The Wilckodontics Accelerated Osteogenic Orthodontics (AOO) procedure is a powerful orthodontic technique that can make the treatment of very complicated scenarios more routine, make the treatment of routine cases extremely fast and predictable and provide a new “orthodontic patient population” for the practitioner. The AOO technique does not owe its success to revolutionary materials that have defined orthodontic progress in the past, although the efficiency of one’s orthodontic tooth movement system can be greatly enhanced. The AOO treatment instead focuses on enhancing the manner in which the periodontium responds to applied forces and on providing for a more intact periodontium and increased alveolar volume to support the teeth and overlying soft tissues in retention. The surgical component of the AOO technique is an in-office procedure. The post-operative recovery should be no more uncomfortable than that of other orthodontic-related surgeries such as third molar removal, bicuspide extractions, exposures and gingival grafting, and it is certainly less of an issue than the recovery following orthognathic surgery.

Over the past two decades, attempts in engineering an “optimal response” of the alveolar bone to applied “optimal force” has produced refinements in selective alveolar decortication that have propelled both orthodontics and periodontics directly into the field of dentofacial orthopedics. Modern computerized tomographic (CT) imaging suggested that what was for almost half a century thought to be “bony block movement” could more accurately be described as “bone matrix transportation” and that this occurred subsequent to the demineralization of the alveolar housing in response to osseous insult. This cascading physiologic response was consistent with the regional acceleratory phenomenon (RAP) as initially reported by Frost in endochondral long bones and later by Yaffe, et al., in the membranous bones of the jaws. The metabolism in the healing response was thus accelerated in both the hard and soft tissues of the periodontium and when synthesized with the periodontal tissue engineering principles of enhanced clot stabilization around particulate bone grafting materials provided for orthodontic tooth movement (OTM) 300 to 400 percent faster, increases in the envelope of motion (degree of movement) two- to three-fold, and increased alveolar volume for more stable clinical outcomes and subtle facial morphing.

With the AOO technique, difficult orthodontic scenarios in both adolescents and adults can be successfully treated with stable results. The AOO technique can replace some orthognathic surgeries with severe Class III skeletal dysplasia being a notable exception. With the AOO technique, one is no longer at the mercy of the pre-existing alveolar volume and because of the low morbidity patients 11 to 78 years of age have been treated with marked biologic impunity.

The AOO technique stems from an innovative interpretation of surgically stimulated tooth movement and simultaneous alveolar augmentation. In synthesizing emerging concepts in cellular and molecular biology Murphy has referred to the ability to morph bone with orthodontic tooth movement done in conjunction with periodontal bone activation and alveolar augmentation as “in vivo tissue engineering.” The AOO treatment creates a four- to five-month “window of opportunity” that provides more than enough time to accomplish the major tooth movements when the correct protocols are used. The AOO treatment also provides for an increased differential between anchorage and activated teeth. The activated teeth move so readily that the non-activated teeth provide better relative anchorage. To accommodate the physiologic realities of the different aspects of the AOO treatment, the orthodontist must utilize a very different set of diagnostic and treatment planning parameters. It is only after new protocols are mastered that the full potential of the AOO treatment can be realized.

The Evolution in the Understanding of Facilitated Tooth Movement Subsequent to Selective Alveolar Decortication Without Bone Grafting

Rudimentary surgical intervention to speed tooth movement has been used in various forms for more than a hundred
The facilitated tooth movement subsequent to a corticotomy-based surgery is thus a physiologically based periodontal ligament (PDL) mediated process. An uninterrupted blood supply is critical. The luxation of the teeth or any outlined single-tooth segment of bone in a single-stage surgery (reflection of both facial and lingual flaps) is absolutely contraindicated and can result in intrapulpal and intraosseous morbidity. "Green-stick fracturing" and luxation of small dentoalveolar segments will not serve a useful purpose since these segments will quickly lose their structural integrity as a result of the demineralization process.

The design of the osseous insult used to activate the bone is not critical since it is the degree of metabolic pertubation in response to the osseous insult that sets the stage for the facilitated tooth movement.

However, there are preferred decortication designs that provide greater blood supply for the grafting material and provide greater alveolar demineralization. When performed properly, the bone activation results in increased tissue turnover and a transient demineralization of the alveolar housing, the degree of which is directly commensurate with the intensity and proximity of the surgical insult. This demineralization of the alveolar housing occurs due to an increase in the number of osteoclasts and in the absence of hyalinization necrosis and indirect resorption or infection will leave behind the soft tissue matrix of the bone. The demineralization is a prostaglandin mediated sterile inflammatory process.16

The response to the bone activation is very limited and will only occur in very close approximation to the osseous insult. For example, bone activation on the facial of the alveolus will not provide for any significant demineralization on the lingual of the alveolus. A thin layer of highly reactive bone is very conducive to tooth movement. The opposite of this, a thicker layer of relatively quiescent bone, would thus favor post-treatment stability.

