

Management of the extraction socket: Site preservation prior to implant placement

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In many instances where a tooth is no longer restorable and requires extraction, dental implant tooth replacement may be the treatment of choice in an otherwise dentate patient. While immediate implant placement into extraction sockets has gained in popularity in recent years, there are a number of instances where it may not be appropriate to proceed with immediate implant placement. The main contraindications for immediate implant placement include:

1. Periapical infection - Teeth with large periapical infections do not usually lend themselves to immediate implant placement. Furthermore, teeth with acute, symptomatic periapical infection should not be considered for immediate implant placement.
2. When good primary stability of an implant is not possible when placing it immediately into an extraction socket. If there is insufficient bone beyond the apical area of the tooth into which to anchor the dental implant and achieving primary stability looks questionable, revert to socket grafting and delay the implant placement.
3. Patient driven factors.
4. When there is loss of labial plate due to a draining apical infection or as is vertical root fracture. This is particularly the case in the aesthetic zone where stabilization of the soft tissue profile becomes even more critical.

In cases where immediate implant placement is contraindicated and delayed implant placement more appropriate, it is often worth contemplating socket grafting. This is particularly so in high aesthetic cases or in cases where there is limited bone height for subsequent implant placement



Figure 1. Use of Periotome following intrasulcular incision with scalpel is the first step in atraumatic tooth extraction.



Figure 2. Following successful extraction of the tooth, explore the walls of the extraction socket to ensure all bony walls are intact. Then spend considerable time curetting the socket wall with a sharp spoon curette. Periodontal bone files can also be helpful when debriding socket walls to remove remnant periodontal ligament tissue. Ensure there is not apical granulation tissue left behind. Use copious amounts of sterile water or saline to irrigate and flush the socket so that you can easily visualise the inside of the socket prior to grafting.



Figure 3. Pre-operative view prior to extraction of the 21.

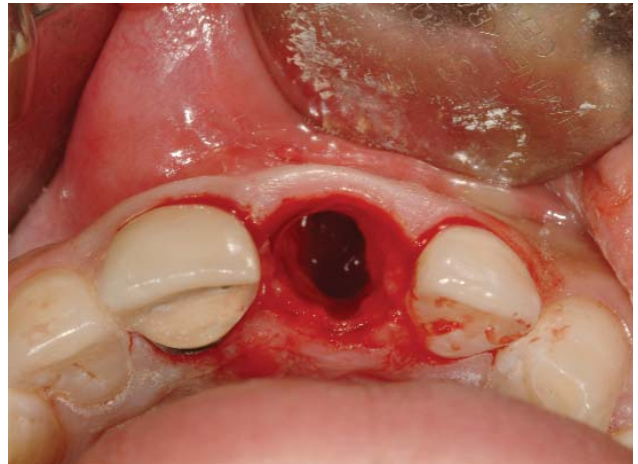


Figure 4. Immediately postoperative following tooth extraction using periosteal elevator and luxator. Curettage of the extraction socket is critical at this time.

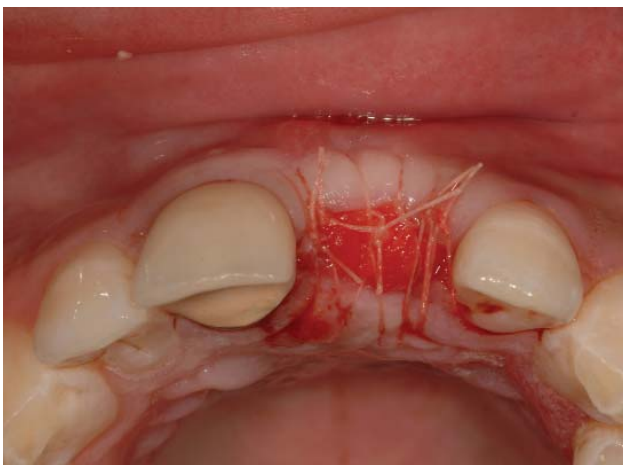


Figure 5. Occlusal view following socket grafting placement of BioOss and Colatape barrier. Closure with a series of interrupted 5-0 Vicryl sutures which are left in place for 10 days.



Figure 6. Subsequent implant placement (single stage) with healing abutment placement at the time of implant placement. Note the excellent preservation of soft tissue profile.

(such as under a maxillary antrum or over the inferior dental nerve canal).

