S.A.R.M.E. for Orthodontic Review:

"Surgically Assisted Rapid Maxillary Expansion: a comparison of technique, response and stability"

As orthodontic treatment options go, transverse maxillary expansion has had the most profound effect on broadened horizons since the introduction of extractions. Not only can we create enough space to alleviate rather profound crowding problems (and therefore most border-line extraction cases). We can correct crossbites, provide more facial fullness, fill unsightly deficient buccal corridors, loosen the maxillary sutures to facilitate maxillary protraction, provide an increase in tongue volume that will often relieve openbites caused by tongue volume or posture. And we can also improve respiratory capacity in most cases, especially in our non-allergic patients, and *when the maxillary expansion is profound.*

The concept of orthopedic expansion was provided scientific credibility largely by the efforts of Krebs and Haas, who published on either side of the Atlantic. They demonstrated that the midpalatal suture was separated during expansion and became recalcified during the first ninety days following expansion. Krebs showed that during expansion the maxillary dental width was expanded more than the maxillary base, and that this was widened more than the nasal cavity. Krebs' long-term material demonstrated a subsequent reduction in width of the maxillary canines, and to a lesser extent the molars, *but also* that there was a generalized increase in the width of the nasal cavity following expansion.

Numerous authors note, however, that there comes a time when the separation of the midpalatal suture becomes more difficult and profoundly more painful. Capelozza's study, which featured 38 patients with a mean age of 20.9 years, reported that only "moderate expansion" was possible. Further, 27% of his patients experienced pain, another 30% reported pain and swelling, and 9% demonstrated pain, swelling and lesions. Only 34% of his patients went through expansion without discomfort.

Vanarsdall and Saacks have demonstrated a correlation between transverse maxillary deficiency and gingival recession. Their findings lead them to side with Turvey, who wrote that "orthodontic expansion, especially in adult patients" was generally accomplished by tipping, and would "result in osseous dehiscences over the roots, and … relapse." As a result, these authors promote maxillary expansion accompanied by surgical assistance.

Their findings have confirmed my own experience, wherein adult patients have had problems with orthopedic expansion. As a result, we recommend surgically assisted expansion on more mature patients and even for younger patients where *the quality* of separation has not matched our needs in treatment.

The procedures that we advocate should be confused with that reported by Phillips and Proffitt, where the maxilla was expanded during a Le Forte I maxillary down-fracture and

supported by a surgical stint. They found that only 61% maintained the crossbite correction and 71% were stable after orthodontics. They have characterized this approach to expansion as being the least stable procedure in orthognathic surgery.

We routinely use one of two surgical approaches in facilitating maxillary expansion. Initially, I wanted to compare the difference between the two surgical procedures. While discussing this with Dr. Andrew Haas, he offered me the use of his Non-surgical expansion group so that I might include those in our comparison. I will briefly summarize our findings, which can be found in volume 67, number 4 of the Angle Orthodontist, 1997.

Our protocol consists of an orthodontic consultation, development of a treatment plan, and discussion with the patient, who is then referred for oral surgical consultation. Records are taken during which time the patient is fitted for an expansion appliance. The appliance is the delivered, (cemented or not in accordance with the wishes of the oral surgeon who might prefer to do the cementation at the time of the surgery, especially if it is a combined surgery). The surgery is performed, (the patient will typically experience about the same morbidity as having 4 wisdom teeth removed). We allow 1 week for healing, and begin expansion thereafter, which will typically take 2 weeks. After that, we ligate the appliance and are free to initiate orthodontics in 4-6 weeks. About four months later, we remove the expansion appliance and convert over to standard molar bands. From that point forward treatment is very routine.

In order to examine the response to surgically assisted maxillary expansion we looked at four groups: *The Non-surgical group*, *the Buccal Corticotomy group*, *the Combined Surgeries group* and a group of *Controls*. The groups were comprised of 15, 7, 15, and 5 patients respectively. All of the expansion groups were treated with Haas-type palatal expansion appliances, which have bands soldered to wires, which are imbedded in plastic, which, in turn, cover the palate. The Non-surgical group was instructed to expand more slowly than patients receiving conventional orthopedic expansion, an approach that Haas and later Handleman have called "slow expansion."

