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Scientific Editorial - Prosthetic Rehabilitation with Removable and Fixed Appliance: Pictorial.

Dr.Syed Nabeel | Editor in Chief Dental Follicle - The E Journal of Dentistry | Founder and CEO DentistryUnited.com | Director: Smile Maker Clinics Pvt. Ltd INDIA

Abstract:

A 45 year old patient reported with multiple missing teeth. On Examination maxillary right canine with both third molars were present and in mandibular arch multiple missing teeth including severely periodontally compromised incisors were present. Patient insisted on no extraction in upper arch and only the grade 3 mobile incisors extraction in lower arch. Removable and Fixed Prosthesis were given in upper and lower arch for rehabilitation and smile makeover.

Key Words: Flexible Denture, Full mouth rehabilitation.

Case report: -

Pic 1 : The Case as presented . Note the Collapsed Bite.

Pic 2 :The Three maxillary teeth.

Pic 3 : The Missing first molars , and lateral incisors.

Pic 4 : The Valplast Flexible Denture for the maxillary arch

Pic 5 :The Cantiliver bridge in the mandibular with the lower anteriors replaced.

Pic 6 : The Occlusion.

Pic 7 :The Post op smile says it all

Conclusion –

Full mouth rehabilitation keeping in view the patients budget and his aspirations are vital in the treatment planning . In this case report , the patients aspirations of retaining all as many teeth as possible as was achieved. Although the patient insisted on a long span bridge in maxillary arch without any implant support, it could not be accepted due to all the logical reasons. Smile Makeover , Full mouth rehabilitation and achieving the former two goals in the patients budget and time in countries like India where we do not have dental insurance is a major challenge and achieving it a bigger challenge while treatment planning .

Management of a gouged access cavity in a lateral incisor with a Talon Cusp: A case report

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Abstract:

Mishaps such as perforation or gouging can occur during access cavity preparation when endodontic therapy is initiated. The presence of anatomic anomalies of the crown of the tooth can lead to complications during access preparation. This case report describes the correction of a misaligned access cavity in a maxillary lateral incisor with a talon cusp.

Key-words: Talon Cusp, Access Cavity, Mishap.

Introduction

Access cavity preparation is the most important phase of nonsurgical endodontic therapy. A well-designed access preparation is important for an optimum endodontic result. Without adequate access, adequate instrumentation and obturation become difficult in the complex and variable root canal system. Inadequate access cavities not only result in compromised preparation and obturation but may also cause procedural accidents such as chamber perforation, canal ledging, gouging and root perforation[1]. The ideal access cavity creates a smooth, straight-line path to the canal system and ultimately to the apex. Sufficient tooth structure must be removed to allow instruments to be placed easily into each canal orifice without interference from canal walls. Optimal access preparation results in straight entry into the canal orifice, with the line angles forming a tapered funnel that drops smoothly into one or more canals[2].

An astute assessment of the inclination of the tooth, root canal morphology, the presence of caries, large restorations and anomalies that may be present helps in preventing mishaps during endodontic therapy[3]. The maxillary lateral incisor may present with developmental anomalies such as Dens Invaginatus, peg shape, radicular grooves and talon cusp[4]. The presence of these anomalies could complicate access cavity preparation. The talon cusp was first reported by Mitchell in 1936[3] and corresponds to abnormal development of the cingulum of the maxillary incisor giving the appearance of an extra cusp on the palatal surface. The talon cusp has also been described as Dens Evaginatus as it appears to be the opposite of Dens Invaginatus[5]. Nabeel et al. (2011) suggested a precise and comprehensive classification for talon cusp based on the extension of the talon cusp and on the surface and anomaly of the involved tooth[6].

Case Report:

A 26 year old Caucasian female patient was referred for endodontic treatment of the upper left lateral incisor. The referring dentist stated that he had initiated access cavity preparation but could not locate the pulp chamber and was afraid of perforating the tooth. Clinical examination revealed an access cavity with a cotton pellet and the outline of an evaginated cingulum on the disto-palatal aspect of the 22 (Fig1.)Thermal tests were negative, there was mild tenderness to percussion and periodontal probing depths were within normal limits. Radiographic examination revealed the presence of a periradicular radiolucency on tooth 22, the radio-opaque outline of the talon cusp and the outline of the misaligned access cavity mesiodistally (Fig.2). From the history the patient mentioned that she has fallen off a slide and sustained trauma to the front of her face and teeth when she was twelve years old. A diagnosis of chronic apical absess was made and the treatment plan was to complete the endodontic treatment over 2 visits with an inter-appointment dressing of Calcium Hydroxide.