The ability to preserve marginal soft tissue contours is an important consideration in the aesthetic zone particularly in cases with thin labial plate of bone. Under normal circumstances, tooth extraction alone in these areas will result in loss of labial plate and soft tissue collapse into the extraction socket within a matter of weeks resulting in loss of bone volume and gingival contour.¹⁻⁵

Site preservation through socket grafting will help to optimise bony fill within the extraction socket, thereby maintaining vertical bone height and helping to stabilize the marginal soft tissues at the site. This generally results in a healed site, which lends itself well to implant placement with a high degree of predictability as well as improved soft tissue contour or 'pink' aesthetic.^{6,7}



Figure 7. Clinical picture on the day of final implant crown placement on the 21 implant. Minimal change in the marginal tissue height is noted. Slight bleeding in the sulcus is related to removal of excess crown cement.

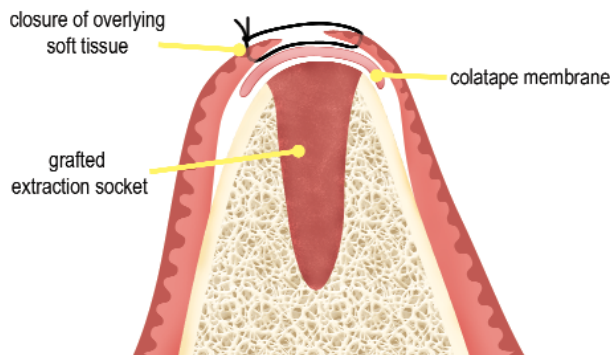
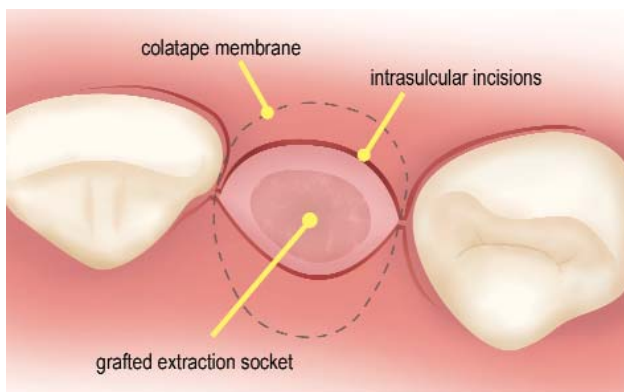


Figure 8. Diagram showing the position and extension of the collagen dressing (Colatape) which is cut to fit over the grafted extraction socket. The edges of the membrane are tucked under the edges of the flap on the buccal/labial and palatally as shown. The membrane itself is not sutured into place in this case. Instead, the flap is adapted over the majority of the membrane (around the edges) and the flap sutures placed over the top of the membrane thereby holding the barrier stable.



Figures 9 and 10. Preoperative view prior to extraction of the 11 and 21 due to endodontic failure.

Clinical assessment

Careful clinical and radiographic evaluation should be undertaken before treatment planning for extraction socket grafting. Radiographically, there should be good interproximal bone height adjacent to the tooth being extracted. Any periapical pathology should preferably be small, well-circumscribed and contained within the surrounding alveolar housing. Evaluation may be enhanced with the use of cone beam CT in such cases. Evaluation of the density of the surrounding bone and whether or not the tooth has had endodontic treatment will also give the clinician insight into the relative ease of the extraction. The anticipated ease of extraction is important as it will influence patient management as well as your approach to the extraction (i.e. to section the tooth/separate roots prior to extraction).

Bone sounding can be used to confirm the condition of the labial/buccal and palatal bone heights prior to extraction. Under infiltration anaesthesia, a periodontal probe can be used to sound the marginal bone through the sulcus around the tooth. This will alert the clinician to the possibility of more extensive labial plate bone loss, which may preclude moving forward with the socket grafting procedure and instead warrant referral for more complex Guided Bone Regeneration (GBR) and connective tissue surgery to successfully manage the case, particularly if it is a highly aesthetic case.

The quality and quantity of gingival tissues around the tooth should also be evaluated to ascertain if there is a need to enhance the existing biotype through the use of connective tissue grafting techniques.

Teeth with acute apical infections are

not ideally suited to extraction and socket grafting. The patient's acute infection should be firstly managed by drainage of any visible abscess and systemic antibiotics for 5-7 days before returning for the extraction and socket grafting procedure.