The **Buccal Corticotomy group** experienced a surgery that involved an intraoral incision; a cut was then made through the cortical bone from the piriform aperture, around to the pterygoid fissure bilaterally. The fissure was not involved surgically. An incision was then made between the apices of the central incisors, allowing an osteotome to be passed posteriorly, along the hard palate far enough back so that manipulation could confirm separation of the two halves.

In the **Combined Surgery group**, an additional procedure was carried out wherein a palatal flap was laid in a horseshoe shape, which allowed access to the midpalatine suture. A bone bur was used to cut through the bone on either side of the suture from the incisive foramen posteriorly to the posterior nasal spine. The two bony cuts were made to prevent septal deviation during the subsequent expansion and to reduce resistance. In

both procedures care was taken to close the soft tissue so as to minimize the potential for problems during healing. Both types of surgeries are carried out in the oral surgeons' office; we believe that only special medical conditions necessitate this being done in the hospital.

While all other patients came from my practice, the Non-surgical group was comprised of patients from the practice of Dr. Andrew Haas. These adult patients were provided Haas-type expansion appliances with instructions to activate them on a slow basis; they were expanded up to two times per day, as pain permitted. Some patients were expanded for as long as one to two months. No surgeries were involved.

Finally, the **Control group** was a group of randomly selected patients who had received conventional orthodontic treatment in my office and were started between the ages 27.3-47.1 (mean age 34.4 years). The mean ages for the other groups were 22.48, 29.19 and 25.97 for the Non-surgical, Buccal Corticotomy and Combined groups, respectively.

This is not a procedure that should be confused with that reported by Phillips and Proffitt where the maxilla was expanded during a Le Forte I maxillary down fracture and supported by a surgical stint. They found that only 61% maintained the crossbite correction and 71% were stable after orthodontics. They characterize their approach to being the least stable procedure in orthognathic surgery.

As one would expect, **the three expansion groups were widened** and the Control group was not. Analysis of variance demonstrated that the differences were statistically significant. The mean amounts of expansion ranged from 3.4-5.9mm at the maxillary molar, and these amounts were essentially stable. The important thing in comparing expansion among the groups is that, in each case, the expansion corrected the crossbite, and the crossbite correction was maintained in every case. In other words, pretreatment needs of the groups determined how much expansion they received. The same applied to **expansion at the maxillary canines** where all expansion groups increased between 3.4 and 4.2mm. These findings are very much in line with those of Bays and Greco and others.

As for **lower arch width**, Haas' 1980 article trumpeted significant amounts of lower arch expansion. There was an increase in lower with, both at the canines and molars, in the Non-surgical expansion group of 1.5mm during treatment, one-third of which was lost in the retention phase. There was no expansion in the other three groups. It should be borne in mind that each of the groups received conventional fixed orthodontic treatment after expansion, and efforts are taken to have the lower arch wire formed in harmony with the original lower arch dimensions in my practice.

We found that arch **depth** did not increase during expansion; in fact, both of the surgically assisted groups experienced a significant reduction in height of the palate. This

was the result of conspicuous scaring that takes place during the surgical process, especially in the Combined Surgery cases. We next looked at the width of the palate, which was expanded significantly more than the control, and the Combined group showed a statistically significant 2.5mm greater expansion of the palatal width than the Non-surgical group.

There was not a significant difference in the amount of **tipping** that took place among the groups, even though it was often the case that those cases which were more compromised in the transverse dimension needed more uprighting during treatment. Many times the premolars in these cases were crowded out of the arch toward the lingual and some amount of buccal flaring was needed in order to "sock-in" the lingual cusps.

Gingival recession was an area of concern for me as I had experienced profound crown lengthening in my non-surgically expanded adult cases. In our study we found no significant differences in recession at the maxillary canines as a result of expansion. The maxillary premolars experienced 0.5mm of crown lengthening in the Non-surgical group, which was significantly more than that which took place in the other groups. Regrettably, this worsened even more during the ensuing years. And at the molar, the recession was slightly worse in the Non-surgical group. This finding of exaggerated tissue loss in the Non-surgically assisted group was corroborated by Handleman when he looked at many of the same cases that we used, but he found this recession only to be significant among

his female sample. He speculated that the accompanying buccal bar that Dr. Haas advocates in the construction of his appliance might be a contributing factor as he saw more recession in cases where this wire had been placed. I suspect that Dr. Handleman shows less recession in the non-surgical group because he measures crown length at the buccal groove and we measure it at the deepest point, which is often the mesiobuccal groove of the maxillary molar, especially at T-3.

