Effects of the multiple-piece maxillary osteotomy on the periodontium

Clinical indications exist for both the surgically assisted rapid maxillary expansion (SARME) and the multiple-piece maxillary osteotomy (MPMO). Recent trends, however, imply that the SARME combined with a subsequent 1-piece osteotomy can supplant the use of the MPMO. Those favoring the SARME frequently cite morbidities associated with the MPMO. Major reported complications include loss of dentoalveolar segments, teeth, and oronasal or oroantral communication. Relapse, tooth devitalization, and damage to the periodontium, including bone loss and soft tissue alteration, comprise the minor morbidities. If these can be avoided or minimized, then the use of the MPMO for its inherent advantages over the SARME in certain clinical situations may be indicated. The purpose of our study was to critically evaluate the periodontium following the use of the MPMO to ascertain if minor morbidities are inherent to the procedure, and to quantify them. Records of 24 MPMO patients were reviewed, ranging from 3 to 24 months after surgery. A specific surgical technique was utilized for all patients, including bone grafting. The vertical segmental osteotomy sites varied and were recorded for comparison. Periodontal probing depths at the segmental osteotomy sites were compared with the adjacent interproximal spaces of each patient. Independent dental examiners were used to review photographs and periapical radiographs to compare the papillae and alveolar bone height, respectively, at the osteotomy site versus the neighboring interproximal areas. A paired t test was used to compare probing depth measurements at the vertical osteotomy site and neighboring interproximal sites. The mean difference between these two sites was 0.01 mm with a standard deviation of 0.25 mm. This was not statistically significant. Statistical analyses were also performed to compare these probing depth differences at varying sites in the maxilla, and to compare probing depth differences to gender, total number of osteotomies performed on each patient, estimated blood loss, and length of procedure. These results were not statistically significant. Independent examiners found no difference in gingival architecture or alveolar bone levels when comparing vertical osteotomy sites to neighboring interproximal sites. This study showed that damage to the periodontium at vertical osteotomy sites was minimal, and not a reason to avoid use of the multiple-piece maxillary osteotomy. (Int J Adult Orthod Orthognath Surg 2001;16:255–265)
procedure; (3) greater versatility in obtaining the best intraoperative occlusion; (4) the ability to level the occlusion at the time of surgery for a stepped open bite closure; (5) one general anesthetic; and (6) avoidance of 2 prior approvals from third-party carriers. Alternative treatments to the LeFort I MPMO include nonsurgically assisted rapid maxillary expansion or surgically assisted rapid maxillary expansion (SARME), followed by a LeFort I osteotomy at a later date. In the adult patient where nonsurgically assisted rapid maxillary expansion is not possible, some surgeons advocate a 2-stage approach including SARME followed by a LeFort I osteotomy. Advocates of this technique state that the LeFort I MPMO is fraught with too many complications, including periodontal defects and gingival contour changes at vertical osteotomy sites, and an increased surgical time due to the complexity of the surgical procedure.

**Review of the literature**

Many different surgical techniques have been described in reference to the multiple-piece LeFort I osteotomy. Techniques have varied over the years from uniooth osteotomies with buccal and palatal flaps to the current practice of multiple-piece osteotomies with complete LeFort I downfracture. Multiple case reports have been published on this topic, but few scientific articles are available.