Increasing Alveolar Volume for Increased Post-treatment Stability and Subtle Facial Morphing

The widely held notion that pre-existing alveolar volume is immutable has placed substantial limitations on the amount of tooth movement thought to be safely achievable with traditional orthodontics and still provide a stable result. The Department of Orthodontics at the University of Washington has collected diagnostic records on more than 600 patients that are 10 or more years into retention.13 Satisfactory mandibular alignment was maintained in less than 30 percent of the patients after a decade of retention. Relapse was typically accompanied by a decrease in arch length and arch width. Interestingly, in a study of mandibular incisor relapse Rothe, et al.14 reported that patients with thinner mandibular cortices are at increased risk for dental relapse.
Utilizing high resolution CT scan imaging, Fuhrmann showed that in adults that had undergone traditional orthodontic treatment there was bony dehiscence formation over the root prominences that only partially resolved during retention. Even at three years retention he found significant bony dehiscences that had not repaired themselves, most notably on the facial of the lower anterior teeth. There was not complete remineralization of the presumed residual soft tissue matrix of the bone and this translated to a net loss of alveolar volume. There was, thus, less bone overlying the root prominences following treatment than had been present prior to the traditional orthodontic treatment. Likewise, our results have shown a net loss of alveolar volume in adults that had been treated with corticotomy-facilitated orthodontics in the absence of simultaneous bone grafting. Even at 12 years retention, there were still lingering alveolar dehiscences over the root prominences that had only partially repaired themselves after debacketing. No additional repair had taken place between two years retention and 12 years retention. It would thus appear that adults are likely to experience a net loss of alveolar volume regardless of whether they underwent traditional orthodontics or corticotomy-facilitated orthodontics with no bone grafting during the surgery.

The bone grafting/alveolar augmentation that is performed in conjunction with the bone activation at the time of AOO surgery will provide for additional alveolar volume over vital root surfaces. The loss of alveolar volume that is associated with adult orthodontic treatment can thus be prevented. Additionally, as long as there has not been accompanying apical migration of the epithelial attachment pre-existing alveolar dehiscences and fenestrations can be corrected. In doing so, the roots of the teeth can be sandwiched between intact facial and lingual layers of bone of adequate thickness. This will in turn provide for improved post-treatment stability. Additionally, the increased tissue turnover and demineralization/remineralization subsequent to the bone activation will contribute to post-treatment stability through memory loss and improved bite settling.

Case Reports
Materials and Methods

The AOO treatment must begin with thorough orthodontic and periodontal evaluations. It is the orthodontist who must design and coordinate the overall treatment plan. There can be no active disease present at the time of the AOO surgery. Any infections must be resolved prior to the surgery.

The AOO treatment is not a panacea and the patient must be made aware of its limitations and potential complications. The success of the AOO treatment is also dependent on patient compliance especially in regards to keeping the orthodontic adjustment appointments every two weeks.

Typically, the patient is bracketed and a light archwire engaged sometime during the week prior to the AOO surgery. The AOO is not a very invasive surgery, but it is long and tedious. The surgery is typically done under IV or oral sedation. Our preference is to typically reflect full thickness flaps both facially and lingually around all of the teeth regardless of the teeth that will be activated. Sulcular releasing incisions are preferred and as much of the interdental papillae as possible reflected with the flaps.

The activation of the bone will be performed in different manners depending on the situation being addressed. Although an emphasis is placed on activating the bone over the root prominences in the direction of the intended tooth movement, the bone in the direction away from which the teeth are being moved should usually also be activated. It is preferable to have a thin layer of bone over the root prominence in the direction of the intended tooth movement. When a tooth is being moved through the long axis of the alveolus an ostectomy is performed through the entire thickness of the alveolus to create this situation. This facilitates closing spaces distal to the canines or in the uprighting of molars. In most other tooth movements, the bone activation is performed with a combination of corticotomy cuts or intramarrow penetrating that extend through the cortical layer of bone and only barely into the medullary bone. Luxation of the teeth or any outlined segments of bone is absolutely contraindicated.

