Composite bone graft for treatment of osseous defects after surgical removal of impacted third and second molars: case report and review of the literature

Khalid S. Hassan, MSc, PhD,a Hesham F. Marei, MSc, MFDS RCS, DDS,b and Adel S. Alagl, BDS, CAGS, DSc,c Dammam, Saudi Arabia; and Assiut and Ismailia, Egypt UNIVERSITY OF DAMMAM, AL-AZHAR UNIVERSITY, AND SUEZ CANAL UNIVERSITY

The aim of this case report was to evaluate the clinical and radiographic measurements of mandibular first molar bone support after mandibular third and second molar extraction and immediate augmentation of the extraction site with a combined autogenous bone graft with Bio-Oss materials. A pyramidal full-thickness mucoperiosteal flap with 1 distal releasing incision was used for removal of impacted third and second molars. During the procedure, autogenous bone graft was collected with a bone trap and then combined with Bio-Oss materials. The osseous defects distal to first molar and extraction site was filled with the composite bone graft and covered with Bio-Gide membrane. After 1 year, there was a successful defect regression and gain of bone and clinical attachment level. Moreover, there was a reduction of probing pocket depth and gingival inflammation. From the results of this study, it can be concluded that grafting of osseous defects and extraction site with autogenous bone graft combined with Bio-Oss materials will predictably result in a decreased risk of developing a periodontal defect on the distal aspect of mandibular first molar. (Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2011;112:e8-e15)

Managing impacted teeth in adults is considered a risk for persistent or new periodontal defects on the distal aspect of the mandibular second molars after the extraction of mandibular third molars. Clinical investigations, however, have shown that surgical removal of impacted mandibular third molars may result in intrabony defects at the distal aspect of the second molar.1-6 In a retrospective study comprising 215 patients, Kugelberg et al. (1985)5 found that 2 years after surgery, 43.3% of the cases exhibited probing pocket depths >7 mm and 32.1% showed intrabony defects >4 mm. Osborne et al.7 showed little benefit achieved by root planing the distal aspect of second molars after extraction of an adjacent impacted third molar. Their results showed only minimal reduction of probing pocket depth or induction of reattachment of gingival tissues to the second molar at or near the cemento-enamel junction. Similarly, little or no benefit was found with different flap designs used in these situations.8-10 Consequently, traditional treatment at the time of extraction of impacted third molars often results in the development of an osseous defect at the distal aspect of the second molar, which may require surgical treatment later.

A number of augmentation procedures are performed today to stimulate regeneration or to enhance attachment of supporting structures in periodontal defect sites. Augmentation of the osseous defect with bone grafts has become one of the most common surgical techniques in recent years. However, the morbidity and limited availability associated with autografts, and the potential for disease transmission, immunogenic response, and variable quality associated with allograft, have led to a wide variety of alternative materials. Various bone-grafting materials are currently used in alveolar bone grafting procedures, with different degrees of success. These materials include autogenous bone (harvested from the patient’s iliac crest, rib, mandible, or maxillary tuberosity), allo genic bone, bone graft substitutes (e.g., tricalcium phosphate, bioactive glass, anorganic bovine minerals, and porous hydroxyapatite), and a combination of these materials.

Autogenous bone is considered to be ideal because of its osteoconductive and osteoinductive properties and because it contains a source of osteoprogenitor cells. It is still considered to be the criterion standard with which other grafting materials are compared. But the
search for a bone graft substitute continues, because of some of the disadvantages associated with the use of autogenous bone grafts, namely, donor site morbidity, need for a second surgical site, possible hospitalization, need for a general anesthetic, and a limited amount of graft available depending on the donor site chosen.

One of the alternative materials often used to restore osseous defects is Bio-Oss, a resorbable anorganic bovine hydroxapatite. Bio-Oss is a safe effective bone graft material from specially processed bovine sources. Under the electron microscope, Bio-Oss looks very similar to human bone. Because of its similarity to human bone, Bio-Oss is highly successful in helping new bone to form. However, recent research has shown the material to be unpredictable in the amount of bone formation and not to be totally resorbable.\textsuperscript{11,12}

For the purposes of the present study, the primary research question was: Among older patients having mandibular third and second molars extracted, does intervention of combined autogenous bone graft with Bio-Oss materials at the time of extraction result in a decreased risk of developing a periodontal defect on the distal aspect of mandibular first molars? The aim of this case report was to evaluate the clinical and radiographic measurements of mandibular first molar bone support before mandibular third and second molar extraction compared with 12 months after extraction and immediate reconstruction of extraction sites with autogenous bone graft combined with Bio-Oss materials.

