Minimizing Alveolar Bone Loss During and After Extractions (Part I) — Review of Techniques: Atraumatic Extraction, Root Retention

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Introduction

Extraction of teeth perhaps was the first surgical procedure developed in the field of dentistry. Surgical techniques have been described since ancient times in scriptures of Sushrutha Samhita (circa 6th century BC)[1] and, over time, the design of instruments continued to evolve to facilitate removal of the tooth in one piece. Aristotle, in mid-300 BC, is known to have used lever mechanisms and fulcrums to design dental instruments. Today, current instrumentation includes various forceps and elevators designed for specific teeth that are designated for maxilla and mandible, left and right, mesial and distal. The primary focus was to remove the tooth as a complete unit; careful attention was paid to minimize any fracture of the crown or the root.

Traditionally, with extraction procedures, a trans-alveolar surgical procedure only became necessary when roots either cracked or fractured or there was insufficient structure remaining on which to engage a forceps. Techniques utilized to remove the root remnants employed lingual-buccal luxation, alveolar purchase, traction, rotation and continuous pressure in one direction. The alveolus was considered as an impediment to extraction and often there was sacrifice of the buccal alveolar plate in an attempt to remove the roots.

The extraction was not the only insult to the alveolar bone. In the attempt to promote prosthetic rehabilitation with a removable appliance, the alveolar bone was compressed following an extraction. The implication was that bleeding can be minimized through compression and any undercuts can also be eliminated with the added advantage of being able to insert and remove the prosthesis with minimal discomfort after healing. When planning for full mouth extraction and immediate dentures, alveoloplasty and alveolectomy using rongeurs, bone files, surgical burs, chisels and rotary surgical instruments are routinely performed. Unfortunately, when using these instruments, a considerable volume of bone is sacrificed. In some extreme cases, surgical resection of the alveolar bone is deliberately carried out to accommodate the placement of implants (such as "All-on-Four"[2,3] techniques). This article will focus on methods to minimize alveolar bone loss caused by extractions. Atraumatic techniques and various methods to employ these will be discussed.

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Fundamental Principles Common to All Extractions

1. Radiographs

Carefully examine the radiographs. Check the morphology of the tooth to be extracted and for the presence of: cervical and root decay, endodontically treated teeth, teeth restored with posts, curved roots, number of roots, a discernible periodontal ligament around the root, alveolar bone quality (i.e., sclerosis), root ankylosis, proximity to vital structures and periodontal condition of the roots.

2. Soft Tissue

Separation of the soft tissue from the tooth is accomplished with a periosteal elevator or with the aid of #12 or #15 scalpel, to sever the gingival fibers that are tenaciously bound to the cementum and to prevent any tear of the attached mucosa during extraction, especially in the cosmetic zone. In cases of mobile teeth, where periodontal support is compromised, retention of the tooth in the socket is primarily from dense diseased

Fig. 1 Gentle malleting of the scalpel handle with #15c blade is used to separate the coronal PDL fibers.

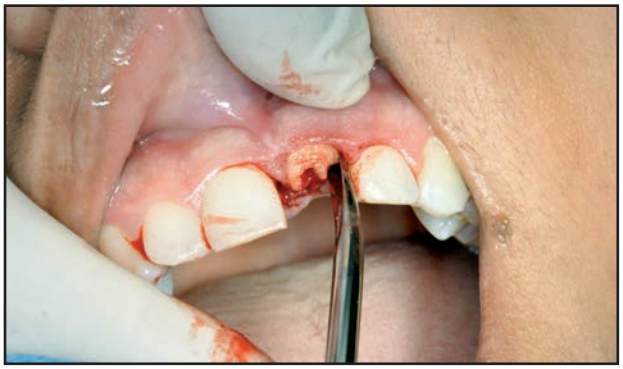

Fig. 2 The periotome is engaged into the created PDL space to luxate the root.