The bone activation is followed by the placement of the particulate bone grafting material over the activated bone both facially and lingually. If, in the maxilla, only the anterior teeth are being activated the bone grafting material can still be used on the buccals of the upper posterior teeth to lessen the likelihood of dark buccal corridors. The amount of the bone grafting material that is used will depend on the extent of the pre-existing alveolar deficiencies, the increase in the dentoalveolar deficiency that is anticipated, and the amount of lower facial recontouring that one is attempting to achieve. Only resorbable bone grafting material is used. One should anticipate at least a 50 percent reduction in volume as the particulate grafting materials are eliminated and replaced with the patient’s own natural bone. Typically, .25 to .5cc of particulate bone grafting material is used per activated tooth, but as much as 24cc of grafting material has been used in a single case. The bone grafting material maintains the space between the periosteum and the activated bone. Micromovement of the particulate grafting material must be minimized. The integrity of the flaps needs to be respected and vertical releasing incisions and releasing incisions at the base of the flaps need to be avoided as much as possible. It is the continuity of the flaps that function as pouches to hold the packed particulate grafting material in place that helps minimize the micromovement of the bone grafting particles. The goal is to end treatment with increased alveolar volume, but not to have the new bone formation occur so rapidly as to impede the tooth movement. Therapeutic levels of bone morphogenetic
proteins would be potentially problematic in this regard, but
growth factors that stimulate soft tissue maturation of the over-
lying flap can have a positive impact on the bone formation in
a secondary fashion.

Non-resorbable, non-wicking sutures are used and left in
place for a minimum of two weeks to allow for re-establish-
ment of the epithelial attachment. The patients should be checked
four to five days following the surgery to make certain that the
flaps have not released.

The patients must not take non-steroid anti-inflammatory
drugs (NSAIDs) beyond the first week after the surgery. The
NSAIDs are prostaglandin inhibitors and can reduce the ster-
ile inflammatory process that is needed to facilitate the rapid
tooth movement.

The orthodontic adjustments are usually made at two-week
intervals. Major movements, especially those requiring orthopedic
forces, are not begun until at least two weeks following the surgery
to give the RAP a chance to take effect. There are occasions in
which the orthodontist will include the use of TADs for increased
anchorage or to alter the location of effective anchorage.

Patient 1

AOO Treatment Demonstrating Intrusion/Extrusion,
Decrowding and Difficult Crossbite Correction

A male, age 23, presented with Class II molar and canine
relationships, severe lower constriction with lower left posterior
lingual crossbites and supraversion of the upper first molars
(Figs. 1a, 2a, 3a, 4a, 4b, 6a, 7a, 8a). It was estimated that the
length of treatment utilizing traditional orthodontics would
be two to 2.5 years along with possible orthognathic surgery.
Patient 1 was completing his graduate studies and was antici-
pating having to leave the area to secure employment. He opted
for the AOO treatment and from bracketing to debracketing
the total treatment time was six months and two weeks (Figs.
1b, 2b, 3b, 8d).

The orthodontic objectives were to align the upper and
lower teeth, correct the lower left lingual posterior crossbite,
open the vertical and skeletal bite and coordinate the archform
while obtaining the “best bite possible.” Knowing that one can
decrowd, intrude and extrude teeth two to three times further
than is possible with traditional orthodontics, necessitates that
the orthodontist develop an anchorage system that makes these
significant movements possible.

The upper first molars were designated as the vertical
anchorage units and the orthodontic appliances were designed
around them. Additionally, the bite had to be mechanically
opened to allow adequate clearance for the dramatic tooth
movements. Key to this was bonding a large gauge wire across
the occlusal surfaces of the lower right second bicuspid and sec-
ond molar (Fig. 8c). The occlusal surface of the lower left molar

Fig. 1a: Patient 1: Before AOO treatment, anterior view.
Fig. 1b: Patient 1: Two years retention, anterior view.

Fig. 2a: Patient 1: Before AOO treatment, profile.
Fig. 2b: Patient 1: 16 months retention, profile.

Fig. 3a: Patient 1: Sectional ceph, pre-treatment, profile.
Fig. 3b: Patient 1: Sectional ceph, three years retention, profile.

Fig. 4a: Patient 1: Before AOO treatment with teeth separated, anterior view.
Fig. 4b: Patient 1: Before AOO treatment, models showing complete lingual cross-
bite of lower left posterior teeth, inferior left lateral view.

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was built up with bonding material to balance the right side. The lower second molars and upper first molars were banded, bondable brackets placed on all of the other teeth, and the movement was achieved with archwire therapy.

At the direction of the orthodontist, bone activation was performed both facially and lingually in the manner of circumcising corticotomy cuts and intramarrow penetrating around all of the remaining upper and lower teeth except around the upper first molars which would serve as the anchorage units. The bone activation can be seen on the facials of the upper anterior teeth in figure 5a. This patient had a fairly intact layer of bone and crestal globella on the facials of most of his teeth. Particulate bone grafting material was layered over the activated bone both facially (Fig. 5b) and lingually. 