Complications of the LeFort I multiple piece maxillary osteotomy have been reported by many authors. Lanigan et al mailed questionnaires to oral and maxillofacial surgeons in North America to find out their experiences with complications after LeFort I osteotomies. Some of the reported minor complications included discoloration, loss of tooth vitality, and loss of gingival papillae with underlying periodontal defects. The major complications included the formation of an oroantral fistula, oronasal fistula, and loss of teeth or dentoalveolar segments. Treatment required for these complications included endodontic therapy, tooth extraction, debridement of necrotic tissues, and hyperbaric oxygen therapy. Reconstruction of defects was reported with use of local flaps, bone grafting, skin grafting, placement of implants, and fabrication of fixed and removable prostheses. A survey of North American oral and maxillofacial surgeons in 1984 by Sher revealed similar complications as the study by Lanigan. Sher also reported permanently mobile maxillary segments, loss of an entire maxilla, massive hemorrhage, and relapse of segments. In a retrospective study, Johnson and Hinds evaluated 17 patients who had undergone subapical osteotomy in the maxilla and mandible in the past 14 months on average. All patients were at least 6 months postsurgery. They looked at thermal and electrical pulp responses of teeth in the osteotomized segments. On pulp testing, they found that 35 of 169 teeth did not respond to electrical or thermal stimulation. Only 4 teeth were abnormal radiographically or clinically. Three of these teeth showed root damage radiographically, and the other tooth had a lesion associated with the apex of the tooth. All teeth had normal color and translucency except the 4 teeth previously mentioned. Lowrie et al studied pulpal tissues in baboons up to 18 months after subapical posterior segmental osteotomies in the maxilla and mandible. They found foci of necrosis in the pulpal tissues at 3 and 6 months postoperatively. This was replaced by pulpal fibrosis at 12 and 18 months. They concluded that these pulpal changes should not affect the long-term prognosis of teeth as long as root apices are not damaged intraoperatively.

A study by Rosenquist in 1993 evaluated 14 patients who had undergone anterior segmental maxillary osteotomies with a 24-month follow-up period. Two different surgical techniques were used to perform the surgical procedures. In some cases, a transverse palatal incision was made and the osteotomy was performed by raising palatal flaps and tunneling, leaving the buccal blood supply intact. In other cases, a buccal flap was raised and the palatal osteotomy was made after tunneling, leaving the palatal blood supply intact. The patients were evaluated postoperatively for stability of the segment, periodontal probing, pulpal status, marginal bone height, and root resorption. They found the average sagittal
relapse of a posteriorly positioned anterior segment to be 1.3 mm at 24 months, in addition to an average marginal bone loss of 1.6 mm at osteotomy sites between teeth. In 5 vertical osteotomy sites, they noted gingival recession of 1–2 mm below the cervix of teeth adjacent to the osteotomy site. Rosenquist concluded that the anterior segmental maxillary osteotomy was a stable and safe procedure.10

Dorfman and Turvey evaluated 10 patients who underwent segmental osteotomies in the maxilla and mandible. There were 22 vertical osteotomy sites in the 10 patients. These osteotomy sites were evaluated using periodontal sounding, along with plaque and gingival indices. Patients were evaluated 1 week prior to surgery and 6 months postoperatively. Eighteen of the osteotomy sites were placed in extraction sites. They found that there was significant loss of interdental crestal height in the interproximal osteotomy sites where extractions were not performed. They recommended a minimum of 3 mm of working space to perform this technique.11

Kwon, Pihlstrom, and Waite evaluated 17 patients undergoing segmental osteotomies in the maxilla and mandible. They measured pocket depth and clinical attachment level at the osteotomy sites and compared this to 6 control teeth located throughout the mouth. Periapical radiographs were used to measure the percentage of osseous support. They found a loss of periodontal osseous support of 3.5%, which was significant \((P \leq .05)\). They also found a decrease in width of attached gingiva adjacent to osteotomy sites of 0.84 mm, which was significant \((P \leq .005)\).12

Carroll et al evaluated patients who had undergone segmental maxillary osteotomies and compared them with patients who had undergone orthodontic treatment alone, without surgical intervention. Patients were evaluated between 1 and 10 years posttreatment. They examined probing depth and attachment levels. Within the surgery group, segmental osteotomies were completed either between the central incisors, or between the canines and second premolars. Carroll et al found a loss of attachment level and increased probing depth of up to 0.3 mm at the canine/second premolar sites. They noted that although a statistically significant difference had been noted, it was not clinically significant.13

