

The Art of Imping

The Dynamics of Raptor Feather Repair



Author: *Melanie Barsony*

Affiliations: *Australian Raptor Care and Conservation Inc, WIRES Northern Rivers*

Abstract:

Bird feathers are finely tuned instruments crucial for avian aerodynamics. Imping is the method of repairing broken or damaged feathers. A feather replacement is done by joining a donor feather to the shaft of a broken feather using a dowel and glue. The repaired feather will subsequently moult out as normal and a new feather will grow to replace it. Imping can greatly reduce the amount of time a wild bird would otherwise need to spend in care – on the contrary, incorrectly repaired feathers will impact directly on the birds' survival post release. Imping truly is a fine art that requires precision and skill. The aim of this paper is to create a better understanding of the imping procedure.

Keywords:

Imping, feather repair, bent feathers, raptors, raptor rehabilitation, birds of prey

Introduction:

Feathers in perfect condition are essential for all birds, but are even more critical for birds of prey whose hunting success impacts directly on their survival. Owls depend on perfect feathers to enable them to hunt silently. Feathers can become damaged by a variety of causes including stress fractures, entanglement, collisions, fighting in the wild, poor handling techniques, inappropriate housing and transportation.

Methods of feather repair evolved with Middle Eastern falconry practices over many centuries and modern advancements have provided refinements to this ancient technique. Imping is only possible if a feather is broken or damaged, not if it has fallen out completely. Primary feathers and rectrices are suitable for imping. Blood feathers cannot be impinged until they have fully grown and no longer have a blood supply. The donor feather must be the exact corresponding feather from a bird of the same species and maturity.

The author has been fortunate to undertake two internships at the Abu Dhabi Falcon Hospital and the imping skills learned there have been transferred and modified to apply to Australian wild bird rehabilitation. The author has conducted numerous imping procedures on many Australian birds (including Laughing Kookaburra, Australian Magpie, Tawny Frogmouth, Yellow-tailed Black Cockatoo and Pied Currawong). This valuable experience allowed the necessary development of skills before advancing to imping species of raptors including

Australian Kestrel, Pacific Baza, White-bellied Sea-Eagle, Brahminy Kite and Eastern Barn Owl.

Before considering whether a bird should undergo imping, a full physical examination with a reputable and experienced veterinary surgeon is essential – this includes, but is not limited to, radiographs, an ophthalmoscopic examination of the eyes, and faecal float and worm egg count. Careful inspection and recording of any feather damage is best carried out while the bird is anaesthetised during the initial consultation. Before imping, the raptor must first have fully recovered from any injuries or disease.

Imping is a highly specialised skill and infinitely more involved than just gluing two parts of a feather together. Unfortunately, inexperienced or careless feather repair will have disastrous consequences. Any imperfections will impact directly the birds' flight and its ability to survive post release. Releasing a raptor with feathers misaligned is a potential death sentence. Even a single incorrectly angled impinged feather can cause intense irritation and bruising around the shaft base. To conduct imping successfully you will need precision, high manual dexterity and a good eye for detail.

Donor Feathers

Sadly, not all rescued raptors survive, but they may have healthy feathers in optimum condition - their wings and tails can be kept in a feather bank and utilised as feather donors to help other birds of prey. If possible, it is helpful to have two or more donor wings or tails of the same species to provide a choice for the most suitable donor. It is best to keep whole wings and tails as single feathers can easily become disorganised. Donor wings and tails are best stored flat packed in cardboard and labelled clearly with species, weight and age and may be kept either frozen or dried. Raptors have ten primary feathers, numbered as P10 being the outermost feather and P1 the feather adjacent to the secondary feathers. Rectrices are numbered with the centre feather being L1 and continuing to L6 to the left side of the right of the centre is R1, continuing to R6. Note: ARCC Inc has an extensive feather bank.