Atraumatic tooth extraction

The key to successful site preservation is minimizing trauma to the hard and soft tissues around the tooth being extracted. In order to achieve this, it is necessary to adopt the appropriate technique and instrumentation. The use of a periosteal elevator and luxator is critical to achieving atraumatic tooth extractions. The surgical approach involves intrasulcular incisions around the tooth to be extracted. Either no flap or a minimal flap is raised around the neck of the tooth. This helps give access for the periosteal elevator and luxator. The periosteal elevator is used to sever

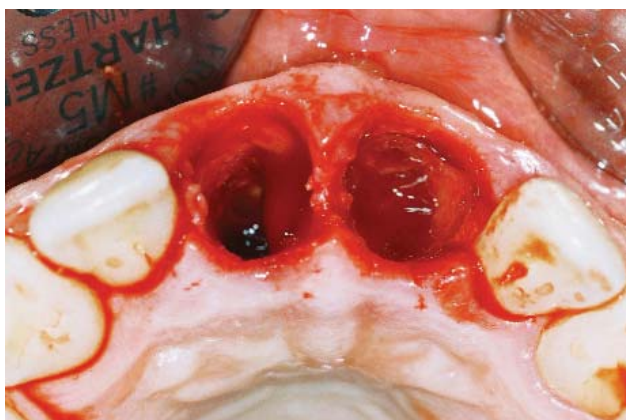


Figure 11. Immediate postoperative view following extraction of the incisors after debridement of the sockets.



Figure 12. Placement of BioOss graft into the sockets prior to placement of Colatape membrane.

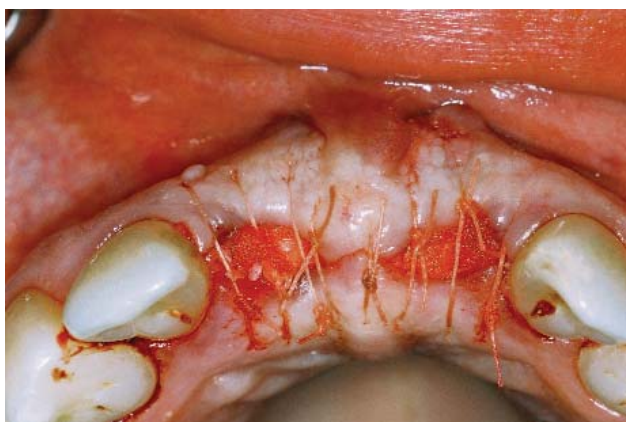


Figure 13. Colatape membrane placed over graft to contain the particulate graft and is tucked under the edges of the flap. Vicryl sutures used to close the extraction sockets.



Figure 14. Frontal view of extraction sites following socket augmentation just prior to fitting the provisional removable partial denture.

some of the periodontal ligament around the coronal aspect of the tooth. The periosteum should NOT be used as an elevator. The initial use of a periosteum also helps create a better access point for the subsequent use of the luxator. The luxator is used to widen the PDL space and get some mobility of the tooth root being extracted. In many instances, the careful use of the luxator, gradually working it circumferentially around the tooth, will result in the extraction of the tooth, which then simply needs to be removed from the mouth with forceps.

Teeth with a severe coronal fracture extending subgingivally or teeth with multiple roots may require additional efforts to ensure an atraumatic extraction. Typically, this involves carefully sectioning the remains of the tooth and removing it in sections. The judicious use of a straight handpiece with a tungsten carbide tapered

fissure bur or round bur sectioning roots but avoiding any contact with the surrounding bone of the socket. By sectioning the tooth root and carefully removing root fragments, there is a reduced risk of trauma to the surrounding alveolar bone, which may otherwise result in fracture of the labial/ buccal plate of bone.

Socket debridement

Once the tooth root has been extracted, it is imperative to thoroughly debride the socket walls. This is best undertaken with a surgical spoon curette. This part of the procedure should not be rushed; each area within the extraction socket needs to be curetted and all remnant periodontal ligament tissues removed from the socket walls. This has the added advantage of inducing some bleeding (increased vascularity) into the socket. Occasionally, you may note that

the extraction sockets fails to show much in the way of vascularity (such as in the mandibular arch) and this may necessitate the need to use a very small round bur to carefully perforate the cortical plate within the extraction socket. It is important to invoke bleeding into the socket as a good blood supply is required for good wound healing. Cortical perforation also helps to encourage osteoprogenitor cells into the healing extraction socket. The use of magnification (loupes) and excellent illumination (fiberoptics) of the surgical site is very beneficial during this procedure. Socket debridement constitutes a critical step in the site preservation technique. Failure to perform this step thoroughly can result in fibrous healing and poor graft consolidation within the socket, thereby potentially jeopardising subsequent dental implant healing.