Mordenfeld and Andersson evaluated 20 patients who underwent LeFort I with midline vertical osteotomies for pulpal and periodontal changes between 12 and 85 months postoperatively. They found that 11% of central incisors did not respond to electrical stimulation. They found no significant difference in probing depth measurements between the mesial and distal sulci of the central incisors. They did find a significant change in marginal bone height at the osteotomy site \((P < .05)\); however, the amount of bone loss was 0.4 mm.14

Schou et al evaluated patients who underwent LeFort I MPMO and compared them to patients who underwent LeFort I without interdental osteotomies to look for marginal bone loss. Radiographs from presurgery and 1 year postsurgery were used to measure marginal bone levels. Patients without interdental osteotomies had a mean marginal bone loss of 0.2 mm. When interdental osteotomies were performed, the average marginal bone loss increased to 0.4 mm, but the difference was not statistically significant between the 2 groups. They concluded that there was not a clinically relevant marginal bone loss following segmental maxillary osteotomies.15

Finally, Schultes et al studied 30 patients 4 to 10 years after segmental maxillary and mandibular osteotomies using panoramic and periapical radiographs of the osteotomy sites. A site was considered to have periodontal pathology if there was a reduction in bone mass of one-third the root length. Root resorption was also noted. Tooth loss was evaluated by comparing pre- and postoperative radiographs. Schultes noted 51 pathologic periodontal sites in 74 osteotomy sites. There was loss of 32 teeth at osteotomy sites postoperatively. There was 15.3% lateral root resorption of teeth near osteotomy sites. They concluded that there was a high incidence of dental and periodontal trauma after segmental osteotomies.16

The compilation of this data provides an incomplete and conflicting picture of the
periodontal effects of multiple-piece maxillary osteotomies and leaves many questions unanswered. The purpose of our study was to critically evaluate the periodontium following the use of the MPMO to ascertain if minor morbidities are inherent to the procedure, and to quantify them.

**Patients and methods**

Records of 24 MPMO patients were reviewed, ranging from 3 to 24 months postsurgery. Patient gender, age at the time of surgery, estimated blood loss, length of the procedure, position of the vertical osteotomy site, and other surgical procedures completed at the same time were recorded. There were 10 males and 14 females, ranging in age from 15 to 48 years.

The surgical procedure was completed in the following manner: The LeFort I incision was made well above the mucogingival junction to maintain an adequate blood supply through the soft tissue pedicle. A standard LeFort I procedure was done, including a horizontal osteotomy from the piriform rim to the pterygoid region. The archwire was then sectioned at the site of the planned vertical transdental cut. Using a #1 periosteal elevator, a mucogingival tunnel was carefully created along the proposed vertical osteotomy site. The papilla was not elevated. A #701 bur was utilized to define a vertical monocortical bone cut between roots, and a fine spatula chisel was used to effect the split (Fig 1). Use of this chisel was accomplished prior to downfracture to ensure spatial orientation, and to provide a solid base to counterbalance the force of the mallet and chisel. Tissue elevation in the area of the vertical osteotomy was minimized throughout. A minimum of 1 mm of bone between the roots was required to complete this vertical osteotomy. The LeFort I downfracture was then completed in the standard fashion. A #701 bur was then used to make bilateral paramidline osteotomies through the palatal bone to complete the segmental portion of the procedure. The sagittal osteotomies of the palate were made para-midline where the soft tissue increases in thickness and the bone is thin. This avoided making an osteotomy in the midline where the bone is thick and soft tissue is thin, which could increase the chance of a palatal soft tissue tear, and places it at a more advantageous location. The segments were then mobilized and placed into position in a modified acrylic splint, which was ligated to each tooth to unify the maxilla.17 The maxilla was then stabilized in its new position using rigid internal fixation (Fig 2). All osseous defects were grafted with autogenous bone, including the coronal areas beneath the papillae (Fig 3). Thin slivers of bone were used when the defect was smaller to fill the vertical defect with as much autogenous bone as possible. A V-Y closure and nasal cinch was then used to reapproximate the soft tissues. The occlusal splint was left in place for 6 weeks. A continuous archwire was placed on the same day the splint was removed.