At three months post AOO surgery the major movements had been accomplished and the lower left lingual posterior crossbite was corrected (Figs. 6b, 7b). The large gauge wire bonded to the occlusals of teeth #29 and #31 was removed. The leveling and aligning and the archform coordination required 3.5 months of additional treatment. The AOO treatment can provide rapid tooth movement over substantial distances, additional alveolar bone and more intact periodontium for a stable result (Figs. 1b, 2b, 3b, 8d). As was demonstrated in this case, developing the proper anchorage system and being fully aware of the increase in the distance that the teeth can be moved can be critical in realizing the full potential of the AOO treatment.

**Patient 2**

**AOO Treatment Demonstrating Extraction/Retraction for Space Closing and Utilizing Orthopedic Forces Using 0-0 Retractors**

A female, age 11, presented with Class II molar and canine relationships, mild to moderate upper and lower crowding, constriction of the upper and lower arches, prominent upper canines and procumbent/protrusive upper incisors (Fig. 9a). This patient also displayed a convex profile and lip incompetence. Additionally, she exhibited lower retrognathic and lower lip curl. The parents and patient were unreceptive to conventional orthodontic treatment functional therapy, and orthognathic surgery due to the length of treatment. The AOO treatment was presented as an option. They opted for the AOO
treatment and the resulting total treatment time from bracketing to debracketing was seven months and two weeks (Fig. 9b).

The pre-treatment angulation of the teeth impacts heavily on the amount of movement that can be anticipated when utilizing the AO O technique. In this case there was substantial proclination of the upper incisors (Fig. 9a). The key aspect in this case became the retraction of the upper anterior teeth following the removal of the upper first bicuspids. Since the molars were in full Class II malocclusion, the space closure was accomplished by retracting the anterior segment and slipping posterior anchorage.

Although extractions are typically performed at the time of the AO O surgery, in this particular case the upper first bicuspids were removed one month prior to the AO O surgery. Following the extraction of the upper first bicuspids and prior to the AO O surgery, surface CT scan imaging was performed (Figs. 12a, 13a, 14a, 15a, 16a). The extent of the proclination of the upper anterior teeth and the surprising absence of bone over the lingual root prominences of the lower incisors was very apparent.

The AO O surgery was performed during the week following the bracketing and archwire engagement. At the direction of the orthodontist, bone activation was performed both facially and lingually in the manner of circumscribing corticotomy cuts and intramarrow penetrating around the lower anterior teeth and lower bicuspids. In the upper arch, the bone activation was accomplished with ostectomies at the edentulous upper first bicuspids sites, bone thinning on the distals of the upper canines and on the linguals of the upper anterior teeth, and circumscribing corticotomy cuts and intramarrow penetrating both facially and lingually around all of the remaining upper teeth (Figs. 10a, b, c). The yellow arrows indicate the through and through ostectomies at the upper first bicuspids sites (Figs. 10a, b). The blue arrows indicate the bone thinning on the linguals of the upper anterior teeth. Thinning the layer of bone to a thickness of 2mm or less on the distal of the upper canines and on the linguals of the upper anterior teeth would greatly facilitate the retraction of the upper anterior teeth. A thin layer of activated bone over the root prominences in the direction of the
tooth movement will facilitate tooth movement. The particulate bone grafting mixture was layered both facially and lingually over the activated bone. The ostectomy sites were also filled with bone grafting material (Fig. 10d).

Two weeks following the AOO surgery the unilateral labial O-O retractors were inserted into the buccal tubes of the upper first molars (Fig. 11a). After four weeks of adjustments utilizing orthopedic forces, the space closing/retraction was complete and the O-O retractors were removed (Fig. 11b). Space closing/retraction is typically delayed for two to four weeks following the AOO surgery to provide time for the thin layer of activated bone to demineralize and undergo an increase in the rate of turnover. By doing so, the tooth movement could be facilitated without increasing the risk of root resorption.

The leveling and aligning was completed over the next six months and the case was debulked at seven months and two weeks post AOO surgery. The case was completed with a Class I canine relationship and a Class I molar relationship. The patient and her parents were very pleased with the treatment outcome and at nine years retention the case was still remarkably stable (Fig. 9b).

At 2.5 years retention a surface CT scan imaging analysis was repeated (Figs. 12b, 13b, 14b, 15b, 16b). The increased volume of bone in the upper and lower anterior/bicuspid areas was very evident in comparison to the pre-treatment CT scans. The upper first bicuspid sites remained closed and the teeth remained aligned. The bone grafting of the ostectomy sites provided for a consolidated upper alveolus. Likewise, on the linguals of the lower incisors there was now a thick layer of bone. At pre-treatment there were severe bony dehiscences on the lingual root prominences of the lower incisors, but at 2.5 years into retention the roots of the lower incisors were sandwiched between two intact layers of bone.