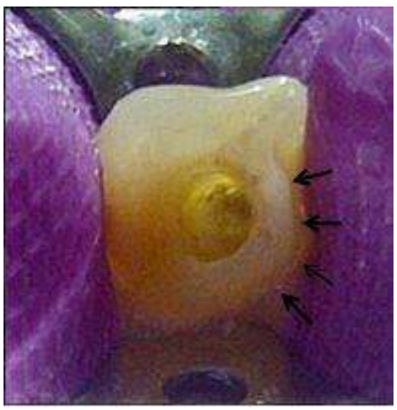

Fig.1. A lingual view showing the access cavity with a cotton pellet in it and the black arrows point to the outline of the remainder of the talon cusp.

Figure.2 The preoperative radiograph showing the periapical radiolucency, the outline of the mis-aligned, gouged access cavity and the coronal radio-opacity depicting the remainder of the talon cusp.

Looking at the inclination of the tooth with respect to the neighbouring teeth and alveolar contours and the radiograph, a line was marked in pencil on the buccal aspect of the tooth corresponding to the long axis of the tooth. Next the distance from the incisal edge to the the pulp chamber was measured on the radiograph and this length was transferred to an 016 tapered diamond crown preparation bur (Komet, Germany) using a permanent marker. Following anaesthesia and rubber dam isolation the hand piece with bur was aligned to the marking on the buccal surface (fig. 4) and then using a gentle pressure the access cavity preparation was performed. At the depth indicated on the bur a slight decrease in apical pressure was felt, denoting the penetration of the pulp chamber. This was verified visually and then the access cavity was flooded with 3% sodium hypochlorite and a pre curved size 15 K-file(Dentsply Bellaiguise, Switzerland) was used to scout the canal and taken to resistance and approximate working length. A radiograph was taken to verify the placement of the file (fig. 5). An apex locator (i-Pex, Nakanishi, Japan) attached to a size 10 k-File was used to verify and confirm the working length. The canal was shaped using the Wave One Large (Dentsply, Maillefer, Bellaiguise, Switzerland). During shaping the Endovac (Sybron, Endo, California) was used for irrigation with the macro cannula during preparation and the micro-cannula was shaping was completed. A final rinse was done with 17% EDTA and the canal dried and Calcium Hydroxide placed (Ultracal, Ultradent, USA).Duotemp (Coltene, Whaledent)was used to seal the access cavity and the patient was reappointed after 6 weeks.

Figure 3. A line was made in pencil on the buccal surface of 22 corresponding to the approximate midline and long axis of the tooth.

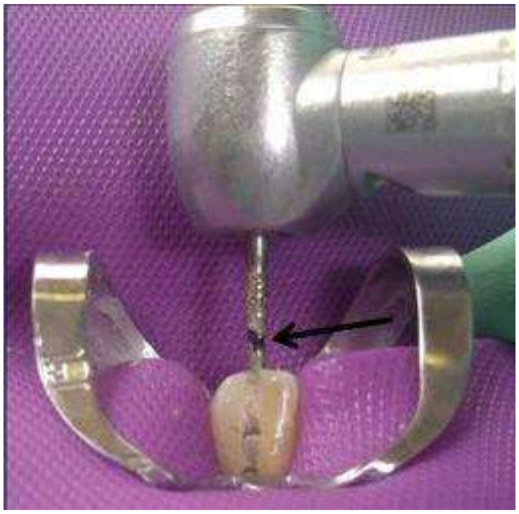

Figure 4. The handpiece with the tapered diamond bur was aligned with the pencil line along the buccal surface of the 22. The depth of the pulp chamber was measured from the incisal edge on the radiograph and this distance was marked on the bur (arrow).

Figure 5. Initial scouting with a size 15 k-file, confirms access to pulp chamber and root canal space and initial working length determination.

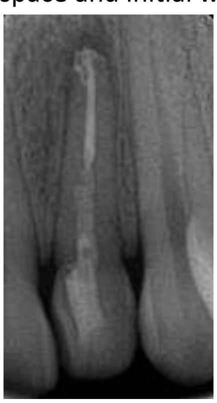

Figure 6. Post operative radiograph showing obturation and a glass fibre post bonded, and the gouged access filled with resin cement.