The position of the vertical osteotomy sites in the maxilla varied according to the proposed treatment plan, and were recorded for comparison. Vertical osteotomies were placed between the central incisors, between the lateral incisors and canines, or between the canines and first premolars. Seven patients had osteotomies between the central incisors. Eleven patients had osteotomies between the lateral incisors and canines, or between the canines and first premolars. Seven patients had osteotomies between the central incisors. Eleven patients had osteotomies between the lateral incisors and canines, with 19 total osteotomy sites. Seven patients had osteotomies between the canines and premolars, with 10 total osteotomy sites (Table 1). Thirteen patients had 2-piece maxillary osteotomies while 10 patients had 3-piece maxillary osteotomies. One of
the patients that underwent a 3-piece maxillary osteotomy had first premolars extracted at the time of surgery, with placement of the vertical osteotomy in the extraction site and posterior repositioning of the anterior maxilla. One patient had a 4-piece osteotomy, with segments between the central incisors and between the canines and premolars (Table 2). Other procedures completed at the same time included mandibular sagittal split osteotomies and genioplasty. Ten patients had maxillary osteotomies alone. Four patients had maxillary and mandibular osteotomies. Five patients had maxillary and mandibular osteotomies with genioplasty, and 5 patients had maxillary osteotomies with genioplasty (Table 3). All patients underwent orthodontic therapy. At the time of this study, 16 of the 24 patients were still in active orthodontic treatment.

Periodontal probing depths at the segmental osteotomy sites were compared with the adjacent interproximal spaces of each patient. Four probing depths were obtained at each interproximal site (mesiobuccal, distobuccal, mesiolingual, and distolingual line angles). These 4 probing depths were averaged to obtain a mean probing depth for each interproximal site. The average of the 2 neighboring interproximals was subtracted from the probing depth of the vertical osteotomy site to obtain the probing depth difference in each patient.

To examine clinically relevant soft tissue changes, 5 independent dental examiners reviewed photographs of the gingival papillae postoperatively. Examiners compared the papilla at the vertical osteotomy site to neighboring papillae in the same patient to evaluate for no change, blunting, or loss of the papillae (Fig 4). The same independent examiners also evaluated postoperative periapical radiographs to compare the alveolar bone height at the osteotomy site versus the neighboring interproximal areas. Each site was evaluated for no bone loss, minimal bone loss, or frank loss of interdental bone at the alveolar crest. Examiners were finally asked to evaluate the apical portion of the vertical osteotomy site for the presence or absence of a radiographic bony defect (Figs 5 and 6). Table 4 shows the scales used by examiners to evaluate clinical photographs and radiographs.

Results

A paired t test was used to compare probing depth measurements at the vertical osteotomy site and neighboring interproximal sites. The mean difference between these 2 sites was 0.01 mm with a standard deviation of 0.25 mm. The level of significance was set with $\alpha < 0.05$. This was found to be not statistically significant ($P = 0.89$). A 1-way ANOVA was performed to compare these probing depth differences when the vertical osteotomy was at different sites in the maxilla. This result was also not statistically significant ($P = .22$). An ANOVA was also performed to compare the difference in probing depth measurement with respect to gender. These results
Fig 4  A clinical photograph used by examiners to evaluate the gingival papilla. The vertical osteotomy site was between tooth 6 and tooth 7.

Figs 5 and 6  Radiographs used by examiners to evaluate apical and crestal bone. The vertical osteotomy site was between tooth 6 and tooth 7. These radiographs are of the same patient.