This case demonstrates that the pre-treatment angulation of the teeth can play an important role in the amount of tooth movement that can be anticipated. In this case the space closing of the edentulous upper first bicuspid sites was accomplished in four weeks. Regardless of whether the space closing had been accomplished with orthopedic or orthodontic forces, the bone thinning on the distals of the upper canines and on the linguals of the upper anterior teeth was of paramount importance in closing the upper first bicuspid spaces and retracting the upper anterior teeth.

This case demonstrated that a tall thin symphysis could be widened to provide additional bone between which the roots of the teeth were sandwiched following treatment (Figs. 15a, 16b). The layer of bone was even thickened on the linguals of the lower incisors where there was no pre-existing concavity in the archform and in doing so the severe bony dehiscences on the linguals of the lower incisors were corrected.

**Patient 3**

**AOO Treatment Demonstrating Anterior Protraction for Space Opening and Prosthetic Replacements**

A female, age 42, presented with a Class III malocclusion and an almost complete upper lingual crossbite (Figs. 17a, 19a). The upper second bicuspid were missing. It was not able to be determined if the second bicuspid had been removed or were congenitally missing. From bracketing to debracketing her total AOO treatment time was nine months and two weeks (Figs. 17b, 19b).

The orthodontic treatment plan centered around opening the upper second bicuspid spaces with stopped/advanced archwires. The upper and lower archforms would then be coordinated and set.

The pre-treatment angulation of teeth always plays an important role in determining the degrees of movement that can be reasonably anticipated. More movement can be achieved if the teeth are initially tipped away from the direction of the intended tooth movement and fortunately that was the situation in this case. The upper incisors were lingually inclined and the upper canines and first bicuspid were tipped slightly distally.

The orthodontist determined that all of the upper and lower teeth should be activated both facially and lingually and then bone grafted. Even though there were significant bony dehiscences present over the facial and lingual root prominences of many of the lower teeth, the greatest sparsity of bone was found on the facial of the upper canines where there were bony dehiscences extending almost to the apices of these two teeth (Fig. 18a). The bone activation was performed in the manner of circumscribing corticotomies cuts and intramarrow penetrating (Fig. 15a). The particulate bone grafting was then performed both facially and lingually over
all of the activated bone (Fig. 18b). This was especially important on the facials of the upper anterior teeth and upper first bicuspids. These teeth were undergoing the most substantial movement in order to open the upper second bicuspids spaces and to correct the upper lingual crossbite.

After five months of treatment and utilization of the stopped/advanced archwire, the spaces for the upper second bicuspids had been opened and the upper lingual crossbite corrected. The resulting anterior openbite was being closed down with vertical elastics (Fig. 18c). After seven months of treatment, the active orthodontic movement was completed (Fig. 18d). At this point it was decided to leave the patient bracketed for a couple of additional months to give the periodontium time to mature while the cellular activity was returning to a normal steady state. The case was then debracketed at nine months and two weeks following the AOO surgery (Figs. 17b, 19b). At 1.5 years into retention the spaces were restored with conventional fixed bridgework and the case had remained stable (Figs. 17c, 19c).

Patient 4

Rapid Forced Eruption of a Deeply Impacted Upper Right Canine in Conjunction with Traditional Orthodontic Treatment

A male, age 14, presented after approximately a year of traditional orthodontic treatment with a deeply impacted upper right canine. The space for the upper right canine had been opened greater than the width of the canine in anticipation of the exposure and forced eruption of this tooth (Fig. 20a). It was determined that the crown of the upper right canine was positioned in the palate and radiographically the crown appeared to be approximating the apices of the upper right lateral and central incisors (Fig. 23a).

The exposure surgery was initiated by the removal of the upper right primary canine and reflection of both facial and lingual full thickness flaps with distal releasing incisions on the mesial of the upper right first bicuspid (Figs. 21a, 22a).

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An ostectomy was then performed through the entire thickness of the alveolus to expose as much of the facial of the anatomic crown of the canine as possible. Only 0.5 to 1mm of the cervical area of the root surface was exposed (Figs. 21b, 22b). The bone was not thinned on the proximal surfaces of the adjacent teeth.