Figure 1: Brown Falcon feather donor
Juvenile Dark, Body weight 561 gm, wings and tail

Anaesthesia

Feather repair must only be done while the bird is perfectly still and unstressed. To ensure this, the bird must be impinged while under anaesthesia at a veterinary clinic. The bird's temperature must be closely monitored and the procedure should take no longer than a maximum of 45 minutes to avoid potential adverse effects associated with prolonged anaesthesia. Depending on the number of feathers needing repair, a subsequent vet appointment may be necessary. Please note that some raptors species such as the Pacific Baza and White-bellied Sea-Eagle are more sensitive to anaesthetic and their recovery time is longer, so duration under gas must be reduced accordingly.

Tools of the Trade:

- Suitable donor feathers
- Small scissors
- Nail clippers, straight edged
- Dog nail clippers
- Long nose pliers
- Surgical blade
- Ruler
- Callipers
- Dremel (eg Dremel 8V Cordless Micro)
- Super Glue (Cyanoacrylate adhesive)
- Two part epoxy resin - 5 min Araldite
- Talcum powder
- Paper pieces (approx 5x5cm or larger depending on size of bird being impinged)
- Cotton buds
- Tissues
- Masking tape
- Pen and paper
- Splints (from feather shafts 1-3mm wide and 3-4 cm long)
- Sewing needles (different sizes) clean and lightly sanded
- Bamboo skewers, prepared in different diameters and lengths of small, medium and large
- Bamboo chopsticks prepared in different diameters and lengths
- Box knife and sandpaper for adjusting dowel diameter
- Work surface for whittling e.g. wooden block



Figure 2: Basic imping tool kit

Bent Feathers

Depending on the extent of the damage, a bent feather that has not split or broken may be repaired without the need for a full replacement. The simple application of heat and moisture via a dampened sponge held onto the bent feather can be

enough to soften the shaft and to then gently straighten the feather. More severely bent feathers can be reinforced with splints, glue and inserts. Splints are the outer layer of the feather shaft sourced from spare donor feathers. With practice strips of this hard keratin layer can be peeled away from the shaft and then cut into lengths of two to four centimetres.



Figure 3: Splints from donor feathers and needle inserts

Splinting Process

Pliers are used to gently straighten the feather from above and below the bent area and from side to side. Place a piece of paper under the feather being repaired to avoid glue getting on the other feathers. Lightly roughen the feather shaft with the Dremel to help the glue adhere to the shaft. Make a shallow incision with the scalpel, approximately one or two centimetres, lengthways along the centre of the shaft that encompasses the bent area and either side. Then using a fine skewer or needle, insert a small amount of super glue into the cut. If needed, a piece of needle can also be inserted for extra strength. Then select a splint of the corresponding size. Attach with super glue and gently squeeze in place using the pliers. Remove any excess glue with tissue. Extra glue should then be applied to both ends of splint and extend a few millimetres along the feather. Sprinkle talcum powder on this glue. When dry, the whole area is smoothed with the Dremel. Use the same procedure to glue a splint on the opposing side of the feather.

Imping Process

If there is more than one damaged feather, begin with the feather closest to secondary feathers and work outwards along the wing. This will help to match the angle of each new feather to those on the wing. Apply masking tape to keep any feather coverlets out of the way of the feather repair area. Feathers that have a proximal break (closer to the body) can be impeded using a bamboo dowel or skewer. If a feather is broken mid-shaft or distally, and the decision is made to make the repair in this position on the feather, it will require a smaller diameter dowel or a sewing needle insert.

Select the most suitable corresponding donor feather based on length and shape of the damaged feather (if it is still intact) or to the corresponding feather on the opposing wing on the bird that is being impeded. Use the dog nail clippers to cut the donor feather longer than required to allow some room for error. Then carefully cut the first damaged feather shaft below the break and remove the broken piece of the feather. This shaft will receive the impeded feather and should be at the least one or two centimetres in length, depending on the size of the bird species.



