total knee replacement: 2 cases with loosening of the tibial component, 1 case with osteoarthritis of the whole knee.

The advantages of the LCS Uni:
The mobile bearing results in low contact stress. That means no wear, no need to restore the alignment, no over-correction of varus into valgus. The non cemented components guarantee a long term stay once they are fixed in the bone.

The disadvantages of the LCS Uni:
The tibial component needs a quite big bone resection and its stem sticks deep in the tibia. If revision is necessary the bone loss of the tibia has to be compensated by bone graft.
The in grow of the components might take time: 40% of the patients are free of pain after 3 months, 30% after 6 months and 30% after 12 months.
Minimal invasive techniques can not be used.

In 4/2002 we started with the PRESERVATION Uni.
Up till now we have 80 cases. 2 patients got a revision ending in total knee replacement. The revisions had been necessary due to loosening of the tibial component (learning curve !).

Advantages of the PRESERVATION so far:
The patients are free of pain immediately.
The patients are allowed to walk without crutches immediately.
The technique is “minimal invasive”.
The mobile bearing of the LCS Uni is integrated into the PRESERVATION.
The range of motion after operation is very good.
The stay of patients in German hospitals after knee replacement is 12-14 days. A reduce to 5-7 days after implanting the PRESERVATION will be possible.

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Disadvantages of the PRESERVATION so far:
The long term result will depend on the quality of fixation of the tibia. So, the cementation of the tibia has to be done very accurately. At this point surgical experience is necessary what means the PRESERVATION needs a learning curve.

UNICOMPARTMENTAL SLED PROSTHESIS ENDO MODELL, INDICATIONS AND RESULTS

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For over 25 years unicompartmental replacement of the knee has been a standard option in the surgical treatment of diseased knees at the Endo-Klinik. We have implanted this prosthesis in more than 3,500 cases.

Our decision regarding the indication for joint replacement is governed by the question as to which prosthesis is most appropriate to compensate for the defect in the joint. Besides the localisation of the defect, the condition of the ligaments and the extent of deformity are also decisive factors.
In our view, ligamentous deficiency is a contraindication for unconstrained prostheses in both unicondylar and total knee replacement.
Our criteria for indication of the unicondylar Sled Prosthesis are strict: we accept a maximum axial deviation of 10° and an extension deficiency of 5° only. We do not implant this prosthesis in patients weighing over 90 kg or suffering from rheumatoid arthritis.
The Sled Prosthesis Endo-Modell, is the result of several modifications to the Sled Prosthesis Modell St.Georg. The most important modifications were made to the anchoring surfaces of the prosthesis components. The principle of articulation with a metal runner on a plane tibial plateau has always been retained. Since 1985 the polyethylene tibial plateau has also been manufactured as a metal-backed version. Both components are fixed in position with PMMA cement.

The operative technique necessary for implantation of a unicondylar Sled prosthesis is demanding and should therefore only be performed by experienced surgeons. Correct alignment of the implant is of utmost importance, particularly when minimally invasive techniques are used.

Failure of the implant is mostly due to secondary ligamentous deficiency. Another, but much less frequent, reason for failure is isolated contralateral arthrosis. Polyethylene wear has no significant influence on the survival of the implant as long as the appropriate components have been chosen and these are correctly positioned.

Follow-up studies show that the long-term results are good. After 12 years the prosthesis was still firmly in position in 85 of 100 patients. Function was good and the patients were pain-free.

When correctly indicated, unicompartmental replacement of the knee is a bone-preserving method of treatment which should be one of the standard strategies in knee arthroplasty.

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