At the second visit the patient reported no discomfort, following anaesthesia and rubber dam isolation the canal was irrigated with 17% EDTA to remove the Calcium Hydroxide dressing, followed by 15ml of 3% Sodium hypochlorite using the Endovac and then a final rinse with 17% EDTA. The canal was dried and obturated by multiple wave warm vertical compaction using the Calamus unit (Dentsply, Maillefer, Bellaiguise, Switzerland). A post space was created and a glass fibre post(Contec Blanco, Hahnenkratt, Germany) was bonded using RelyX Unicem (3M,Germany).A post operative radiograph was taken(fig. 6)

Discussion:

According to Torabinejad and Lemon (2001) in order to prevent mishaps during access cavity preparation, an in depth knowledge of tooth morphology, including both surface and internal anatomy and their relationships, is mandatory to prevent pulp chamber perforations. Clinically, the location and angulations of the tooth must be related to adjacent teeth and alveolar bone to avoid a misaligned access preparation. Additionally, radiographs of the teeth from different angles provide better spatial information about the orientation, size and extent of the pulp chamber. The use of magnification and illumination during endodontic therapy is a useful if not essential adjunct to help avoid mishaps because it greatly enhances visibility of the working area [2, 7, 8]. In maxillary incisors the access cavity is initiated by placing the bur oc-clusal to the cingulum, almost perpendi-cular to the palatal surface with a slight tilt towards the long axis of the tooth. The cingulum is chosen as a starting point, because, in contrast to the gingival margin which can retract and the incisal margin which can undergo occlusal wear or erosion, this ridge re-mains constant throughout the patient's life[9]. In lateral incisors with a talon cusp, the evaginated cingulum can be cut back to resemble shape of the cingulum of a normal lateral incisor before beginning access cavity preparation[4]. The common error of perforating or gouging the gingivo-labial aspect is usually due to two factors: not allowing adequate access toward the incisal aspect of the cavity preparation or not properly aligning the bur vertically with the long axis of the tooth. Another common failure is not providing adequate access or removal of the lingual shoulder[10].

Conclusion:

Careful assessment and meticulous planning is important before access cavity preparation. In Maxillary lateral incisors with talon cusps, the cusp can be trimmed down to resemble the cingulum of a normal lateral incisor before endodontic treatment, thereby establishing a familiar anatomy for the clinician. Highlighting landmarks on the tooth when anatomic anomalies are present can help the clinician to orientate themselves better and avoid mishaps during access cavity preparation.

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Improving Endodontic Success through Coronal Leakage Prevention

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Abstract:

Coronal leakage is a frequently overlooked cause for endodontic failure and relates to both the restoration present in the coronal portion of the tooth and the materials used to obturate the canal system. This article will address materials and techniques to prevent coronal leakage and improve the long term prognosis of endodontic treatment.

Key words: coronal leakage, endodontics, obturation

Introduction

Endodontic failure has been associated with coronal leakage within the canal system following obturation. The literature suggests that coronal leakage is far more likely a determinant of clinical success or failure then apical leakage.1 Recent advances in resin obturation materials have been shown to provide superior sealing of the canal system but without addressing the coronal aspect of the tooth, failure endodontically may occur. Studies confirm that a sound coronal seal is of paramount importance to the overall success of root canal treatment.2, 3 Regardless of the obturation method the best rule is: a properly cleaned, shaped, and obturated tooth should be permanently restored as soon as possible.4

No matter what our intentions are following obturation of the canal system, patients may delay restoration of the tooth that has been treated. Financial and time constraints often influence when the final restoration is completed. Additionally, between visits an adhesive material will prevent leakage and contamination of the canal.

Coronal leakage

Coronal leakage has been indicated in the literature as the major determinant of endodontic success or failure. No matter what we place in the canal, if the coronal portion of the tooth is not sealed with materials that bond to tooth structure and are resistant to dissolution by oral fluids, then, over time endodontic failure may be inevitable.

It is not unusual to have a patient present with decay at the margin of a crown of a tooth that had prior endodontic therapy. Because the tooth was treated endodontically, sensitivity that may indicate a problem under the crown will not alert the patient to seek dental care. Coronal leakage for even a minimal amount of time may quickly lead to apical migration of bacteria. When the patient does present coronal leakage may have been ongoing for an extended period of time complicating treatment or rendering the tooth non-restorable necessitating extraction.

The literature indicates significant coronal dye and bacterial leakage following exposure of sealed root canals to artificial and natural saliva leading to complete bacterial leakage may occur within 2 days.5 Supported in an invitro study, found that dye leakage can occur in as little as three (3) days.6 It has been suggested that gutta-percha does not offer an effective barrier to crown-down leakage when exposed to the oral environment.7 Additional studies using gutta percha and various sealers, indicate that gutta percha will allow bacterial leakage. But use of an adhesive sealer can significantly slow or stop coronal-apical bacterial migration.8

The predominant bacteria found in root-filled teeth with coronal leakage and persistent apical periodontitis is the Gram-positive facultative anaerobe Staphylococcus. This is followed by the groups Streptococcus and Enterococcus; all normal salivary flora.9 Coronal leakage provides a constant source of microorganisms and nutrients that initiate and maintain periradicular inflammation and may well be the largest cause of failure in endodontic therapy.10