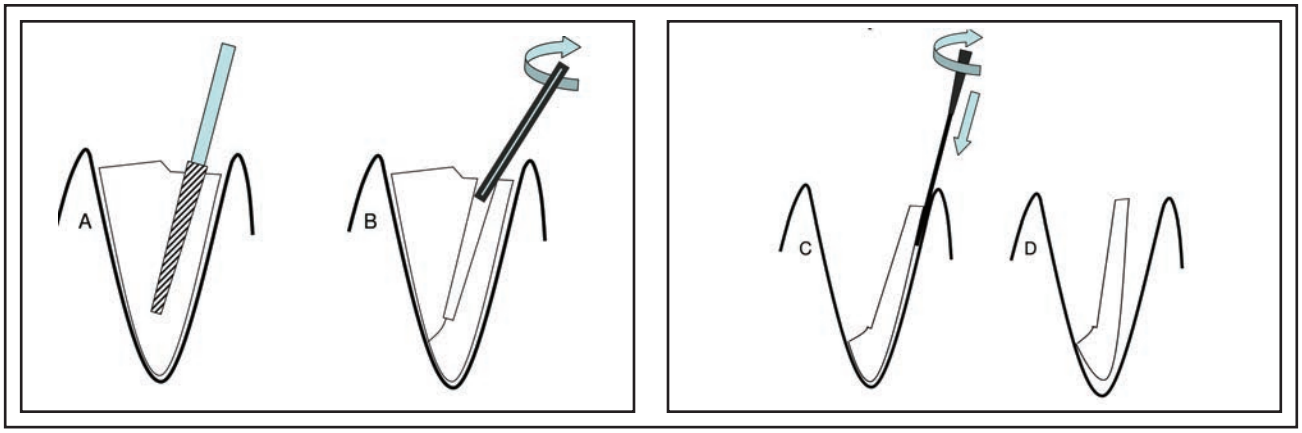

Fig. 3 Sectioning of a single root for an atraumatic extraction. **(A)** Cutting within a root with a 700XXL or 701XL bur; **(B)** Fracturing off occlusal fragment with an elevator; **(C)** Insertion and rotation of the periotome blade within the periodontal space (mobilizing the remaining root fragment); **(D)** Luxation and removal of the remaining fragment. *(Diagrams courtesy of Dr. Michael Leizerovitz)*

gingival tissues. Failure to separate these tissues that lack bony support often result in significant and exaggerated removal of the gingival tissue along with the mobile tooth.

3. Tooth Luxation

When luxating the tooth, an elevator is first inserted in the space between the tooth and the alveolar bone to verify any detectable mobility. The leverage should not involve a fulcrum on the adjacent tooth as it may cause luxation and/or fracture of the healthy neighboring tooth.

Techniques Utilized to Preserve Bone During Extraction

1. Circum-radicular pericision (fiberotomy) using periotomes, scalpels and luxators.
2. Tooth division using rotary instrumentation.
3. Circum-septal osteotomy using rotary instrumentation and piezosurgery.
4. Forced eruption techniques.
5. Extrusion techniques (Benex® extractors).

Techniques

1. Circum-Radicular Pericision Using Scalpels and Periotomes

This technique is performed around single rooted teeth to free the root from the adjoining alveolus by severing the periodontal ligament in the coronal portion of the root. This will enable the root to have space for further luxation and permit thinner elevators or periotomes to gain entry into the periradicular space. Gentle malleting of the scalpel handle with #15c blade is used to separate the coronal PDL fibers (Fig. 1).

As the blade enters the periodontal ligament space, the blade handle is rocked minimally to retrieve the scalpel. Extra care must be exercised during removal of the blade so as to prevent any injury to the lip or other vital soft tissue structures. Alternatively a periotome can be used carefully around the root surface. The blade of the periotome should be placed into the periodontal ligament (PDL) space in an axial direction even though some tips

Fig. 4 Vertical sectioning the mandibular first molar along the buccal groove that anatomically coincides with the furcation.

Fig. 5 The elevator is employed to create a wedge effect between the sectioned tooth structure to facilitate luxation between the separated tooth fragments.

Fig. 6 A circum-radicular Piezosurgery is performed in a circumferential direction around an anterior tooth, with the exception of the facial side so as to preserve the facial alveolar bone plate and maintain esthetics.

Fig. 7 Benex® extractor system

may have an angle. The blade of the periotome is placed in the PDL space by penetrating in an apical direction. The periotome is gradually manipulated circumferentially along the PDL space of the tooth by following a "walking motion."[4] After the periotome displaces the PDL to create a space around the roots (Fig. 2), a Luxator® (Directa AB, Sweden) can be substituted to further luxate the root.

2. Tooth Sectioning Utilizing Rotary Instrumentation

When a single rooted tooth is planned for an atraumatic extraction, crown removal and intentional splitting of the root into manageable sections allows for easier separation of the root from the socket and the PDL, which then allows a periotome to engage into the root and produce an enhanced wedge effect, thereby elevating the tooth with minimal bone loss (Fig. 3).

When a multi-rooted tooth is planned for extraction, the component roots can be sectioned and removed atraumatically in a manner similar to a single rooted tooth (Fig. 4). To facilitate removal, each root should be removed in the direction of least resistance (Fig. 5).