There can be problems with surgically assisted expansion, but many of them can be anticipated and ameliorated. We deliver the appliance 3 to 5 days before the surgery so the patient can acclimate. We provide them with multiple doses of Tylenol and Ibuprofen. We warn them ahead of time that they should expect the creation of a diastema and that there could be a diminished papilla, but assure them that the space will be closed at the end of treatment. If they smoke we endeavor to have them quit; and, if this is not a possibility, we advocate tips that get the heat and tar beyond the incisive papilla, which can fail to heal in smokers. Finally, it is not necessary and, in fact, undesirable to over-expand a surgically assisted case the way you would an orthopedic expansion case. They do not relapse nearly to the same extent. Three to five millimeters of over-expansion is plenty.

No discussion of Surgically Assisted Maxillary Expansion would be complete without a discussion of the age at which this should be considered, instead of orthopedic expansion,

and for that matter, under which circumstances slow expansion should be considered.

Within limits, it is safe to say that the older a patient is, the more difficult it will be to

achieve a good quality expansion. If the amount of widening needed is rather minimal,

slow expansion as advocated for adults by Haas and Handleman is a safe approach.

Anyone who is observant and has been doing orthopedic expansion long enough will

have come upon cases, even among youngsters, that have not responded according to

expectations, and some who have not responded at all. It may be some form of

osteopetrosis, stenosis, or ankylosis of the midpalatine suture, but the point is that all

patients do not respond the same. When you look at Krebs' data from 1964, there is

tremendous variation in when the suture releases and to what extent. Capelozza

emphasizes, with references from previous literature, extreme examples of variation. We

have taken to making a post-expansion evaluation of the quality of the expansion in an

effort to determine the impact on remaining treatment or on remaining growth. We take a

post-operative occlusal x-ray to assess the amount of separation at the suture and to

document the increase in diastema width, if created. We note amount of pain during

expansion, the change in molar width and any change in the functional placement of the

tongue.

Hartgerink and Vig challenge the findings of Linder Arensen and Woodside as to the

impact of maxillary expansion on nasal respiration; perhaps there should have been a

better assessment of the quality of expansion in the patients they were measuring. We certainly have found, if only anecdotally, wonderful improvements in patients' ability to breath through their noses and even smell and taste things that they have never experienced before. While age is a profound contributor as to when surgically assisted expansion should be considered, there is a multitude of other factors that have to be borne in mind, not the least of which is how the patient has responded to date.

I share Vanarsdall's concern for periodontal status and the increased strain on the buccal alveolus during expansion in adult patients. This and my patients' experience with pain and palatal ulceration while using slow maxillary expansion on adults almost never leads me to a non-surgical approach. I would consider it a compromise. Even Handleman, who is a published advocate for non-surgical expansion, agrees that there are strong indications for S.A.R.M.E. with any transverse discrepancy greater than 3-5mm, and certainly a history of periodontal disease or pre-existing gingival recession, a concern regarding the vertical facial pattern and an ability to have proper tongue posture and function, the anticipation of subsequent orthognathic surgeries involving the maxilla, and failed attempts at orthopedic expansion when expansion will be essential to appropriate facial growth. In treating true skeletal transverse asymmetries, we will make the buccal corticotomy much more profound on the affected side, and perhaps only small perforations on the non-affected side, if it is not in crossbite. The factors that influence my choice in requesting the buccal corticotomies verses the combined procedure is one of

severity of the presenting malocclusion and whether or not I need a profoundly increased

lingual volume, especially there is the presence of an openbite in any way.

I believe in this procedure whole-heartedly, and suggest that you develop a relationship

with an excellent oral surgeon that can help you in providing this procedure to your

patients who are compromised in the transverse dimension. Thank you.