Endodontic obturation materials do not prevent coronal microleakage for an indefinite period of time.11 In a sample of 937 root filled teeth which had not received restorative treatment during the previous year, the data showed that the technical standard of both coronal restoration and root filling were essential to periapical health.12 It is not uncommon for coronal leakage to occur following root canal treatment as a result of the presence of a deficient composite resin fillings and secondary caries under restorations.13

Yet the endodontic materials utilized over the past fifty (50) years have shown that they do not prevent coronal leakage when challenged. In yet another investigation, forty-five root canals were cleaned, shaped, and then obturated with gutta-percha and root canal sealer, using a lateral condensation technique. The coronal portions of the root filling materials were placed in contact with Staphylococcus epidermidis and Proteus vulgaris. The number of days required for these bacteria to penetrate the entire root canals was determined. Over 50% of the root canals were completely contaminated after 19-day exposure to S. epidermidis. Fifty percent of the root canals were also totally contaminated when the coronal surfaces of their fillings were exposed to P. vulgaris for 42 days.14 When comparing AH-26 and other commonly used sealers after 45 days exposure to the oral cavity, none of the sealers was capable of preventing leakage and coronal dye penetration.15 So we can see that the quality of both the coronal restoration and obturation material are essential to periapical health as none of the present-day root canal sealers may hermetically seal "the root canal wall—gutta percha filling interface". In this respect the importance of perfectly sealing coronal restorations (both temporary and permanent) needs to be emphasized.16

Pre-Endodontic Therapy Buildups (Canal Projection)

Coronal leakage is a major contributor to Endodontic failure.17 A bonded core placed prior to disinfection and obturation of the canal system of the tooth can greatly diminish the leakage potential both during and after Endodontic therapy.

Isolation of the pulp chamber can be a challenging task when minimal coronal structure remains and Endodontic therapy is required as part of the oral rehabilitation. (Figure 1) Coronal reinforcement has traditionally been addressed following the Endodontic phase. But a coronal bonded buildup can simplify the Endodontic phase and strengthen the tooth, decreasing the possibility of further damage to the tooth due to the dam clamp or mastication before a full coverage restoration can be placed. The Canal Projector core allows isolation of the individual canals by surrounding them with a resin buildup. (Figure 2) Sealing the pulpal floor and area surrounding the canal orifices also will decrease coronal leakage potential during and following endodontic treatment.

Figure 1: Severe coronal breakdown of a lower molar requiring endodontic therapy.

Following identification of the canal orifices and caries removal, a Canal Projector cone (CJ Engineering, Santa Barbara, CA - www.cjmengineering.com) is placed on a hand file and inserted into each canal. A dentin adhesive is placed on all exposed surfaces and light cured. This is followed by injection of a dual-cure buildup material around the projector cones. When set of the buildup material has been completed the handfiles and projectors can be removed leaving straight-line access into each individual canal. Visualization of the orifice is elevated to the occlusal plane instead of deep within the tooth and a bonded seal coronally around each orifice is achieved. Should the restoring dentist wish to place posts in to the tooth, post space preparation is simplified and misdirection of the post preparation is minimized.

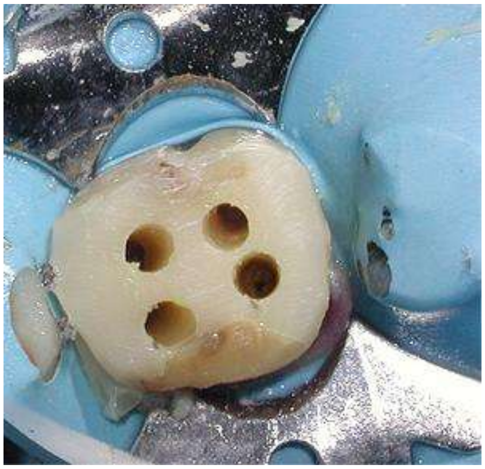

Figure 2: Coronal pre-endodontic buildup achieved with Canal Projectors providing individual straight-line access into each canal.

Coronal Restoration (Access sealing)

Microorganisms can penetrate through different temporary restorative materials and supposedly well obturated root canals. The use of adhesive sealers may, play an important role by minimizing coronal leakage. In addition the importance of an immediate definitive coronal seal should be emphasized after obturation of the canal system.18-20

Figure 3: Temporary restoration using the glass ionomer Fugi Triage® Pink (GC America, Alsip, IL) to seal endodontic access.