3. Circum-Radicular and Circumseptal Osteotomies: Piezosurgery and Rotary Instrumentation

The advent of Piezosurgery has made atraumatic extraction possible along with minimal removal of bone surrounding the roots. While the scalpels, luxators and periotomes are linear instruments that can be utilized uni-directionally, the Piezosurgery tips can truly be used in a multidirectional fashion (Fig. 6).

Various Piezo instrumentation tips provide efficient access along the root surface. The instrument setting, with adequate irrigation is "bone, quality 1" (hard bone). To prevent unnecessary bone loss, caution must be exercised to direct the working tips into the PDL space as the tips are capable of making their own path into the bone outside the PDL. Additionally, they should not be used

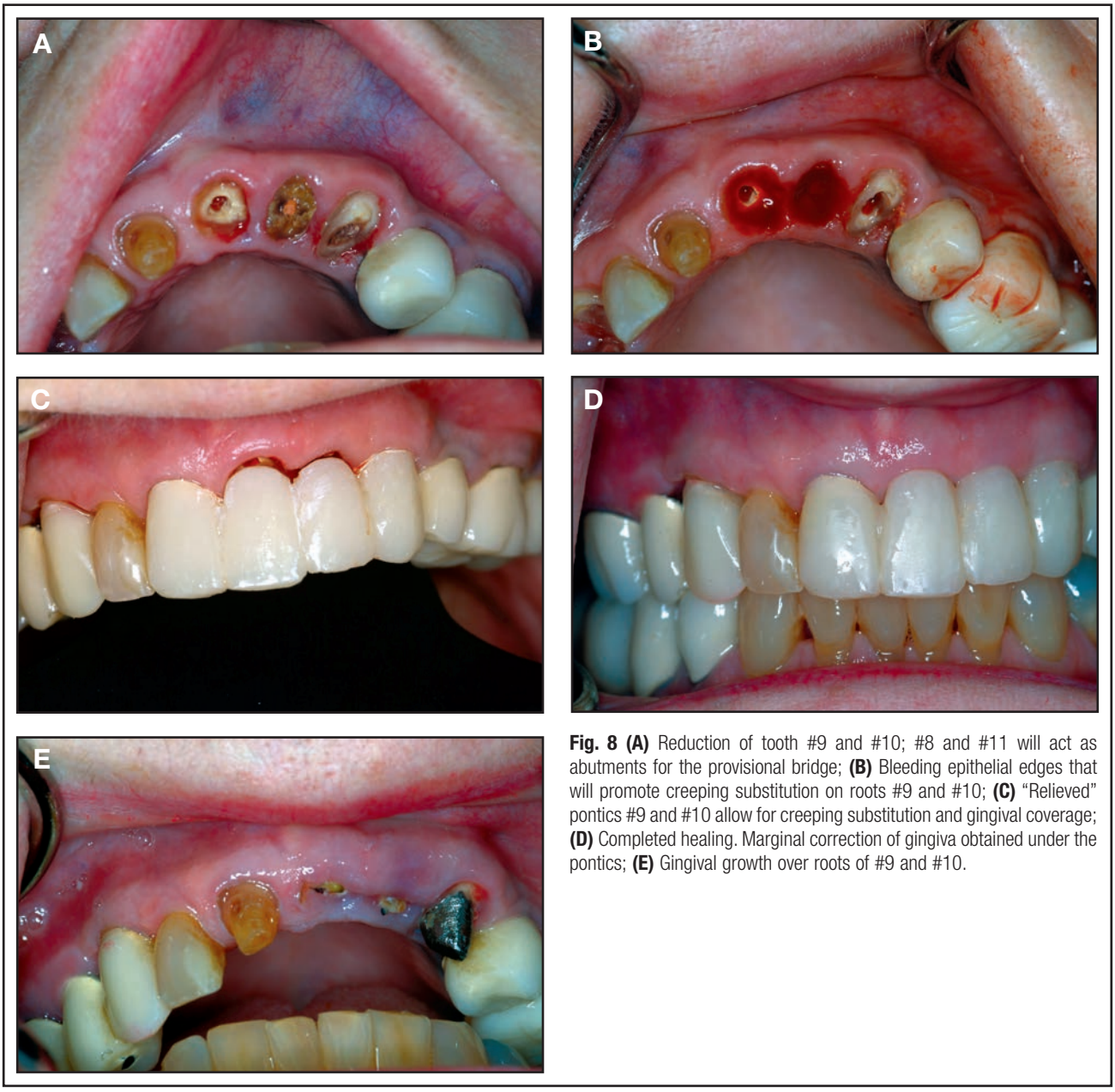

Fig. 8 (A) Reduction of tooth #9 and #10; #8 and #11 will act as abutments for the provisional bridge; **(B)** Bleeding epithelial edges that will promote creeping substitution on roots #9 and #10; **(C)** "Relieved" pontics #9 and #10 allow for creeping substitution and gingival coverage; **(D)** Completed healing. Marginal correction of gingiva obtained under the pontics; **(E)** Gingival growth over roots of #9 and #10.

facially along the root as this may cause facial bone loss in a "closed" flapless procedure.