Figure 4: White-bellied Sea-Eagle juvenile with damaged feather removed proximal to body

If cutting higher up the feather where there are vanes, be careful to cut the shaft only, not across the vanes as well. Remember that the shape of each raptors wing is particular to the species, and matching each donor feather to its correct length within the wing is crucial. Measure the length of the corresponding feather on the opposing wing, and then subtract the length of the remaining shaft to give you the final length of the donor feather. Before actually cutting the donor feather to the desired length, hold it in place exactly where it will be impeded and again compare with feathers next to it and the feathers of other wing. Take note of how much longer or shorter it should be to its neighbouring feathers (the callipers are handy to

check this). Measure twice or three times and cut once! If it is cut too short you will end up with a useless feather. Only when you are sure of its desired length, cut the donor feather.

Gently clear the inside of the feather shaft on the bird using an awl or similar tool and insert a suitable piece of dowel halfway into the shaft. The fit must be snug but not forced as the shaft can easily split (if this happens it will no longer be suitable to take the impeded feather). The dowel may need to be whittled down and/or sanded for a snug fit. If it is too loose select a larger size dowel. Remove the dowel and insert its other end halfway into donor feather, again, this end may need to be whittled or sanded. Sometimes, the diameter of the donor feather will vary from the bird being impeded, so careful adjustments to the dowel will be necessary.

When the dowel fits snugly into both the donor feather and the shaft of the bird, attach the donor feather in place without glue and check again carefully to make sure of its length and that the feather shaft ends achieve a perfect union. Make any slight adjustments to its length as needed. When fully satisfied the feather is the correct length, mix up a small amount of Araldite glue as per instructions.

Place a piece of paper under the feather shaft on the bird to avoid any excess glue getting onto its other feathers. Roll the end of the dowel in a small amount of prepared glue and insert into the donor feather, twirling to make sure of a good coating. Repeat this once or twice then insert the dowel up to half its length into the donor feather. Apply glue to dowel end of donor feather and repeat this process with the shaft on the bird, then affix the feather in place. Wipe away any excess glue. Now is a critical time to ensure a correct feather angle before the glue dries. Carefully check the new feather's alignment with the other feathers by



Figure 5: Gluing the donor feather in place

partly folding and opening the wing to scrutinize whether the vanes are perfectly parallel to the other feathers in the wing. It may be necessary to slightly twist the new feather to ensure it is positioned at exactly the correct angle to the corresponding feathers.

When the glue is fully dry (the left-over glue will be an indication) remove the paper and if needed use the Dremel smooth any rough edges on the repair. Carefully and gently remove all masking tape. The pointed end of a skewer is then run between the feathers to make sure no feather down has been stuck together. Check carefully that there is no glue anywhere on the bird and all masking tape is removed. Multiple feather repairs are challenging, especially if both wings are involved. If this is the case, be guided by the donor wing as to individual length of each feather.

Rectrices

The importance of rectrices in bird aerodynamics is often overlooked. Without a full tail, the bird will struggle to reduce speed or manoeuvre in flight. The process of imping tail feathers is the same as above, with equal importance to feather length and alignment. It may be necessary to turn the bird over to check the angle of each impinged tail feather before the glue dries.



Figure 6: Brahminy Kite with multiple damaged tail feathers will require imping

Post imping

Always remember to administer subcutaneous fluids before the bird wakes up after the procedure. The bird must then be allowed to rest quietly in the transport container (with a towel on the bottom and a second rolled-up towel for support) for at least one hour. If the raptor requires another vet visit to complete more feathers, it is best kept in a smaller aviary to minimise it attempting too much too soon. After a raptor has had all feathers repaired, observing its sustained flight and aerodynamic balance in a large circular aviary (such as the Peter Spitzer Free Flight Aviary at the Higher Ground Raptor Centre) over several days will enable the rehabilitator to ascertain the success of the imping procedure.