Seventy extracted single-rooted mandibular premolars were studied to determine the length of time needed for bacteria present in natural human saliva to penetrate through three commonly used temporary restorative materials and through the entire root canal system obturated with the lateral condensation technique. The average time for broth contamination of access cavities closed with gutta percha (7.85 days), IRM (12.95 days) and Cavit-G (9.80 days) indicating that even in the short periods of time normally permitted between visits, complete leakage may result. IRM, long a common temporary material was shown to leak to a significantly higher degree then glass ionomers.21 Glass-ionomer cement due to its adhesive nature may prevent bacterial penetration to the periapex of root-filled teeth over a 1-month period as compared to IRM or Cavit temporary restorations.22 Another important consideration with regard to the temporary restoration's ability to prevent coronal leakage is how the material behaves under mechanical load and thermocycling. Non-adhesive temporaries show an increased percentage of marginal breakdown and increased microleakage after thermocycling and loading. There was no significant improvement with increased thickness of the temporary material.23-25 When crowns were sealed with IRM, recontamination was detected within 13.5 days in the canals medicated with chlorhexidine, after 17.2 days in the group medicated with CaOH2 and after 11.9 days in the group medicated with both chlorhexidine and CaOH2. The group with no medication, but sealed with IRM, showed recontamination after 8.7 days. There were statistically significant differences between the teeth with or without coronal seal. The coronal seal delayed but did not prevent leakage of microorganisms.26 Other studies, confirm that IRM started to leak after ten (10) days, whereas Cavit and Dyract leaked after two (2) weeks.27

The use of a resin based temporary restorative material or glass ionomer over partially removed resin composite restorations could be beneficial in achieving better resistance to marginal leakage. (Figure 3) Maintaining partially removed permanent restorations does not seem to cause a problem with achieving marginal seal.28 Glass ionomer provided a statistically better coronal seal then bonded composite or a bonded amalgam preventing bacterial apical migration.29 This may be due to the glass ionomers ability to adhere to the scerlotic dentin found on the pulpal floor better then adhesive resins. The key seems to be, lock out the coronal bacteria and the apical area will heal. (Figure 4 and 5)

Figure 4: Placement of an immediate coronal restoration with Fugi IX™ (GC America, Alsip, IL) glass ionomer following endodontic therapy with evident periapical lesion. (Courtesy of Dr. Martin Trope)

Figure 5: Coronal seal has been maintained allowing apical healing of periapical lesion one year following treatment. (Courtesy of Dr. Martin Trope)

Mineral Trioxide Aggregate (MTA) has since its introduction a few years ago been advocated as a sealing material especially when perforation has occurred. But an investigation found mild inflammation was observed in 17% and 39% of the roots with and without an orifice plug, respectively without development of severe inflammation, the sealing efficacy of MTA orifice plugs could not be determined.30

Should amalgam be the material of choice for the dentist, a bonded amalgam produced significantly less leakage than did the non-bonded amalgams. To prevent the reinfection of the endodontically treated molar, it may be preferable to restore the tooth immediately after obturation by employing a bonded amalgam coronal-radicular technique.31 Whereas, core buildup or access closure, with adhesive materials has shown good long term leakage resistance. The "sandwich" technique (GI base with overlaying composite) and the composite resin restorations allowed significantly less coronal leakage than glass ionomer cement restorations. This may be because the composite resin prevents salivary dissolution of the glass ionomer long term.32

Figure 6: The pulp chamber has been etched and an adhesive applied to all surfaces.

Results indicate that the sealing ability of adhesive and flowable materials can decrease coronal leakage potential.33 Because of the risk of coronal microleakage, endodontically treated teeth should be restored as quickly as possible.34 It is more prudent to use a permanent restorative material for provisional restorations to prevent inadequate canal sealing and the resulting risk of fluid penetration.35 To minimize the potential of perforation when rentering the tooth to place either a post or to retreat endodontically, placement of a contrasting colored resin over each orifice may be beneficial. This is followed by covering the entire pulpal floor with a tooth colored flowable resin. (Figure 6, 7 and 8) These are available in a multitude of easily identifiable colored flowable composites. Available in pink (PermaFlo® Pink) or purple (PermaFlo® Purple) from Ultradent (South Jordan, UT), dark red (Flow-it dark gingival) from Pentron Clinical Technologies (Wallingford, CT) or dark blue from DenMat (Santa Maria, CA).

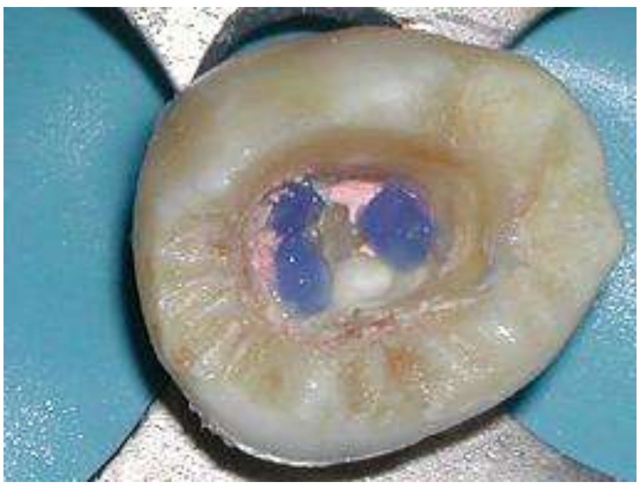

Figure 7: To assist in locating the orifices later, a contrasting color light cure resin is applied over each orifice and cured.