Rotary instrumentation like the 700XXL or 701XL surgical length burs can be used to create troughs in dense bone when dilacerations are encountered. These burs, besides creating a channel in bone can also section roots and remove undercut areas in bone that do not permit extraction of curved roots. To prevent thermal trauma and reduced heat generation to the alveolar bone, intermittent use of the hand-piece with adequate irrigation must be employed. The use of interdental or inter-radicular osteotomy coupled with atraumatic removal of tooth or root structure will enable the surgeon to leave the buccal and lingual alveolar plates intact. To aid bone preservation, such minimally invasive surgical techniques must be employed in esthetic zones and for immediate implant rehabilitation sites.

4. Forced Eruption Extraction Technique

Forced Eruption is also known as vertical eruption, orthodontic eruption, and assisted eruption.[5] In patients who have a high risk of bleeding or are at risk for osteonecrosis, for example: history of bisphosphonates, radiation or cancer treatments, atraumatic extraction can

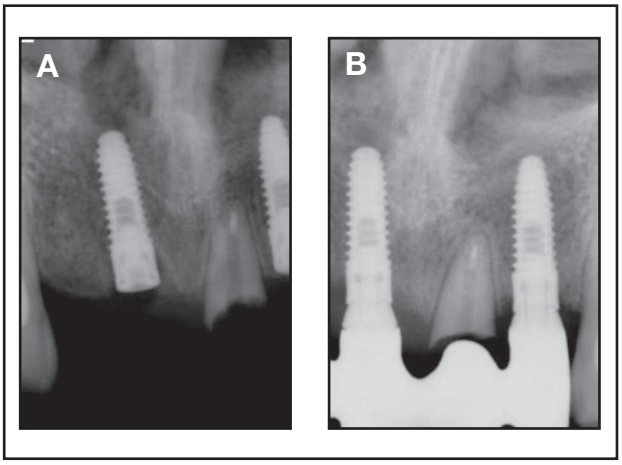

Fig. 9 (A) Root left in situ following immediate implant placement; **(B)** Postop showing preservation of bone around the retained root which helps preserve the natural shape and volume of the buccal eminence.

be carried out with the use of rubber bands extruding the tooth over a period of time. This sort of rapid extrusion will cause the eruption of the root out of the alveolar bone and will prevent the alveolus to migrate in the coronal direction along with the tooth.[6]

5. Benex® Vertical Extraction Technique

In cases where an endodontically treated tooth or a fractured root is adjacent to natural teeth and the use of periotomes or luxators is not possible due to lack of a fulcrum, an active vertical extraction method using the Benex® (Meisinger, Switzerland) extractor system can be attempted (Fig. 7). This method uses a drill system to place a post into the root. An active extruder rests on the adjacent teeth, applies coronal force and luxates the root from its socket.[7,8]

Root Retention

It is not uncommon to leave a vital or endodontically treated root submerged under the mucosa by reducing the root to the osseous level.[9,10] The gingiva will migrate over the root maintaining a natural buccal eminence (Fig. 8A-E). This eliminates the need for grafting techniques and prevents loss of the facial plate. This technique is very predictable under implant or tooth supported fixed partial dentures[11] (Figs. 9A,B; 10A-C).