The ostectomy provides a clear and direct path for the canine to move into the proper position. There can be no bone left touching the enamel in the direction of the intended tooth movement or the tooth will hang up. Once the sheath is removed from around the crown the ability of the crown to resorb bone is lost. The ostectomy also provides clearance for the most ideal placement of the bracket on the crown of the canine and for the chain elastic that connects this bracket to the brackets on the adjacent teeth (Figs. 21c, 22c). The chain elastic thus provides a tripoding effect. By preferential adjustment of the tension on the two arms of the chain elastic, the canine can be guided directly into the desired position. Please note that in this case there is also a backup ligature wire extending from the bracket on the canine to the archwire. The use of the backup ligature wire has since been discontinued. The hook on the bracket that extends apically should prevent the chain elastic from slipping off the bracket during adjustments. Intramarrow penetrating was performed facially and transmucosal penetrating was performed linguually to activate the bone. The flaps were then returned to their original positioning and sutured with a resorbable material (Figs. 21d, 22d).

Since this forced eruption was done in conjunction with traditional orthodontic treatment, the adjustments were being performed at six-week intervals. At approximately six months following the exposure surgery (at the fourth adjustment appointment), the upper right canine had been brought into position and was ready to be engaged in the archwire (Figs. 21e, 22e). At three days post debracketing the area can be seen clinically in figure 20b and radiographically in figure 23b. Even though the deeply impacted upper right canine was brought into position in only six months there has been no significant apical root resorption and the periodontium was intact. At eight months retention the case had remained stable and there was no evidence of vertical relapse of the upper right canine (Figs. 20c, 21f, 22f, 23c).

We suspect that these forced eruptions tend to remain stable and they do not retract apically for a couple reasons. The bone activation likely provides for some loss of memory just by virtue of the demineralization/remineralization process. Perhaps, even more pertinent in these situations is that the bone activation provides for a two- to three-fold increase in the rate of the tissue turnover. This is a transient phenomenon, but it will take time for the bone turnover to return to a steady state. In the average person this could take one to two years to resolve.

Since these forced eruptions are being done in conjunction with traditional orthodontics, even after the forced eruption itself is complete, the patient might still be bracketed for another year or more while the finer leveling and alignment movements are completed and the bite is set. It is during this year or so that the increased rate of tissue turnover in the periodontium might provide for increased stability. The more times the supporting tissues turn over while a tooth is held in the same position, the more likely this tooth will remain stable. There is no need to do bone grafting in conjunction with the forced eruption of deeply impacted teeth since stretching the periodontal ligament (PDL) will cause the bone to fill-in on the tension side of the root.

These deeply impacted canines should absolutely never be luxated. Ankylosed teeth cannot be forcibly erupted using this technique. These forced eruptions are strictly PDL mediated. Luxation can lead to a damaged PDL and cause the tooth to stop moving.
Patient 5

AOO Treatment Demonstrating Orthopedic Dentoalveolar Expansion to Correct Maxillary Arch Constriction in the Molar/Bicuspid Areas and Sequencing for the Forced Eruption of the Palatally Impacted Upper Left Canine

A female, age 23, presented with severe upper crowding and moderate lower crowding, an Angle Class I relationship on the right side and an Angle Class II relationship on the left side, a 3 to 4mm anterior openbite, a 2mm upper midline shift to the left side and multiple upper anterior and posterior teeth in lingual crossbite with constriction of the upper arch (Figs. 24a, 25a). The patient was completing her graduate studies and wanted to improve her appearance in anticipation of job interviews. The total AOO treatment time from bracketing to debracketing and including the forced eruption of tooth #11 was 11 months (Figs. 24b, 25b).

A deeply impacted tooth cannot be forcibly erupted simultaneously with the AOO treatment since the deeply impacted tooth will act as the unwanted anchor toward which the activated teeth will be very readily inclined to move. A deeply impacted tooth will need to be forcibly erupted either prior to the AOO activation of the teeth or following the major movement of the activated teeth. In this case a space had to be created before the impacted canine could be forcibly erupted. It was decided to first complete the major movements and open the space utilizing the AOO treatment and then forcibly erupt the impacted upper left canine. The upper left canine had caused extensive root resorption of the upper left lateral incisor and it was anticipated that the upper left lateral incisor would need to be removed and replaced at some point following the orthodontic work.