Table 1  Location of vertical osteotomies within the maxilla

<table>
<thead>
<tr>
<th>Location</th>
<th>No. of patients</th>
<th>No. of osteotomy sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between central incisors</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Between lateral incisor and canine</td>
<td>11</td>
<td>19</td>
</tr>
<tr>
<td>Between canine and first premolar</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>36</td>
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Table 2  Type of maxillary osteotomy

<table>
<thead>
<tr>
<th>Type of osteotomy</th>
<th>No. of patients</th>
</tr>
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<tbody>
<tr>
<td>2-piece LeFort I</td>
<td>13</td>
</tr>
<tr>
<td>3-piece LeFort I</td>
<td>10</td>
</tr>
<tr>
<td>4-piece LeFort I</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
</tr>
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</table>

Table 3  Total number of osteotomies per patient

<table>
<thead>
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<th>Type of osteotomy</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maxilla alone</td>
<td>10</td>
</tr>
<tr>
<td>Maxilla/mandible</td>
<td>4</td>
</tr>
<tr>
<td>Maxilla/mandible/chin</td>
<td>5</td>
</tr>
<tr>
<td>Maxilla/chin</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
</tr>
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were not statistically significant ($P = .10$). Probing depth differences were also compared to the total number of osteotomies performed on each patient. This was also not statistically significant ($P = .15$). A multivariable regression analysis was completed to compare the difference in probing depths to gender, type of maxillary osteotomy, total procedures performed, estimated blood loss, and length of procedure. These variables were shown to not significantly affect probing depth. The mean score for all examiners evaluating change in the papilla at the osteotomy site as compared to neighboring sites was 1.3, where 1 equals a normal papilla and 2 equals a blunted papilla. The mean score for all examiners evaluating crestal height of alveolar bone was 1.2, where 1 equals no loss of interdental bone height and 2 equals minimal loss of height. The mean score for all examiners evaluating an apical bony defect in the osteotomy site was 1.1, where 1 equals no evidence of bony defect and 2 equals evidence of a bony defect.

It is of note that no major morbidities occurred, including lost teeth or maxillary segments, oroantral or oronasal fistulae.

**Discussion**

The treatment of maxillary transverse deficiency is an important part of the orthodontic-surgical treatment plan. The correction of maxillary transverse deficiency can be completed in 3 ways: (1) nonsurgical rapid maxillary expansion; (2) surgically assisted rapid maxillary expansion (SARME); and (3) LeFort I multiple-piece maxillary osteotomy (MPMO). Nonsurgical rapid maxillary expansion can be completed in children up to ages 16 to 18.18 When attempted in the adult patient, however, nonsurgical RME can result in bending of the dentoalveolar segments and lateral tooth displacement.19 These movements in the adult patient are unstable and often do not provide adequate expansion to correct the transverse deficiency. In the adult patient, the treatment of maxillary transverse deficiency...
requires surgical intervention. The treatment options include the surgically assisted rapid maxillary expansion and the LeFort I multiple-piece maxillary osteotomy. There are clinical indications for both of these procedures and many factors to be considered when deciding which procedure to perform. Some of these factors include the magnitude of width deficiency, associated vertical and sagittal dysplasias, the arch morphology, arch length discrepancy, upper incisor angulation, open bite, and stability. The magnitude of width deficiency is measured at the first molar. The literature states that treatment of maxillary transverse deficiency of 10 mm or greater is best treated with SARME while those less than 10 mm can reasonably be treated with a LeFort I MPMO. The patient with associated vertical and sagittal dysplasias of the maxilla may be best treated with the LeFort I MPMO to correct all dysplasias in 1 surgical procedure in order to reduce the risks associated with multiple general anesthetics. The patient with an isolated transverse deficiency in the maxilla may be best treated with the SARME. The arch morphology of the palate is another consideration. A high-arched palate can favor the LeFort I MPMO, whereas a low-arched, flat palate favors the SARME. In patients with a low-arched palate, it may be difficult to obtain a significant amount of transverse expansion during a LeFort I MPMO because the soft tissues of the palate may restrict movement. A small or moderate arch length discrepancy favors a nonextraction treatment plan and a SARME. When a large anterior open bite is present, it is possible to level the upper arch in 2 planes, and then perform a LeFort I MPMO to level the arch at the time of surgery.