Figure 8: The entire pulpal floor is covered by a flowable composite and cured

Coronal microleakage has received considerable attention as a factor related to failure of endodontic treatment and much emphasis is placed on the quality of the final restoration. Intracanal posts are frequently used for the retention of coronal restorations. Many authors have examined coronal microleakage with respect to gutta-percha root fillings and coronal restorations, but few have investigated the coronal seal afforded by various post systems. The seal provided by a cemented post depends on the seal of the cement used. It appears that the dentine-bonding cements (adhesive resins and glass ionomers) have less microleakage than the traditional, non-dentine-bonding cements (i.e. zinc phosphates and polycarboxolates).36 Resin-supported polyethylene fiber and glass fiber dowels showed the lowest coronal leakage when compared with stainless steel and zirconia dowels. This may be due to better adhesion of the luting agent to these resin impregnated posts then metal or ceramic posts which do not allow adhesive penetration into the surface of the post. There were no significant differences between resin-supported polyethylene fiber and glass fiber dowels at any time period. The initial leakage measurement in zirconia

dowel and stainless steel dowels were similar but became significantly different at 3 and 6 months. Resin-supported polyethylene fiber dowels and glass fiber dowels tested exhibited less microleakage compared to zirconia dowel systems.37

Cleansening the Canal (Smear Layers)

Coronal sealing ability is not the only factor to influence the seal of the canal and prevent apical leakage. How well the sealer adheres to the canal walls is also important. Smear layer can play a factor which may prevent sealer penetration into the dentinal tubules. The frequency of bacterial penetration through teeth obturated with intact smear layer (70%) was-significantly greater than that of teeth from which the smear layer had been removed (30%). Removal of the smear layer enhanced sealability as evidenced by increased resistance to bacterial penetration. 38 The incidence of apical leakage was reduced in the absence of the smear and the adaptation of gutta-percha was improved no matter what obturation method was used later.39-41 However, regardless of the obturation technique (Thermoplastized, lateral or vertical condensation or single cone) when a non-adhesive sealer was used leakage increased after 30 days.42

Figure 9: Periapical lesions present associated with lower premolar and molar obturated with Resilon system at completion of endodontic treatment. (Courtesy of Dr. Joseph Maggio)

What is used to obturate the canals is important, however the manner in which the canal was prepared prior to obturation also determines how well the canal is sealed when therapy is completed. Rotary instrumentation with NiTi files has shown less microleakage then hand instrument prepared canals irrespective of what was used to obturate the canal.43 The machining of the canal walls with NiTi rotary instruments provides smoother canal walls and shapes that are easier to obturate then can be achieved with stainless steel files. The better the adaptation of the obturation material to the instrumented dentinal walls, the less leakage is to be expected along the entire root length. The better the canal walls are prepared, the more smear layer and organic debris is removed which is beneficial to root canal sealing.

Smear layer removal is best achieved by irrigating the canals with NaOCL (sodium hypochlorite) followed but 17% EDTA solution.44 Whereas, the NaOCL dissolves the organic component of the smear layer exposing the dentinal tubules lining the canal walls. EDTA, a chelating agent, dissolves the inorganic portion of the dentin opening the dentinal tubules. Alternating between the two irrigants as the instrumentation is being performed will permit removal of more organic debris further into the tubules, increasing resistance to bacterial penetration once the canal is obturated.45, 46

Obturation

The purpose of the obturation phase of a endodontic therapy is two-fold; to prevent microorganisms from re-entering the root canal system, and to isolate any microorganisms that may remain within the tooth from nutrients in tissue fluids. No matter how well we seal the canal, if the coronal portion of the tooth is not thoroughly sealed then bacterial leakage may be a matter of time. Accessory canals maybe present in the pulp chamber leading to the furcation area. This may be an additional source of leakage that often goes unaddressed either following obturation of the canals or during the restorative phase. Placement of a layer of resin-modified glass ionomer cement or adhesive resin to seal this area immediately following obturation can prevent leakage prior to final restoration of the tooth.47 But, it must always be remembered that success will only be achieved if the root canal system has been as thoroughly debrided as possible of infected material. Irrigation is key, to removal of this smear layer lining the canal walls.

