Palatal expansion in adults: The surgical approach

William Northway
Traverse City, Mich

The discerning orthodontist has a treatment regimen that preferentially deals with arch deficiencies and might not necessitate extractions. Orthodontic expansion has been shown to be predictably unstable, and interproximal reduction is effective only up to a point, and so most of us use skeletal expansion in some form or another.

This article is an effort to gather from the literature and personal experience a strategy for expansion in adults that is workable, predictable, and stable. I intend to demonstrate that there are benefits to expansion through surgery that are not obtainable otherwise. Although nonsurgical expansion is preferred for some adult patients, surgically assisted rapid maxillary expansion is the clear choice for others. The discussion should not culminate in yes or no but, rather, an effort to find the tipping point, a point on either side of which a superior result might be achieved.

In any effort to find the difference between success and shortcoming, age should be a primary consideration. Haas[1] indicated that orthopedic expansion would invariably open the midpalatine suture until age 16 or 17. Melsen[2] demonstrated histologically that, after the ages of 15 in girls and 17 in boys, both sutures consist of a narrow sheet of connective tissue with inactive osteoblasts. As the patient matures, increasingly, Sharpey's fibers could be followed uninterruptedly across the suture. Using metal implants, Krebs[3] showed that orthopedic expansion resulted in a ratio of sutural expansion to dental expansion of about 50% until age 13; this dropped to approximately 30% and progressively less as boys approach age 14 and older. Among girls, the drop occurred earlier and more profoundly.

A healthy periodontium might be the ultimate harbinger of a successful dental response. Claffey and Shanley[4] studied gingival thickness (thin vs thick), correlated it with the tendency toward bleeding on probing, and found that thin tissues were at a disadvantage in maintaining marginal levels. The tendency toward bleeding at the outset proved less deleterious; thin tissues, healthy before treatment, experienced greater loss of probing attachment during treatment. Haffajee et al[5] used discriminant analysis to evaluate the impact of 11 predictor variables and concluded that the association between bleeding on probing, age, and previous attachment loss largely contributed to further attachment loss. From intrinsic periodontal properties, the concept of differential response to various gingival biotypes has evolved.

Starnbach et al[6] wrote that, in general, bones react to the forces placed upon them. In young rhesus monkeys, they showed that, although rapid maxillary expansion caused the periodontal membranes on the palatal side of the teeth to become disorganized and wider, alveolar bone on the pressure side resulted in resorption. When we looked at the effects of expansion in adults, we found less recession in our surgical group than in our nonsurgical group.[7] It seems clear that an alveolar contour showing the eminences of root structure or a lack of thick, attached keratinized tissue should sound a cautionary alarm that might push one toward surgically assisted rapid maxillary expansion. Digital palpation is recommended to test the contour as part of the diagnostic criteria.

Treatment should be based on established diagnostic criteria. Although most of us use expansion to treat dental crossbite, to facilitate a broader smile, or to accommodate arch length discrepancies, Betts et al[8] stressed the importance of a more specific clinical diagnosis. They developed and published a cephalometric analysis for frontal cephalograms, which calculates the transverse maxillomandibular width differential. They advocated that transverse discrepancies up to 5 mm might be treated with camouflage, but beyond that they encouraged the consideration of a surgical approach to expansion.

STABILITY OF EXPANSION

Stability is measured in different ways. Chamberland and Proffit[9] showed that much of the mean

Private practice, Traverse City, Mich.
Reprint requests to: William Northway, 12776 S West Bay Shore Dr, Traverse City, MI 49684; e-mail, northway@umich.edu.
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expansion during surgically assisted rapid maxillary expansion was lost after surgery and about half of the expansion was skeletal; this portion was found to be stable. This needs to be put into context: most authors who studied surgically assisted rapid maxillary expansion reported stability as the maintenance of results achieved once all appliances were removed.[7,10-23]

The amount of expansion reported in any study should be different from the amounts reported by other investigators because of the particular needs of the sample. That said, managing the extra space achieved by expansion that is given back during the healing process and, subsequently, during the orthodontic stage of treatment will directly impact the quality of the results. If there is a midline discrepancy at the outset, careful regulation of space closure can make the midlines concentric. If extra transverse alveolar width can be achieved during the expansion stage, consolidation of the arch form can bring the teeth better onto bone during the orthodontic stage, providing a more favorable gingival contour, or even a reduction in recession. Although studies do not report an advantage between surgically assisted and nonsurgical rapid maxillary expansion in terms of dental arch width, a surgical approach provides a better opportunity to leave the teeth centered over the alveolus.

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EFFICIENCY OF DIFFERENT EXPANDERS

In a search to find the most efficient system for expansion, the types of expanders must be compared. Chaconas and Caputo[24] used a 3-dimensional photoelastic replica of a human skull to compare the forces produced by activated orthodontic appliances. They concluded that the Haas and hyrax appliances provided the most significant amounts of orthopedic force; activation caused removable appliances to dislodge, lessening their effectiveness. In a study designed to evaluate the effect of surgically assisted rapid maxillary expansion on the sagittal and vertical maxillary planes, Bretos et al[25] compared the Haas appliance with the hyrax and found minor differences between responses, but none were statistically significant.

In Europe, comparisons of the results of many bone-borne appliances with those from tooth-borne appliances have failed to yield significant differences.[16,26] Laudeman et al[27] used 3-dimensional scanned dental casts to compare bone-borne and tooth-borne expanders used during surgically assisted rapid maxillary expansion and found that, although bone-borne expanders provided greater initial expansion, they also resulted in increased loss of periodontal attachment, especially in the anterior teeth.