In the lower arch, the molars were designated as the anchorage units and the bone activation and bone grafting were performed around the lower anterior teeth and lower bicuspids where a moderate amount of overlap crowding would need to be resolved. In comparison, however, all of the upper teeth would be undergoing a much more extensive amount of movement. Accordingly, the orthodontist designated that bone activation be performed both facially and lingually around all of the upper teeth. The bone activation was performed in an aggressive fashion and extended into the furcations of the upper molars to attempt to impact on the bone on the buccal of the palatal roots of these teeth (Fig. 26a). It is impossible to create a thin layer of bone on the buccal of the palatal root to facilitate the tooth movement, but osseous insult in close approximation to the

Fig. 24a: Patient 5: Before AOO treatment, constricted maxilla with unerupted upper left canine, anterior view.
Fig. 24b: Patient 5: Post debracketing, anterior view.
Fig. 25a: Patient 5: Before AOO treatment, constricted maxilla with unerupted upper left canine, palatal view.
Fig. 25b: Patient 5: Post debracketing, palatal view.
Fig. 26a: Patient 5: AOO surgery, bone activation performed around all teeth, arrow indicates incisal edge of unerupted upper left canine, palatal view.
Fig. 26b: Patient 5: Showing the dentoalveolar expander inserted 2.5 weeks following the AOO surgery and prior to the suture removal, palatal view.
Fig. 26c: Patient 5: 5.5 weeks post AOO surgery, the dentoalveolar expansion is complete after three weeks of adjustments by the patient, palatal view.
Fig. 26d: Patient 5: 2.5 months post AOO surgery, showing the TPA for crossarch stabilization one month after removal of the dentoalveolar expander, palatal view.
Fig. 26e: Patient 5: Five months post AOO surgery, the space has been opened for tooth #11 utilizing a stopped and advanced wire, palatal view.
Fig. 26f: Patient 5: Six months post AOO surgery, tooth #11 has been surgically exposed and bracketed both facially and lingually, palatal view.
Fig. 26g: Patient 5: 7.5 months post AOO surgery and six weeks post exposure surgery, tooth #11 is ready to be engaged in the archwire, palatal view.
Fig. 26h: Patient 5: 8.5 months post AOO surgery and 10 weeks post exposure surgery, palatal view.

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bone on the buccal of the palatal root will at least provide for increased cellular activity and decreased mineral content.

The dentoalveolar expander was inserted in the palate 19 days following the AOO surgery and prior to the completion of the removal of the sutures (Fig. 26b). The expansion protocol can be different from palatal expansion since we are creating dentoalveolar expansion and not sutural expansion. After three weeks of daily adjustments by the patient the dentoalveolar expansion was complete at 5.5 weeks post AOO surgery and the expander was ready to be removed (Fig. 26c). It is imperative that a TPA be placed immediately following the removal of the expander to help maintain the increased arch width (Fig. 26d). No diastema was created between the upper central incisors because the expansion was almost completely dentoalveolar and not sutural.

Immediately following the completion of the dentoalveolar expansion a stopped/advanced archwire was inserted to begin opening the space in which to forcibly erupt the upper left canine. Five months following the AOO surgery and 3.5 months after the completion of the dentoalveolar expansion, the space opening for the upper left canine was complete (Fig. 26e). It is imperative that a TPA be placed immediately following the removal of the expander to help maintain the increased arch width (Fig. 26d). No diastema was created between the upper central incisors because the expansion was almost completely dentoalveolar and not sutural.

Six months following the AOO surgery and after completion of the major tooth movements, the impacted upper left canine was surgically exposed (Fig. 26f). Note that the crown of tooth #11 is now positioned somewhat distal to tooth #10 in comparison to the AOO surgery at which time the crown of tooth #11 was positioned directly on the lingual of tooth #10 after having erupted through the root of this tooth (Fig. 26a). An ostectomy was performed between teeth #10 and #12 so that a bracket could be placed on the facial of tooth #11 and then joined to the brackets on the adjacent teeth with a chain elastic and thus provide for a tripoding effect. Additionally, a bracket was also placed on the lingual of the crown of tooth #11. A stainless steel finger spring was attached to this bracket from the TPA to aid in quickly extruding the crown of #11 away from the badly resorbed root of tooth #10. After six weeks of forced eruption tooth #11 had been brought down into position and was ready to be engaged into the archwire (Fig. 26g). At 8.5 months following the AOO surgery and 10 weeks after the exposure surgery, tooth #11 was engaged in the archwire and aligning was being performed in preparation for debonding (Fig. 26h). The total AOO treatment time from bracketing to debonding was 11 months (Figs. 24b, 25b).

In this case, it was necessary to use an orthopedic dentoalveolar expander because of the constriction of the arch in the molar areas. It would not have been possible to correct the constriction in the molar areas with archwire therapy alone. The dentoalveolar expander was inserted 2.5 weeks after the AOO surgery to allow adequate time for the increased cellular activity and demineralization to occur. The expansion is PDL mediated and dentoalveolar in nature and as such does not result in any significant sutural expansion or the creation of a diastema between the upper central incisors (even in adolescents). Six millimeters of expansion in the upper posterior areas can be readily achieved and can be expected to remain stable with routine post-treatment retention.

