The Mandibular Retromolar Area as a Donor Site in Maxillofacial Bone Grafting: Surgical Notes

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Bone harvesting from the mandibular retromolar area represents an attractive approach to obtaining corticocancellous bone blocks for reconstruction of a deficient alveolar ridge. Knowledge of the local anatomy, adherence to proper surgical techniques, and judicious use of appropriate surgical armamentarium are paramount to minimizing operative hazards. The objective of this article is to review pertinent surgical notes related to the safe harvesting of corticocancellous bone blocks from the retromolar area using a trephine bur technique. (Int J Periodontics Restorative Dent 2011;31:275–283.)

Alveolar bone deficiencies, ranging in severity and extent, are often associated with tooth loss, periodontal disease, traumatic injuries, and congenital disorders. Various bone grafting techniques and materials have been advocated for the reconstruction of the deficient alveolar ridge.1–3 Although alloge neic and xenogeneic bone grafts, as well as alloplastic materials, have been advocated to restore deficient alveolar volume, autogenous bone is still considered the gold standard for grafting of the oral and maxillofacial skeleton.4–6 This is based on the superior osteoinductive and osteoconductive properties of autogenous bone,7 leading to high therapeutic predictability.

A variety of intraoral and extraoral donor sites are available to the surgeon for harvesting autogenous bone. Determining the site of bone harvest is usually based on the amount, geometry, and type of bone required for the alveolar reconstruction, as well as the morbidity, cost, and convenience in surgical access. Intraoral donor sites are preferred to extraoral sites...
because of the convenience in surgical access, the minimal graft resorption, as well as the reduced morbidity and cost.8,9 Intraoral bone harvesting sites include the symphysis area and lateral body of the mandible, the retromolar area and ascending ramus, as well as the maxillary tuberosity and zygoma.8–14 Several authors have emphasized the benefits of harvesting bone from the retromolar area and the ascending ramus.9,15–17 The procedure is associated with fewer postoperative complications, and the harvested bone requires a short healing period in addition to exhibiting minimal postoperative resorption. Several vital anatomical structures, however, are susceptible to injury during bone harvesting, and adherence to sound surgical guidelines is critical to avoid surgical complications.

The objective of this article is to review and discuss relevant surgical notes related to the safe harvesting of bone blocks from the mandibular retromolar area using a trephine bur technique.

Surgical notes

Flap access

Careful digital palpation of the mandibular retromolar area and the ascending ramus is essential prior to accessing the donor site surgically. Special attention is paid to locating the buccinator crest as well as to evaluating the presence and extent of the mandibular lingual concavity. After confirming the position of the buccinator crest, the mucosal tissues along the external oblique ridge are stretched toward the buccal vestibule, and a crestal incision is made using a 12B blade (Bard-Parker). Although several incision designs to access the retromolar area have been proposed,18 the use of a crestal incision starting at the base of the ascending ramus and extending anteriorly toward the distal aspect of the most posterior tooth is recommended. The incision is continued anteriorly with a 15C blade into the buccal gingival sulcus of the most posterior tooth (Fig 1). Special care is taken during the crestal incision to position the surgical blade at an angle to the alveolar crest (Fig 2). This precaution will help minimize the risk of the blade slipping into the sublingual space, resulting in injury to the lingual nerve. It should be noted that during the crestal incision, contact is never lost between the tip of the blade and the bone crest.

Fig 1 (left) Flap design for accessing the donor site. The incision line (red) begins at the level of the ascending ramus and extends anteriorly up to the mesial line angle of the most posterior tooth.

Fig 2 (right) A 12B blade is used along the buccal incline of the buccinator crest with a slight buccal inclination to avoid slippage into the sublingual space. Red = buccally inclined long axis of the surgical blade.
Whereas the incision for harvesting bone from the lateral aspect of the mandible and the ascending ramus is made over the external oblique ridge to allow ample access to the lateral aspect of the mandibular body, the incision proposed herein is made slightly more lingual so that it traces the highest point of the buccinator crest. This approach helps facilitate flap elevation and allows full access to the total width of the retromolar area. The incision also permits access to the lingual aspect of the mandible so that proper assessment of the extent and severity of the lingual concavity can be made.

At the completion of surgery, the aforementioned flap design allows the incision line to be supported by bone, thus minimizing the risk of incision-line dehiscence and flap retraction. Depending on the width of the mandibular buccal shelf and the amount of surgical access required, a distal oblique releasing incision angled toward the buccal vestibule may be performed. To minimize injury to the buccal nerve, the buccal soft tissues should be stretched superiorly and laterally prior to making the releasing incision. This preventive measure is intended to minimize damage to the buccal nerve by displacing the neurovascular bundle away from the incision line. A mucoperiosteal envelope flap is then reflected to the buccal aspect, exposing the retromolar area as well as the base and lateral aspect of the ascending ramus. Should there be a need to extend the crestal incision superiorly over the ascending ramus for additional access, a short initial incision is recommended, followed by blunt dissection and retraction superiorly.