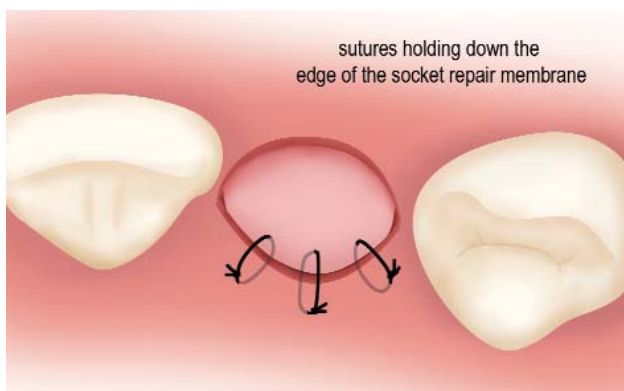
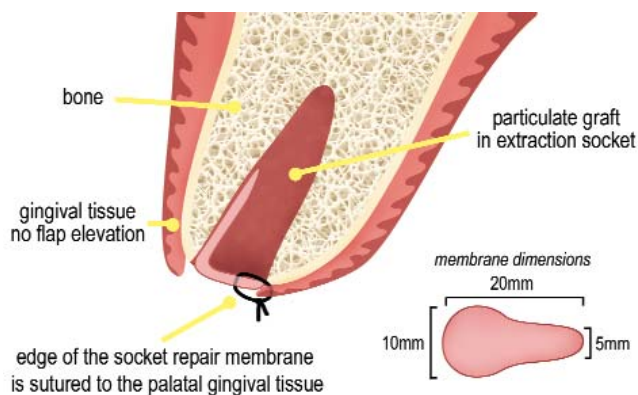


Figure 15. A cross-sectional and occlusal view on the use of the socket repair membrane. Note the position of the membrane internal to the socket on the cross-sectional view. The membrane dimensions are also shown. The membrane can be trimmed and shaped to fit.

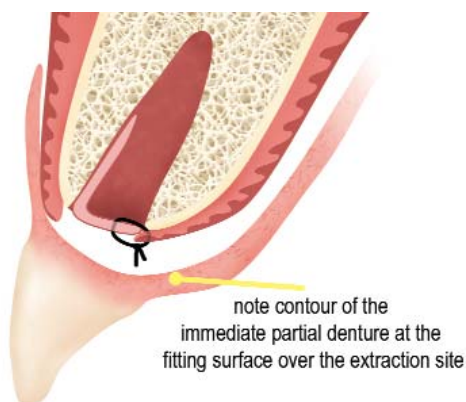


Figure 16. This diagram depicts the cross section on the partial denture ideally suited for use over a socket that has been grafted. Initially, one should avoid an ovate pontic. The partial denture should also be tooth supported to prevent pressure on the soft tissues.

Selection and placement of bone graft material

A number of different materials have been suggested for use in extraction sockets, however not all are suitable.⁸⁻¹² The decision on what is used should be based on biological principles. A graft material should be biocompatible, support bone growth and be resorbable. Thus, materials of choice include autogenous bone, BioOss and Freeze Dried Bone Allograft (FDBA). The material used for socket augmentation should support vital bone formation into the socket in order to allow for successful osseointegration of the dental implant that will subsequently be placed into the site. Thus, it is also preferable that the material used is resorbable and ultimately replaced with vital bone long term.¹³

Materials not suitable for socket grafting prior to implant placement include non-resorbable hydroxyapatite, calcified copolymer alloplast (Bioplant HTR, Bioplant Inc.) and 'bioactive' glasses. These materials, while supporting some bone ingrowth histologically, show a tendency toward fibrous encapsulation thereby making them unsuitable for subsequent implant placement. Notwithstanding, such materials can be used safely and predictably when ridge preservation is required beneath a future bridge pontic in cases where dental implant placement is not contemplated.