The transverse stability of both LeFort I MPMO and SARME is affected by many factors. These factors which affect the transverse stability include: preoperative dental compensations, surgical technique, patient cooperation, orthognathic splint construction and use, orthodontic holding appliances (archwire or transpalatal arch), magnitude of expansion, coordination between surgeon and orthodontist, arch coordination, vertical and occlusal influences, and importantly, skeletal and dental relapse. Having the molars upright and removing dental compensations preoperatively can help to prevent relapse. A heavy archwire inserted postsurgically can help to maintain transverse expansion and prevent skeletal relapse. The use of a modified splint for 6 weeks postoperatively also helps to prevent skeletal relapse. The magnitude of expansion plays a role in transverse stability, as larger expansions are more prone to relapse. When studies are completed to evaluate the transverse stability of the LeFort I MPMO or SARME, it is important to distinguish between dental and skeletal relapse. Skeletal relapse can be attributed more to the surgical procedure, whereas dental relapse is not. Without making this critical determination, one cannot rightly state that a procedure is “stable” or “unstable,” because we do not know if the cause of relapse lies within the surgical procedure. It is also of note that many times when a MPMO is done, it is after many months of orthodontically attempting to obtain an adequate transverse relationship without success, and the surgery then becomes a “bail-out” procedure to obtain the appropriate occlusion. This is a potential set-up for transverse relapse, because the maxillary molars have been flared buccally, and the mandibular molars lingually to attempt a nonsurgical correction. Performing surgery at this time leads to relapse because, postoperatively, the molars will upright and still leave the patient with a transverse deficiency in the maxilla.

The treatment planning process is an important step. When the orthodontist and surgeon decide on a LeFort I MPMO as part of the treatment plan, the patient’s treatment can progress with this in mind. This can help to avoid some of the problems listed above, such as maintaining the molars upright presurgically, instead of partially trying to correct a transverse deficiency by flaring the molars, setting the patient up for transverse relapse.

When the patient is ready for surgery, the surgeon should perform a detailed surgical work-up. Attention to every detail from this point on is extremely important. Good impressions, good models, accurate mountings, and records all play a hand in the success of the surgery. Appropriate pictures
and radiographs help in planning the surgical procedure. A model surgery must be completed as well. This will mimic and accurately predict the movements made in the operating room. It is advisable to obtain periapical radiographs and draw the roots of the teeth onto the cast before sectioning the model. After setting the ideal occlusion, it is important to look at the movements that have been made, keeping in mind: “Can the maxilla really be moved in this manner? Is this movement biologically sound?” If the expansion is too great, it may not be possible to replicate that movement in the operating room. It is important to think of how the soft tissues will accommodate the planned movements. A modified surgical splint can then be made. At the time of surgery, meticulous care of the soft tissues with minimal periosteal elevation, and attention to detail throughout the procedure, are very important. The patient should have close postoperative monitoring and follow-up by the surgeon and the orthodontist.

The literature often states that the complications of MPMO are significant and that the procedure should be avoided. Our studies indicate that the LeFort I MPMO can be a safe procedure with a low complication rate. The results of this study indicate that there is no statistical difference in probing depth at a segmental maxillary osteotomy site when compared with adjacent interproximal sites on the same patient. There was no statistical difference in probing depths, whether the osteotomy site was between the central incisors, lateral incisors and canines, or between the canines and premolars. Patient age, gender, blood loss, and length of procedure also had no effect. Independent dental examiners found no difference in the appearance of the gingival papilla at the osteotomy site when compared to neighboring papillae in the same patient. They found no radiographic loss of alveolar crestal height or apical bony defect at the vertical osteotomy site when compared to neighboring interdental spaces.