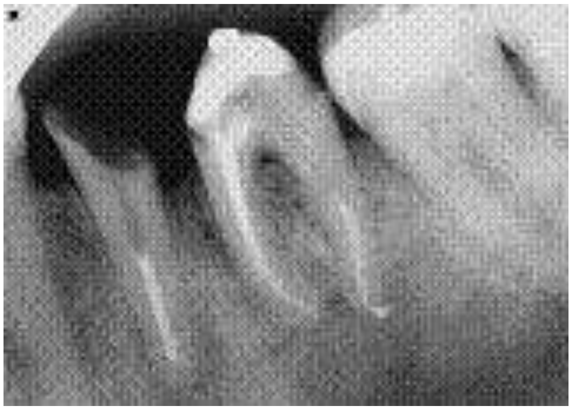

Figure 10: Seven months post completion of endodontic treatment, showing lose of coronal restorations, yet apical lesions seen previously have resolved significantly. (Courtesy of Dr. Joseph Maggio)

The obturation material is a two pronged sword. What sealer is used is as important as which core material is placed within the canal. Gutta percha has limitations in resistance to coronal leakage which have been overcome with the newer resin alternatives. Although sealers can form close adhesion to the root canal wall, none is able to bond to the gutta percha core material. Upon setting, shrinkage of the sealer allows the sealer to pull away from the gutta percha core, leaving a microgap gap through which bacteria may pass.48 Several alternatives are available for core material selection.

Resilon™, a resin gutta percha alternative that is bondable with methacrylic sealers such as Epiphany™ (Pentron Clinical Technologies, Wallingford, CT) and RealSeal™ (SybronEndo, Orange, CA) was introduced three years ago after extensive studies. The core material Resilon™, is available in .02, .04 or .06 taper ISO sized cones from Pentron Clinical Technologies (Wallingford, CT) or SybronEndo (Orange CA) and as sized apical plugs (Lightspeed Technologies, San Antonio, TX).49, 50 Resilon™ showed significantly less leakage than gutta percha. In studies performed at University of North Carolina, the gutta percha group demonstrated leakage in 80% of specimens when and was not dependant on obturation technique nor which sealer was used.51 Because of these limitations seen with gutta percha, the seal of a coronal restoration may be as important as the gutta percha fill in preventing reinfection of the root canal. Studies have shown that leakage of bacteria with Resilon™ is significantly reduced compared with gutta percha. The significance of this is should the coronal break down the adhesive obturation material may slow down or prevent apical migration of bacteria allowing healing to occur. (Figure 9 and 10) An additional benefit when filling the canals with the new resin-based obturation material an increase was observed in the invitro resistance to fracture of endodontically treated single-canal extracted teeth when compared with standard gutta percha techniques. Resilon™ demonstrated a twenty-five (25) percent increase in root strength than gutta percha samples.52

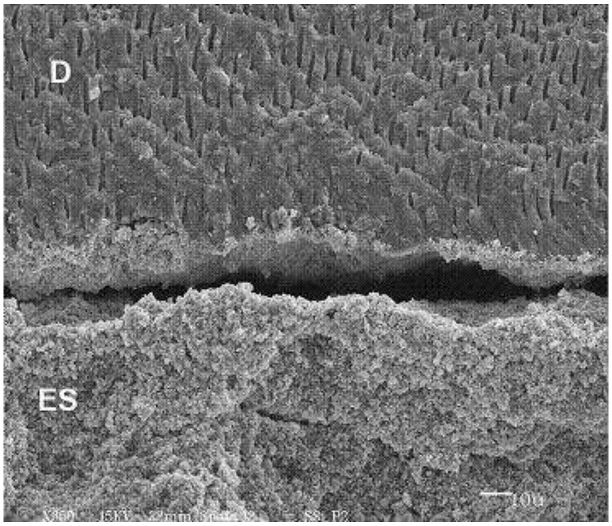

Figure 11: SEM demonstrating microgap formation with AH-26 epoxy sealer due to polymerization shrinkage. (ES – epoxy sealer, D – dentin)

Fiber obturators, an alternative core material may be used when a post will be placed to strengthen the root and retain the coronal core. These allow obturation of the canal and placement of the post at the same step assuring coronal seal.53, 54 Microbial leakage occurred more quickly in lateral and vertical condensation techniques compared with obturation with fiber obturation systems.55 Currently two fiber obturator systems are commercially available; the FibreFill™ system (Pentron Clinical Technologies, Wallingford, CT) which was introduced in 2001 and the recently available InnoEndo™ system (Heraeus Kulzer, Armonk, NY). Both systems use resin sealers allowing formation of a monoblock across the root to both strengthen and seal the canal system.