**Bone harvesting**

**Trephine selection**

Bone harvesting from the retromolar area is accomplished using trephine burs of different diameters (Fig 3). The burs are used on a contra-angle surgical handpiece rotating at approximately 30,000 rpm under copious saline irrigation. During bone harvesting, special effort is made to preserve the integrity of the mandibular buccal and lingual cortices (Fig 4). Retaining both cortical plates is accomplished by selecting a trephine bur with a diameter that is 2 to 4 mm smaller than the width of the alveolar shelf. This preventive measure is designed to confine the bone harvesting to the buccolingual dimension of the retromolar area while preserving the continuity of the buccal and lingual cortical.
plates. Because of the narrowing of the mediolateral dimension of the mandibular body apically, the judicious selection of appropriate trephine bur diameters cannot be overemphasized to avoid injury to the lingual nerve.

Protection of the lingual nerve and artery
Perforations of the lingual cortex should be avoided at all costs to limit injuries to the lingual nerve and artery. Smith et al\textsuperscript{21} showed that the mandibular base at the level of the retromolar area is, on average, 5 mm narrower than the alveolar shelf. This apical narrowing may lead surgeons to underestimate the extent of the lingual concavity that is present immediately inferior to the alveolar shelf during bone harvesting. Failing to pay close attention to the lingual concavity during bone harvesting can result in perforation of the lingual cortex, with concomitant injury to the lingual nerve and accompanying artery (Fig 5). Preventing the aforementioned situation can be accomplished by keeping a safety zone of 1 to 2 mm between the osteotomy and the lingual plate and by placing the trephine bur at an angle from the vertical plane during bone harvesting, away from the lingual cortical plate (Fig 6). This latter preventive measure ensures that the long access of the trephine bur is positioned more in line with the natural lingual inclination of the mandibular body in the retromolar area. Alternatively, the trephine bur can be used to harvest bone along the lateral aspect of the mandible, provided the drilling depth does not exceed 5 to 6 mm and is confined to the area superior to the mandibular canal (Fig 7).

Because of the variation in the depth of the undercut on the lingual surface immediately inferior to the internal oblique ridge of the mandible, it is not always possible to ensure that the lingual plate is never breached.\textsuperscript{22} Should a trephine bur inadvertently penetrate the lingual cortical plate, serious damage to the lingual nerve can take place, altering its anatomical continuity or physiologic conductivity. To protect against such an injury, the use of a lingual retractor is recommended (Fig 8). Although reports of increased incidence of transient nerve damage associated with the use of generic retractors have been cited,\textsuperscript{23} there is good evidence to suggest that when a specially designed lingual retractor is used (no. 92-380-00, KLS Martin), the likelihood of nerve injury is greatly reduced.\textsuperscript{24,25} Based on the author’s experience and on reports from other investigators,\textsuperscript{8,17} impairment of the sensory function of the lingual nerve resulting from lingual flap retraction occurs infrequently and is usually transient in nature.

\textbf{Figs 4a and 4b  Retromolar donor site (a) before and (b) after bone harvesting. Note the preservation of the circumferential integrity of the bone.}
Figs 5a to 5c  Occlusal view of the retromolar area (a) before and (b) after elevation of the bone block. (b and c) Note the unsuspected perforation of the lingual mandibular plate and associated concavity (arrowhead).

Figs 6a and 6b  The trephine bur long axis (red) is slightly tilted from the vertical plane to minimize a breach along the mandibular lingual concavity.
Fig 7  Bone harvesting from the retromolar area via an alternative buccal approach. This approach is indicated in the presence of a narrow buccolingual dimension of the retromolar shelf. Special care should be taken to avoid perforating the lingual plate.

Figs 8a to 8c  Lingual retractor used to protect the lingual nerve and artery from inadvertent perforation of the cortical plate.

Figs 9a and 9b  
(a) Freeing of the bone block from its base with the help of a curved-end chisel and mallet. Note the perfect fit of the chisel into the circular osteotomy. 
(b) Curved-end chisel.
Protection of the inferior alveolar nerve and artery

To avoid injury to the inferior alveolar nerve and artery, special care should be taken to keep a 2-mm safety distance between the cutting edge of the trephine bur and the superior aspect of the mandibular canal.8,26,27 To maintain that margin of safety, it is important for the surgeon to be aware of the ultrastructural differences between cortical and cancellous bone.28 A considerable difference in drilling resistance can be encountered between the two types of bone. This can lead to a situation where the surgeon may inadvertently place excessive vertical pressure on the handpiece to cut through the mandibular cortical layer. However, once the trephine has cut through the cortical layer, little resistance is encountered from the underlying cancellous bone. This decreased resistance can easily take the surgeon by surprise, causing the trephine bur to unexpectedly sink several millimeters deeper into the bone than initially planned. This is most likely to happen in situations where the trephine does not engage either cortex on the buccal or lingual aspects of the osteotomy.