Kent reported interdental bone loss of 1 to 5 mm at vertical osteotomy sites at least 1 year postoperatively. Burk reported blunting of papillae and periodontal pocket formation secondary to resorption of the alveolar crest after unithooth osteotomies. The current study does not corroborate these findings. Results of the current study differ from those found by Dorfman and Turvey, where they did find interdental bone loss when osteotomies were completed between 2 adjacent teeth; however, these osteotomies were completed on only 2 patients, lending question to the power of the statistical significance of the result. The study by Rosenquist found marginal bone loss of 1.6 mm at osteotomy sites between teeth. This study does not describe the surgical technique in complete detail and does not disclose how many cases were treated with each of 2 different surgical procedures, leaving questions about the methodology of the study. Schultes et al noted a high rate of dental and periodontal trauma after segmental maxillary and mandibular osteotomies. They did not, however, include any clinical data or information about the patients to correlate with radiographic findings. They comment about periodontal pockets and lesions in the study, but there is no evidence that probing depths were measured on the patients. They do not discuss the method by which they calculated loss of periodontal bone mass when related to root lengths. These factors make this study difficult to interpret. The study by Mordenfeld and Andersson found a loss in marginal bone height at the osteotomy site, but this was only 0.4 mm and not clinically significant. It is of note that all of their osteotomies were between the maxillary central incisors, where a natural suture line exists. They did not discuss vertical osteotomies at locations other than between the maxillary central incisors. The study by Kwon, Pihlstrom, and Waite involves segmental osteotomies of the maxilla and mandible with no specific description of where the segmental osteotomies were performed. There is no description of the surgical technique or whether bone grafting materials were used. These factors make it difficult to compare to the current study as the surgical technique used may greatly influence the eventual outcome. Carroll et al noted a small increase in probing depth and loss of attachment level at segmental osteotomy sites between canines and second premolars. They
felt that although the data was statistically significant, it was not clinically significant. These results are similar to those found in the study by Schou et al. They found a difference in marginal bone height of 0.4 mm in sites where an interdental osteotomy was performed; however, it was not significantly different from that of teeth without interdental osteotomies. These studies found results similar to those of the current study.

Conclusions

Clinical indications exist for both the surgically assisted rapid maxillary expansion (SARME) and the multiple-piece maxillary osteotomy (MPMO), as previously mentioned. Recent trends, however, imply that the SARME combined with a subsequent 1-piece osteotomy can supplant the use of the MPMO. Those favoring the SARME frequently site morbidities associated with the MPMO. Major complications reported include loss of dentoalveolar segments, teeth, and oronasal or oroantral communication. Maintenance of an adequate soft tissue pedicle from the palatal as well as the buccal periosteum is critical to avoid loss of segments and teeth. Relapse, tooth devitalization, and damage to the periodontium, including bone loss and soft tissue alteration, comprise the minor morbidities. Some of the reported causes of damage to the periodontium include intraoperative damage to tooth roots adjacent to the vertical osteotomy site, and excessive removal of bone, resulting in a periodontal defect. If the above complications can be avoided, or minimized through a meticulous surgical technique, then the use of the MPMO for its inherent advantages over the SARME in certain clinical situations may be indicated. Some advantages of MPMO include: (1) One surgical procedure with 3-dimensional movement possibilities; (2) One general anesthetic; (3) The ability to extract premolars and posteriorly reposition the anterior maxillary segment while maintaining ideal incisor angulation (thus avoiding retroclined incisors or a large maxillary setback procedure); (4) Greater versatility in obtaining the best intraoperative occlusion; (5) The ability to level the occlusion at the time of surgery for a stepped open bite closure; and (6) Avoidance of 2 prior approvals from third-party carriers.

There are definite indications for SARME. These include: (1) Significant maxillary transverse discrepancy; and (2) An adult patient with only a transverse discrepancy. In patients requiring a LeFort I osteotomy with a transverse discrepancy that cannot be corrected with traditional RME, the multiple-piece maxillary osteotomy can be a useful procedure to have in the surgical armamentarium. The surgical technique for the MPMO requires meticulous attention to detail, not only to avoid major and minor complications previously discussed, but also to ensure reliable positive outcomes.

The data in this study indicated that there was minimal damage to the periodontium by performing segmental maxillary osteotomies using the technique described. This study showed that damage to the hard and soft tissues of the periodontium at vertical osteotomy sites was minimal, and not a reason to avoid use of the multiple-piece maxillary osteotomy.

References