Other materials recently suggested for use in extraction sockets include Puros™ cancellous particulate allograft (Zimmer Dental) and Straumann Bone Ceramic (Hydroxyapatite and beta-tricalcium phosphate). These materials appear to hold some promise and while we need further medium to long term evidence on the efficacy of these materials in extraction sockets, initial reports on the use of the Puros™ graft material appear to compare well with other studies in which freeze dried bone allograft has been used for socket grafting.

Following socket debridement, the graft material should be lightly packed into the extraction socket in an incremental fashion. A flat plastic instrument and plugger can be used to lightly condense the particulate graft to the top of the bony socket walls. Avoid heavy condensing of the graft particulate into the socket as this may compromise the vascularity within the socket and subsequent osseous healing. Also, do not overfill the extraction socket as excess graft material may be lost post operatively and may compromise soft tissue healing over the socket. Graft material should be placed into the socket to the level of the surrounding socket walls.

Use of a graft containment barrier

To assist with containment of the graft particles within the extraction socket, a resorbable barrier membrane is recommended. This is particularly important if there is no primary closure through a coronally advanced flap or the addition of a connective tissue graft. The principle purpose of the barrier membrane is to contain the graft material while soft tissue healing takes place over the extraction site. As epithelialization takes place within the first 2-3 weeks post extraction, it is possible to use a collagen barrier with a shorter resorption time. Thus, the materials of choice would be Colatape or the recently released Socket Repair Membrane (Zimmer).

When using a piece of Colatape, a small oval shape should be cut and positioned over the grafted extraction socket. The edge of the membrane should be tucked under the minimal flap on the buccal/labial and palatal aspect (Figure 8). A crossover suture or interrupted sutures can then be used to adapt the marginal soft tis-

sues over the barrier membrane. When using the Socket Repair Membrane technique, the membrane is inserted into the extraction socket prior to placement of the socket bone graft material. The pointed end of the membrane is placed on the inside extraction socket, on the labial aspect of the socket, with the rounded end of the membrane left protruding out of the top of the socket. The bone graft material is then placed into the socket and finally the protruding rounded end of the membrane is folded over the socket and edge of the barrier membrane sutured to the marginal gingiva on the palatal aspect. Three to four small interrupted sutures are recommended using a 4-0 or finer suture (Figure 15).

Although a barrier membrane is employed in socket grafting procedures, the point that needs to be emphasised is that this does not constitute Guided Bone Regeneration (GBR). GBR by contrast requires the use of non-resorbable barriers (ePTFE) or resorbable barrier with much longer resorption times (e.g. Biomend, Bioguide, Resolute Adapt Gore-Tex). These types of membrane always require complete primary closure with full soft tissue coverage. Thus a GTR barrier membrane may be required when labial bone loss is identified prior to tooth extraction. Whenever a socket has one or more bony walls missing or damaged, it will be necessary to contemplate Guided Bone Regeneration (GBR). This is a completely different procedure with different objectives and should not be confused with extraction socket grafting for site preservation.

Provisional restorations

In most cases where socket augmentation is undertaken as a prelude to subsequent implant placement, the patient will require a provisional restoration to maintain aesthetics, function and possibly maintenance of space. The design of the provisional should take into account the fact that you are trying to preserve the ridge contour, which is generally convex in buccal palatal cross section. Thus, in the case of an interim plastic partial removable denture, one should always ensure that the denture is tooth supported in the area of the extraction (i.e. has stops on the adjacent teeth to prevent the partial denture tooth from putting pressure

directly on the tissues around the extraction site) and have its fitting surface adjacent to the soft tissues that have a more concave contour (Figure 16). A socketed denture should be avoided in cases where socket grafting is undertaken.

If a fixed or bonded provisional is used, again one should attempt to create a concave contour where the prosthesis resembles more of a ridge lap design and does not impinge into the soft tissues. In cases where the provisional restoration is to be used for soft tissue sculpting, the addition of material to the fitting surface of the prosthesis should start 4-5 weeks post extraction and be undertaken incrementally until the desired soft tissue profile is achieved.

Concluding remarks

Site preservation ultimately provides stability of the hard and soft tissues at the level of the marginal gingiva post extrac-

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tion by preventing soft tissue collapse. Support of the labial plate through the initial healing of the extraction socket also maintains the osseous ridge contour thereby simplifying subsequent implant placement. This is particularly important when treating in the anterior aesthetic zone. Implant placement into a previously grafted extraction site should not proceed sooner than 4 months post extraction to allow for sufficient healing and consolidation of the bone through the grafted socket and ensure good initial stability of the implant at placement.

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