**Patient 6**

**AOO Treatment Demonstrating Archwire Expansion for the Correction of Maxillary Arch Constriction in the Anterior/Bicuspid Areas**

A male, age 23, presented with Class I canine and molar relationships, very substantial upper and lower crowding, severe upper arch constriction in the anterior and bicuspid areas, and bilateral crossbites in the anterior and posterior areas. The estimated length of treatment utilizing traditional orthodontic therapy along with assisted surgical expansion was two to 2.5 years. The total AOO treatment time from bracketing to debonding ended up being six months and two weeks (Figs. 27c, 29c).

The AOO surgery was performed in both the upper and lower arches and all of the teeth were activated and bone grafted. Of particular interest in this case is that the severe maxillary constriction was present in the anterior and bicuspid areas, but not in the molar areas. This is very evident in the pre-surgery clinical photographs and in the pre-treatment surface CT scan imaging (Fig.
28a, 30a). With archwire therapy alone the severe anterior/bicuspid constriction was corrected in only four months (Figs. 29b, 29e). The finer finishing movements were completed in the following 2.5 months and the case debracketed (Figs. 27c, 29c).

There are numerous observations that can be made in a comparison of the pre-treatment photographs (Figs. 27a, 29a) and post-treatment photographs (Figs. 27c, 29c) and in a comparison of the pre-treatment surface CT scan imaging (Figs. 28a, 30a, 31a) and post-treatment surface CT scan imaging (Figs. 28b, 30b, 31b). The cross-arch expansion in the canine areas was 8mm cusp tip to cusp tip. Additionally, in a comparison of the pre- and post-treatment surface CT scan imaging it is readily apparent that there is considerably more bone over the root prominences both facially and lingually following treatment than was present prior to the AO O treatment. Even the dentoalveolar deficiency at B point was filled in. The roots of all of the upper and lower teeth were sandwiched between thicker layers of bone at post-treatment than existed at pre-treatment. At eight months retention both upper and lower arches were re-entered to harvest bone biopsies. On the buccal of the upper left first bicuspid where there was a dehiscence extending almost to the apex of the root at pre-treatment, there was now a healthy layer of bone 3 to 4mm in thickness. A similar situation was found on the facials of the lower anterior teeth, most notably on the facial of the lower left canine.

This case also serves as a good example in demonstrating the significance of the pre-treatment angulation of the teeth. The upper canines and bicuspids were linguoly inclined at pre-treatment making it feasible to correct much of the crossbite by tipping these teeth facially. Likewise, the upper and lower incisors were relatively upright which facilitated tipping them facially to accomplish the upper and lower decrowding. Had these teeth been tipped labially at pre-treatment considerably less correction would have been possible.

Summary

The Accelerated Osteogenic Orthodontic technique can provide the trained practitioner with the ability to accomplish treatments in an in-office setting that would have previously not been a consideration. Central to this inevitable progress has been the spirit of interdisciplinary collaboration that has synthesized modified traditional orthodontic tooth movement protocols with periodontal tissue engineering and regenerative surgery. The result of this has not only been rapid orthodontic tooth movement with drastically shortened treatment times but also an increased scope of treatment with reduced side effects such as root resorption, relapse, inadequate alveolar bone and bacterial time/load factors like caries and infection.

The AO O treatment should not be considered a rescue technique or a treatment of last resort. Teeth that have become ankylosed as a result of blunt trauma or previous luxation will not be amenable to this treatment. Although borderline dental Class III occlusion might be amenable to treatment, severe skeletal Class III situations cannot be adequately addressed with this technique. The movement accomplished with the AO O technique is dentoalveolar in nature and as such the surrounding periodontium must be healthy. Reduced alveolar vitality that can result from the use of bisphosphonates or long-term corticosteroid therapy precludes the use of this technique.

In otherwise healthy individuals however even severe malocclusions can usually be adequately addressed. Age in itself is not a limiting factor. In fact, due to the ability to increase the tissue turnover rate by two- to three-fold the AO O treatment can be viewed as a “transient fountain of youth” for older individuals. Our oldest patient was 78 years of age at the time of her AO O treatment. The total AO O treatment time for her case was four months and two weeks. At 88 years of age she is still enjoying the benefits of her treatment.

It is fair to say that the majority of our AO O patients would have not followed through with needed orthodontic work were the AO O treatment not an available option. For this underserved population of patients, the AO O treatment has filled a void that until now has not been adequately addressed. If you have enthusiasm for continued practice growth and if you welcome the thrill of a challenge, becoming trained in the AO O technique is something that you will want to consider.

References


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