**CASE REPORT**

A 42-year-old male patient was referred to the Periodontics and Oral and Maxillofacial Surgery Divisions, College of Dentistry, University of Dammam, Saudi Arabia, with impacted mandibular third and second molars (teeth #31 and #32) associated with osseous defect distal to tooth #30 (mandibular right first molar). There was history of pain during eating and when the mouth was closed. The patient’s medical status was noncontributory, he was a nonsmoker, and he mentioned that he had no trauma to the related area. Additionally, he had not received antibiotic, antimicrobial, or nonsteroidal antiinflammatory drug therapy for the preceding 3 months.

The following clinical parameters were assessed at the baseline and 3, 6, 9, and 12 months after surgery with the use of the same periodontal probe (PCP-NUC 15 Probe; Hu-Friedy, Chicago, IL, USA): gingival index (GI),\textsuperscript{13} pocket probing depth (PPD), and clinical attachment level (CAL).\textsuperscript{14} Radiographic measures also were evaluated presurgically and at 3, 6, 9, and 12 months after surgery. In addition, before and after the augmentation procedure, bone sounding measurements were taken with a calibrated Williams periodontal probe to the nearest millimeter: vertical height of the defect (VDH) measured from the most apical extent of the defect to a fixed point on the tooth surface (because the coronal aspect of gingival margin may have changed after surgery). After local anesthesia, these measurements were taken again after 3, 6, 9, and 12 months.

The patient was prepared for surgery with an initial phase of therapy, including oral hygiene instructions, scaling, and root planing. Approximately 4 weeks after initial therapy, he was reevaluated to assess clinical parameters and plaque control. He was required to achieve a good oral hygiene (<20% O’Leary plaque index) before progressing to the surgical phase of therapy.

**Ethics**

Written informed consent was obtained from the patient before surgical procedure, and the protocol was reviewed and approved by the Ethical Committee of the College of Dentistry, University of Dammam, Saudi Arabia.
Surgical procedure

A pyramidal full-thickness mucoperiosteal flap with 1 distal releasing incision were elevated to expose the impacted third and second molars and sectioning with a rotary instrumentation to facilitate their removal and reserve the alveolar bone (Figs. 1 and 2). Autogenous bone graft was collected with a bone trap according to the method described by Sivolella et al.15 (Omniasurg ASP 100; Omnia, Fidenza, Italy). The trap filter was equipped with a removable internal mesh with a pore diameter of 300 μm. Two distinct systems were used for aspiration and bone collection. One system was used for the control of saliva and bleeding and was kept at a distance of 1.5 cm from the osteotomy site. The other system was sterile and disposable and comprised a filter for collecting bone chips and a plastic suction tube. The latter was held as close as possible to the osteotomy site to collect the bone debris and reduce the aspiration of saliva (Fig. 3, a). The collected tissues were placed in a sterile bone well containing sterile saline solution at room temperature and covered with a cap to minimize the risk of contamination (Fig. 3, b). After the extractions, any remaining dental follicle was curetted from the surgical sites and the exposed distal root surface of the first molar was root planed with hand instruments. The surgical sites were then irrigated with sterile normal saline solution.

After preparation of the receiving site, excess saline solution was removed and the osseous defects distal to first molar were filled with the collected materials mixed with Bio-Oss and covered with Bio-Gide membrane (Figs. 3, c and d, and 4-6). The soft tissue flaps were then reaproximated to gain primary closure and ensure complete coverage of the membrane. The buccal flaps were sutured to their original posi-
tions with 3-0 resorbable Vicryl chromic suture (Johnson and Johnson; Fig. 7). Sterile gauze packs were then placed over the surgical sites as pressure packs. The patient was placed on Augmentin 1 g twice per day for 7 days, and 0.12% chlorhexidine gluconate twice daily for 6 weeks for plaque control.

Radiographic evaluation

Standardized radiographs were taken with the Rinn film holder before and at intervals of 3, 6, 9, and 12 months after surgery. Identical exposure parameters were used at all examinations, and the films were processed automatically. All periapical radiographs were digitized and saved in a Tagged Image File Format (TIFF), and then the bone density and marginal bone levels were measured with the use of ImageJ.
In this software, the area to be measured, the region of interest (ROI), was selected (color density selection). A single pixel that represents a specific color (white pixels in radiographs) was selected along with a threshold allowing for automatic selection of all other pixels in the ROI within the threshold; the area was traced and counted as the number of pixels as a ratio of the whole ROI. Average density is determined based on a scale of 0-256 and the number 256 (8 bits) represents the whitest pixel on the screen, while the number 0 represents the areas of the darkest pixels on the screen, the ROI of these radiographs was a circle of a fixed size to contain the critical size defect precisely. The program calculates every pixel in the image and then performs the calculations necessary to get a number representing the average density of all the pixels. The marginal bone level measurements were done by measuring to points from the cemento-enamel junction to the defects in the preoperative radiographs, then comparing with the postoperative radiographs. Moreover, the radiographic alveolar bone level was determined immediately after surgical removal of third and second molars and before placement of the composite graft (Fig. 9) and then 6, 9, and 12 months after surgery.