Sealer selection is very important to prevent microleakage and permit a bond to the core material. Zinc oxide and eugenol (ZOE) sealers has been a mainstay in endodontic therapy for over one hundred (100) years. When exposed to coronal leakage ZOE sealers demonstrated complete leakage by the second day. Results indicated that none of the ZOE formulations tested could predictably produce a fluid-tight seal even up to the fourth day.56

AH-26, an epoxy sealer originally introduced forty (40) years ago was also unable to bond to gutta percha leading to coronal leakage issues. Leakage with AH-26 was not dependant on obturation technique showing gross leakage increasing within the first four (4) months following obturation when coronally challenged. Coronal leakage was significantly greater during the first 4 months57. Complete bacterial leakage with AH-26 may be seen in as few as 8.5 weeks should the coronal restoration permit leakage.58

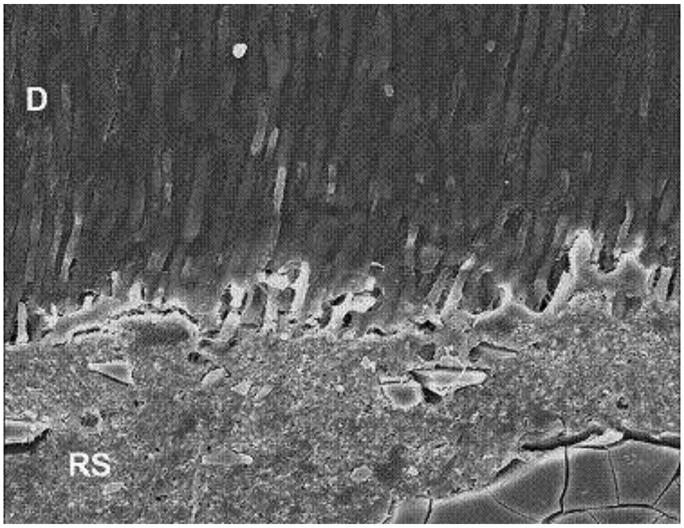

Figure 12: SEM demonstrating intimate contact with methacrylic sealer and Resilon and dentinal tubula penetration of the sealer. (RS – methacrylic sealer, D – dentin)

Additionally, invitro studies found gutta percha and AH-26 or AH-26 plus permitted leakage of both bacteria and fungi. Leakage in experimental teeth occurred between 14 and 87 days, with 47% of the samples showing leakage. AH26 sealer permitted bacterial leakage in 45% and fungi leakage in 60% samples. Whereas, the samples with AH Plus, demonstrated bacterial leakage in 50% and fungi 55% of the samples. There was no statistically significant difference in penetration of bacteria and fungi between the two versions of the sealer.59 Comparative studies looking at periapical inflammation between teeth treated with gutta percha with AH-26 sealer and Resilon with methacrylic sealer found statistically less inflammatory response with the Resilon treated teeth. Mild inflammation was observed in 82% of roots filled with gutta percha and AH-26 sealer compared with 19% of Resilon treated teeth. The monoblock provided by the Resilon system was associated with less apical periodontitis, which may be because of its superior resistance to coronal microleakage.60 As AH-26 is unable to bond to gutta percha, polymerization shrinkage of the epoxy resin can result in a microgap leading to the leakage reported in the literature. (Figure 11) Alternatively, the bond reported between the methacrylic sealer (Epiphany or RealSeal) and Resilon is sufficient to prevent microgap formation as the sealer polymerizes. (Figure 12)

Electrophoresis leakage studies recently completed at University of Maryland comparing gutta percha with AH-26 sealer and Resilon™ with Epiphany™ sealer found significant differences in leakage resistance. The gutta percha/AH-26 group demonstrated an average resistance of 404.6 micro amps with one hundred (100) percent of the samples leaking compared to an average resistance of 27.7 micro amps with sixty (60) percent showing some leakage. The lower the value of resistance in micro amps, the more resistant the specimen was to leakge.61 These results support other studies indicating that gutta percha and AH-26 when challenged do not offer resistance to coronal leakage. Should the practitioner wish to continue using these materials a permanent restoration needs to be placed at the appointment when endodontic therapy is completed?

Conclusion

Of 41 articles published between 1969 and 1999 (the majority from the 1990s) the literature suggests that the prognosis of root canal-treated teeth can be improved by sealing the canal and minimizing the leakage of oral fluids and bacteria into the periradicular areas as soon as possible after the completion of root canal therapy62.

Endodontic success is a multifactoral issue. Like a jigsaw puzzle, the full picture can only be seen when all the pieces are fit together. How the canals are instrumented is as important as what is used to obturate the canal system. This is also influenced by what is placed coronally and when the coronal aspect is sealed. NiTi rotary instruments and an irrigation protocol that includes NaOCL and EDTA will maximize the sealing ability of glass ionomer or the newer methacrylic resin sealers. The last piece of the puzzle, sealing coronally should be performed with adhesive permanent restorative materials immediately at the conclusion of the first endodontic appointment to prevent apical migration of bacteria and assure sealability of the canals.

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