In a 1984 report of various cast metal and acrylic appliances during surgically assisted rapid maxillary expansion, Kraut[28] advised the insertion of petrolatum gauze between the expansion appliance and the palatal vault to support the palatal flap and prevent hematoma formation. Betts et al[8] advocated the use the Haas appliance, which contacts the palate with acrylic, fulfilling this same function; furthermore, it supports the architecture of the palate during healing much the same way that a shoe tree prevents shrinking as shoes dry out. It allows the palatal volume to be preserved.

Increasingly, we are asked to provide expansion to improve respiratory function. Whereas the literature often credits Haas,[29] Krebs,[3] and others with improvement in nasal respiration, few articles have reported significant changes in nasal resistance as a result of clinical testing. Schwarz et al[30] used graduated coronal tomographs and found significant increases in the available nasal airway space. These increases were attributed primarily to shrinkage of inflamed nasal mucosa. Atac et al[31] and Babacon et al[32] compared rapid maxillary expansion in children with surgically assisted rapid maxillary expansion in older patients and found no significant differences in response. Studies with acoustic rhinometry, frontal and lateral cephalomety, and computed tomography scans hve reported a number of tendencies and likely changes in responses.[20,26,31-33]

Seeberger et al[22] and Wreidt et al[34] examined patients using acoustic rhinometry before and after surgically assisted rapid maxillary expansion and recorded profound increases in total nasal volumes. They also reported that their patients experienced better nasal airflow or a distinct subjective improvement in nasal breathing. Kurt et al[17] studied soft-tissue changes using cephalometry, as did Zhao et al[35] using cone-beam computed tomography, and found no evidence to support the hypothesis that rapid maxillary expansion could enlarge the oropharyngeal airway volumes. In spite of all of the airway widening reported above, no articles demonstrate statistically significant improvement in respiratory function; the one constant that resurfaces in the literature that examines expansion and its influence on nasal respiration is the incredible variability in patient responses.[17,22,33,36] This is undoubtedly a function of the array of systems involved: allergies, physiologic responses of epithelial surfaces, soft-tissue anatomies, bony anatomic differences, and postures.

If you provide skeletal expansion—either surgical or conventional—you will often find patients whose open bite will close. Using electropalatography, Ichida et al[37] demonstrated a relationship between lingual-palatal contact duration in swallowing and facial morphology as measured by parameters that describe mandibular rotation and inclination of maxillary incisors. Increased contact led to labially inclined incisors and more open mandibular and occlusal planes. Ozbek et al[38] demonstrated that palatal expansion resulted in higher tongue posture in children who reported no respiratory impairment. They noted that the position of the tongue at rest was the critical factor. When we compared 3 groups of adults treated with expansion, we found significant increases in palatal volume when our patients had surgically assisted rapid maxillary expansion via buccal osteotomy and parasagittal separation.[7] This has had a profound impact on closing open bites in our practice: the space available for the tongue is greater!

IMPACT OF THE SURGICAL TECHNIQUE

Once the adjunctive needs are established, the appropriate surgical technique can be selected. Early on, the degree of surgical intervention was linked to age, with procedures becoming more radical for older patients.[39] Performing surgeries on monkeys, Brossman et al,[40] and later Kennedy et al,[41] attempted to identify regions of resistance to maxillary expansion. Beyond the midpalatal suture, skeletal resistance to expansion will emanate primarily from 3 maxillary buttresses: nasomaxillary, zygomaticomaxillary, and pterygomaxillary.

Described in 1974 by Glassman, the bilateral buccal osteotomy has become the surgical approach for the majority of teams that have described their approach to surgically assisted rapid maxillary expansion in the literature[9,11,12,14,19-22,26-28,30-33,42,43] Although most also place an osteotome between the central incisors and drive it along the palatal floor until separation is achieved, there are many derivations of this surgery. Once completed, the procedure is the equivalent of a subtotal LeFort I osteotomy without the downfracture. Betts et al[8] provided an excellent step-by-step diagnostic and procedural description.

An important consideration with surgically assisted rapid maxillary expansion is whether to separate the pterygoid plates. The pterygoid fissure is vascular and highly innervated. This has led many surgeons to avoid the procedure and still report successful results.[7,10,11,14,16,21,22,26,31,34]

Lehman and Haas[18] wrote that, in the rare patient with palatal exostosis, parasagittal osteotomies might be necessary to achieve expansion. Kraut[28] reported that, when 2 of his 25 patients treated with conventional approaches failed to separate, they succeeded when he used an osteotomy at the midpalatal suture. When we compared the impact of buccal osteotomies performed with the insertion of an osteotome driven backward to loosen the halves of the palate in patients in when parasagittal separation was also done, we found that the latter provided statistically significant greater palatal volume.[7]

CONCLUSIONS

I have approached this review with a certain bias, one anchored in the conviction that there is a superior plan of treatment for our patients, one that when mixed with perseverance aims toward the best possible results. The literature is replete with tendencies toward superior results, but couched in the reality that there is tremendous variability in responses. I have come to believe that, when considering skeletal expansion, surgically assisted rapid maxillary expansion is the treatment of choice when the patient's alveolar discrepancy exceeds 5 mm or in patients with skeletal asymmetries: it is easy for the procedure—hence, the response—to be more radical on the affected side.

In this era when the option of orthognathic surgery is slowly being removed from treatment alternatives, the mobility of maxillary segments after surgically assisted rapid maxillary expansion provides a much broader realm of orthopedic options.

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