It is important to note that 1 year after augmentation of the osseous defect distal to mandibular right first molar, there were no clinical or radiographic signs suggestive of treatment failure, but instead the patient’s follow-up showed that the case management was successful and yielded defect regression and gain of bone and CAL. Moreover, there was a reduction of PPD and GI.

The radiographic findings revealed significant differences in alveolar bone height from baseline to the different monitoring periods after grafting with autogenous bone combined with Bio-Oss materials (Figs. 8, 10, 11, and 12).

DISCUSSION

According to several studies, there is a risk of an osseous defect at the distal aspect of the mandibular second molar after the removal of impacted third molars. Those studies have demonstrated that 43.3% of cases resulted in probing depths ≥7 mm 2 years after third molar removal.18-20

A consideration when managing impacted teeth in adults is the risk of developing or having persistent periodontal osseous defects on the distal aspect of the mandibular second molars. For the purposes of the present study, the primary research question was: Among older patients having mandibular third and second molars extracted, does grafting with autogenous

Fig. 10. Radiograph immediately after surgery, showing shadow of composite bone grafts.
bone graft combined with Bio-Oss at the time of extraction result in a decreased risk of developing a periodontal defect on the distal aspect of mandibular first molars? This study did not include collection of tissue for histologic examination, because of ethical considerations.

It can be concluded that the use of conventional impacted third molars surgery in older patients may result in intrabony defects at the distal aspect of the adjacent second molars that do not improve over the years. These defects may require surgical treatment at a later time.

Clearly, the present patient was at risk of developing postoperative periodontal osseous defects. In this study, an attempt was made to record probing pocket depth (PPD) as well as CAL and bone sounding before surgical removal of the third and second molars. This proved to be very difficult due to the location of the second molar in relation to the first molar. Often, the probe met the occlusal surface of the second molar and the depth of the defect was underestimated; the cementoenamel junction of the first molar could be located beneath the second molar. Clinical parameter results are therefore given only 6, 9, and 12 months after surgery, and the radiographic alveolar bone level was determined immediately after surgical removal of third and second molars and before placement of the composite graft as well as 6, 9, and 12 months after surgery.

Autografts contain viable cells that have the ability to form new bone; the only disadvantage is that a second surgical site is often needed; the present case study resolved that problem by obtaining the autogenous graft from the bone covering the impacted molars by using the bone trap at the same area of the surgical site.

It is important to note that autogenous bone graft appeared to be the graft of choice in treatment of intrabony defects. The ability of bone replacement graft to bind with bone and enhance both osteoinduction and osteoconduction is important. The present study used a combined technique of using autogenous bone graft and Bio-Oss materials in an attempt to obtain osteoinductive as well as osteoconductive actions.

The results of this case study revealed that there was an gain in CALs associated with the technique of using
combined autogenous bone graft and Bio-Oss materials. The CAL at 12 months after surgery was 1.32 mm. Moreover, a significant reduction in PPD was obtained after the use of combined bone graft. These results are in accordance with the study performed by Scabbia and Trombelli,22 which claimed that there is a clinically and statistically significant improvement in terms of CAL gain, PPD reduction, and radiographic findings when Bio-Oss was used for the treatment of deep intraosseous defects. The differences between that study and ours is that Scabbia and Trombelli used a single bone graft material.

It is important to note that the intraoral radiograph taken immediately after third and second molar removal and before placement of the composite graft was used as a baseline, because of the difficulty of determining the bottom of the defect with the second molar in place. Radiographic changes in alveolar bone height recorded over the 1-year period after grafting in the present study revealed a loss of height compared with baseline. At the end of 1 year, the mean alveolar height for the grafted side was 2.52 mm. This represented a net increase of 7.59 mm compared with baseline. However, a patient population may exist that would predictably benefit from grafting the extraction sites after removal of impacted molars. A study by Pecora et al.23 showed a statistically significant benefit of guided tissue regeneration therapy compared with no intervention in a sample limited to subjects ≥26 years old, with ≥1 horizontal impaction, and PPD ≥5 mm for ≥1 of the sites. The present case study included a subject ≥26 years of age, PPD ≤3 mm, and CAL ≤2 mm. From the results of this study, it can be concluded that grafting of osseous defects distal to the mandibular first molar by using an autogenous bone graft combined with Bio-Oss materials covered by Bio-Gide will predictably result in a decreased risk of developing a periodontal defect on the distal aspect of mandibular first molar.

REFERENCES
16. McDonald SP. A method to reduce interproximal overlapping and improve reproducibility of bitewing radiographs for use in...

Reprint requests:
Khalid S. Hassan
Division of Periodontics
Department of Preventive Dental Sciences
College of Dentistry
University of Dammam
P.O. Box 1982
Dammam 31441
Saudi Arabia
hassan.khalid56@yahoo.com)