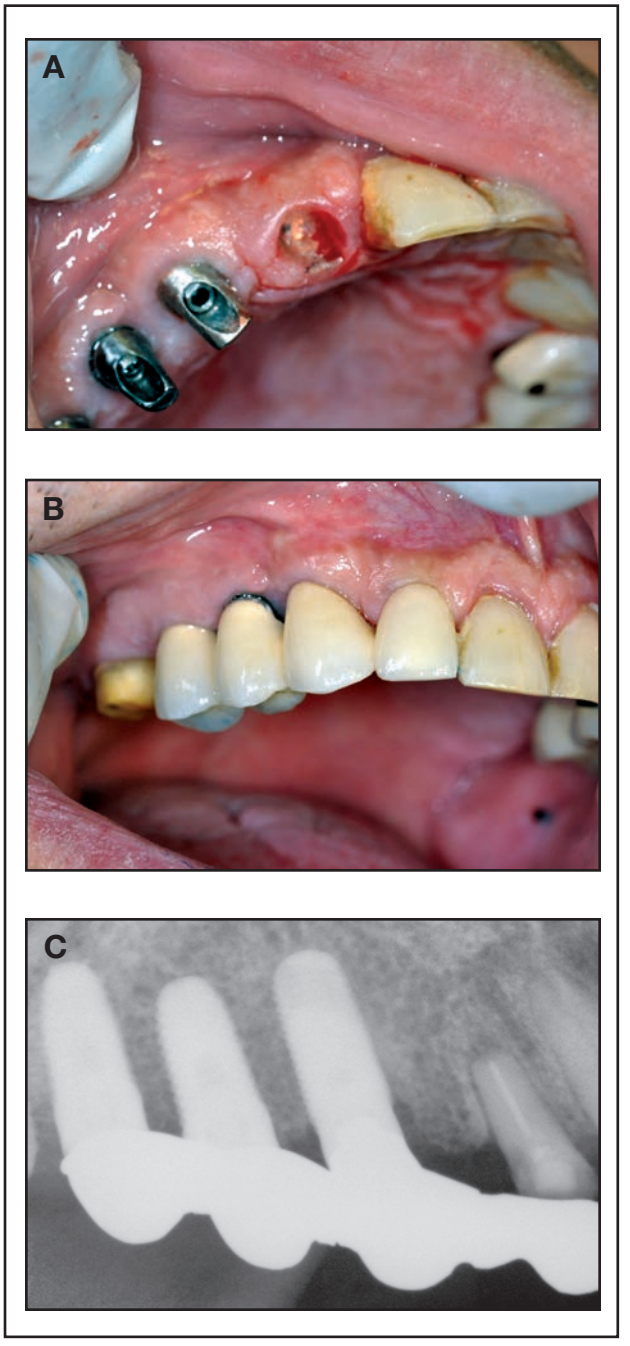

Fig. 10 (A) Root preservation of #7 to preserve alveolar architecture; **(B)** Postop healing and esthetic outcome with a cantilever pontic #7 in the esthetic zone (Note: maintenance of facial eminence over #7); **(C)** Postop radiograph showing retained root canal treated root.

Conclusion

With the advent of new restorative techniques, it has become incumbent that methodical treatment planning by the dentist would help to achieve maximal form, function and esthetics. In today's world, it is imperative that we plan extraction procedures so as to maximally preserve the alveolar bone, with the least amount of complications. This article reviewed various techniques of atraumatic extractions, aiming to preserve the alveolar bone in preparation for implant placement and for the development of pontic sites.

Appropriate diagnosis of the preexisting tooth/root condition is essential to determine the ideal technique necessary to achieve better outcomes. Sometimes a combination of procedures is necessary to successfully remove the tooth. One must be aware of all available techniques and achieve proficiency with these techniques before attempting such extraction procedures. A judicious approach will enlighten the practitioner in ideal case selection, treatment planning, execution and when indicated, help them decide when it is best to consult with and/or refer to a specialist. ❑

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From the Desks of the Scientific Editors, *Earl G. Freymiller, MD, DMD; Michael Leizerovitz, DDS, MaCSD*

grafted coronectomy. The procedure overcomes certain known complications, such as lack of periodontal healing of the second molar and delayed root migration, which plagued the standard coronectomy technique.

The article by Dr. Bruce Donoff and Adam Fagin discusses the types and incidence of both Inferior Alveolar Nerve and Lingual Nerve damage. As part of informed consent, the patient must be forewarned of this possible complication before surgery. If injury to a nerve occurs, the problem must be documented as to the location and severity of the damage. Dentists should be upfront with patients, explaining to them what has happened, and reassuring them that everything possible will be done to achieve a positive outcome. It is important that the patient be referred, earlier rather than later, to a clinician experienced in the management of nerve damage so that the condition can be addressed properly.

Overall, to have fewer complications, dentists must know their "surgical boundaries" and self-regulate. Not knowing will often harm the patient. As Will Rogers said: "The trouble is not with what we know, it is with what we know which is not so." Yet, even knowing one's own limits and despite the continuous introduction of new materials and techniques, the most experienced doctors will still encounter problems.

When complications arise, and the doctor is unsure as to how to treat the patient, having personal rapport with a specialist is extremely helpful for both the patient and the dentist. Knowing the specialist's areas of expertise will help decide to whom the patient should be referred and ensure that the case is appropriately treated. It is important that the referring dentist clearly inform the specialist of the patient's history and the circumstance surrounding the complication. This will help to provide the appropriate treatment and generally will result in better outcomes. Additionally, if the patients are less frustrated, they may be less inclined to attempt resolving the surgical problem through the legal system.

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