Considering the serrated design of the cutting edge of the trephine bur, should injury to the inferior alveolar nerve occur, serious damage to the neurovascular bundle can be expected. To protect against such an injury, the following measures are suggested: (1) maintain an accurate reference point at all times to monitor the drilling depth; (2) use a vertical stop, when possible, to prevent against the inadvertent apical displacement of the handpiece; and (3) when approaching the junction between the cortical and cancellous bone with the trephine bur, limit the vertical forces placed on the handpiece; instead, use a slight rotational movement of the handpiece head to better control the vertical displacement of the trephine bur.

Bone block elevation

After completing the circular osteotomy with the trephine bur, the bone block is separated from its base using a curved-end chisel (no. 37-595-15, KLS Martin). With a mallet, the chisel is tapped into the osteotomy space with firm strokes (Fig 9). Care is taken to support the chin during bone tapping to minimize trauma to the temporomandibular joint. The chisel is alternately moved to the mesial, distal, and buccal aspects of the osteotomy until the bone block is separated from its base. The insertion of the chisel on the lingual aspect should be avoided to prevent fracturing the lingual plate. Once separated from its base, the bone cylinder is teased out of the osteotomy site using a 2/4 Molt curette (no. CM2/4, Hu-Friedy). The bone block cylinder is then transferred to a secure container filled with sterile saline where it is stored until use. Another approach to separating the bone block from its base is accomplished by applying slight pendular movements to the handpiece head after the desired drilling depth has been reached with the trephine bur.
Donor site management
As long as the bone harvesting does not interrupt the continuity of the buccal and lingual mandibular cortical plates, the donor site will function like a four-wall intrabony defect, in which bone fill has been reported to proceed uneventfully with no need for bone substitute addition.8,29 If, on the other hand, the integrity of either the buccal or lingual cortices is compromised, the addition of bone substitutes with or without a resorbable membrane can be contemplated. To minimize irritation to the overlying flap, sharp edges created at the donor osteotomy site should be smoothed with the help of bone files or round burs prior to flap closure.

Discussion
Bone harvesting from the mandibular retromolar area offers a predictable approach for the reconstruction of the deficient alveolar ridge. Several approaches have been proposed for obtaining bone from the posterior mandible. Misch19 described a technique for accessing the lateral aspect of the mandibular body and the ascending ramus. Although the procedure was reported to carry a low incidence of complications, no controlled prospective studies have been conducted that provide information on the neurologic disturbances to the inferior alveolar nerve that may be associated with this procedure.17,30 Furthermore, bone block harvesting from the lateral aspect of the mandible and the ascending ramus is not without its disadvantages. Among the challenges encountered, the surgical access can be rather difficult when making the vertical and horizontal osteotomy cuts along the lateral aspect of the mandible.9 Moreover, injury to the inferior alveolar neurovascular bundle represents a serious risk, especially if the osteotomy cuts are made lateral to the mandibular canal and distal to the first molar, as reported by Rajchel et al.31 Using direct measurements on 45 dry mandibles, they reported that the thickness of the buccal cortical plate in the mandibular retromolar area rarely exceeds 2 mm,31 contradicting clinical reports that suggest a thickness of 3 to 5 mm of buccal cortical plate along the lateral aspect of the posterior mandible.9,16 In their study, Rajchel et al.31 cautioned against placement of osteotomy cuts over the mandibular canal in the retromolar area because of a marked risk of nerve injury.

Considering that bone harvesting is generally an elective procedure, the possibility of serious disability caused by damage to the inferior alveolar nerve during bone harvesting from the lateral aspect of the mandibular body and the ascending ramus has to be carefully weighed, and alternative bone harvesting techniques need to be considered. An alternative technique includes harvesting bone from the mandibular retromolar area and the ascending ramus using trephine burs. Studies have shown that the width of the mandibular shelf in the retromolar area ranges from 10 to 17 mm, with a mean value of 14 mm, while the bone height above the mandibular canal ranges from 7 to 15 mm, with a mean of 11 mm.8,21 Nkenke et al8 reported the routine use of 10-mm-diameter trephines for bone harvesting from the retromolar area with no instance of inferior alveolar nerve injury. A safety margin of 2 mm above the inferior alveolar nerve was observed in all patients, and a lingual retractor was used to protect against perforation of the lingual cortex. The authors concluded that the procedure carried a minimal risk of complication and was well tolerated by patients.

Conclusion
Bone harvesting from the retromolar area using trephine burs constitutes a safe, predictable approach for the reconstruction of the deficient alveolar ridge. Although the procedure is associated with minimal neurosensory disturbances, thorough knowledge of the three-dimensional anatomy of the mandibular retromolar area and adherence to sound surgical principles are paramount to avoiding procedural errors during bone harvesting.
References