Imping helpful hints:

- Practice on deceased birds first, using two cadavers of the same species to replicate a real imping scenario
- Before the imping procedure, cut a single feather from the donor wing and prepare a suitable diameter and length dowel. You can then use this as a guide to whittle a variety of dowels for the procedure. Keep the sizes separate in zip lock bags marked small, medium and large
- When imping, complete the repair on one feather at a time from start to finish, rather than trying to prepare all the donor feathers beforehand. This will avoid any mix up of feathers and will enable a more precise finish
- A few pieces of paper on top of each other placed under the feather prior to gluing will allow the top piece of paper to be removed if it gets glue on it. This will lessen the chance of glue contaminating other areas
- Don't use excessive amounts of glue
- Never force a dowel into a shaft; it must be snug but not tight
- Double check before cutting any feathers
- Work quickly but don't rush

Case Study 1: Inappropriate Imping

A Pacific Baza (*Aviceda subcristata*) suffered the results of improper imping performed by an inexperienced rehabilitator. Both sets of primaries and some of the rectrices were impeded over an extensive time under anesthetic. Many of the feathers were misaligned, particularly on her right wing. There was also excess glue on other feathers and even a piece of masking tape still stuck on her body. The carbon fibre inserts appeared to be more difficult to whittle to the correct diameter and caused splitting in many of the feather shafts. The carbon fibre was also found to be less flexible than bamboo dowel. The end result of this entire process was the Baza moulted of all the impeded feathers over a number of weeks. Fortunately she had not been immediately released after the imping procedure or she would have suffered a miserable death. Over a period of many months in care she slowly regrew all the moulted feathers.



Figure 7: Misalignment of feathers is obvious



Figure 8: Impeded feathers are of incorrect lengths in both wings



Figure 9: Split feather shafts due to inserts being too tight



Figure 10: Premature moult of feathers

Case Study 2: Precision Imping

A juvenile Eastern Barn Owl (*Tyto delicatula*) collided with a car and suffered a mild concussion and three broken primary feathers. After veterinary checks and a full recovery from the concussion, an imping procedure to repair the damaged feathers was conducted.



Figure 11: Three damaged feathers; the first feather to be repaired has been removed

Figure 12: The donor feather is first inserted without glue to check its length



Figure 13: Donor feather glued in place prior to checking its alignment



Figure 14: Checking feather alignment



Figure 15: Barn Owl prior to release



Figure 16: Barn Owl's repaired wing while in the aviary revealing the impeded feathers precise alignment

Conclusion

Imping is a valuable art to learn and the importance of achieving a highly skilled result cannot be underestimated. Diligence and a keen eye for detail are required to enable the rehabilitator to conduct successful feather repair and allow the raptor the best chance of survival post release.

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References

- [1] Abu Dhabi Falcon Hospital Internship Program 2013; Falcon Husbandry and Healthcare
- [2] Abu Dhabi Falcon Hospital Internship Program 2014; Avian Husbandry and Medicine
- [3] Margit Gabriele Muller *Practical Handbook of Falcon Husbandry and Medicine*; Nova Science Publishers, Inc 2009
- [4] Stephen Debus *Birds of Prey of Australia A Field Guide*; CSIRO Publishing Second Edition 2012
- [5] Hermann Wagner, Matthias Weger, Michael Klaas, Wolfgang Schröder *Features of Owl Wings that Promote Silent Flight*; The Royal Society Publishing Interface Focus 2017 Feb 6 Accessed online at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5206597/>
- [6] Adrian L. R. Thomas *On the Tails of Birds* BioScience, Volume 47, Issue 4, 1 April 1997, Pages 215–225. Accessed online at Oxford Academic https://www.google.com.au/search?q=On+the+Tails+of+Birds+Adrian+L+R+Thomas&rlz=1C1ASUT_enAU529AU531&oq=On+the+Tails+of+Birds+Adrian+L+R+Thomas&ags=chrome
- [7] Australian Raptor Care and Conservation Inc. <http://www.australianraptorcareandconservation.com/>
<http://www.australianraptorcareandconservation.com/blog/>
- [8] Higher Ground Raptor Centre , <https://www.highergroundraptors.com/>