

JCO ROUNDTABLE

Stability of Orthodontic Treatment Part 1

EUGENE L. GOTTLIEB, DDS, Moderator
MAURO COZZANI, DMD, MSD
JULIA F. DE HARFIN, DDS, PHD
ROBERT D. HELMHOLDT, DDS
LEE R. LOGAN, DDS, MS
DAVID W. WARREN, DDS

DR. GOTTLIEB What is the most frequent evidence of instability of results?

DR. WARREN The most frequent evidence that I see is a return of rotations of the anterior teeth.

DR. COZZANI I'd say incisor crowding in the mandibular arch.

DR. LOGAN For me, the main one is rotations of mandibular anterior teeth. I would also list:

- Prognathic mandibular growth.
- Recurrence of a maxillary diastema.
- Recurrence of an open bite that has been closed with anterior vertical elastics.
- Lingually placed maxillary lateral incisors.
- Infraversion of lingually impacted maxillary canines that have had surgical treatment and erupted orthodontically.

In addition, Class II corrections achieved

with elastics, Herbst appliances, or functional appliances, particularly in dolichocephalic cases, tend to be unstable, as do posterior crossbites corrected with removable appliances, archwires, or elastics. All adult mandibular bicuspid extraction sites tend to show some loss of contact, and maxillary first bicuspid extraction sites adjacent to small maxillary second bicuspid tend to re-open.

DR. HARFIN We need to consider both skeletal and dental stability in all three dimensions—vertical, sagittal, and transverse. In each dimension, the recurrence of the initial problem is a sign of instability of the orthodontic treatment.

DR. HELMHOLDT I would sum it up as a return toward original occlusal malrelationships and imbrications.

DR. GOTTLIEB Which malrelationships are more likely than others to recur?

DR. HELMHOLDT I think the most commonly recurring relapses are rotations and diastemas.

DR. COZZANI Rotations are probably the most studied, and it seems that they are the most difficult to retain. Closed- and open-bite cases are more difficult to define in growing and non-growing patients. Function is involved, and therefore they are not easily studied.

DR. HARFIN After 35 years of experience, I can say that vertical problems are the most likely

Dr. Gottlieb is Senior Editor, *Journal of Clinical Orthodontics*, 1828 Pearl St., Boulder, CO 80302. Dr. Cozzani is coeditor of *Progress in Orthodontics*; an adjunct professor, Department of Orthodontics, University of Ferrara; and in the private practice of orthodontics at via Vailunga 37, 19125 La Spezia, Italy. Dr. Harfin is Professor and Chairman, Orthodontic Department, Maimónides University, Buenos Aires; President of the Latin American Association of Orthodontists; a member of the Executive Committee of the World Federation of Orthodontics; and in the private practice of orthodontics at Av. Santa Fe 3242, Buenos Aires, CP C1425BGU, Argentina. Dr. Helmholt is in the private practice of orthodontics at 1700 N.E. 26th St., Fort Lauderdale, FL 33305. Dr. Logan is in the private practice of orthodontics at 18250 Roscoe Blvd., Suite 315, Northridge, CA 91325. Dr. Warren is an orthodontic consultant, Veterans' Hospital, Miami; a courtesy staff member, Oral Surgery Department, Jackson Memorial Hospital, University of Miami; and in the private practice of orthodontics at 6601 S.W. 80th St., Suite 112, Miami, FL 33143.

to recur. Open-bite cases are difficult to retain, even if you overcorrect them. The other relationships are more easy to keep from relapsing by overcorrecting them and using long fixed-retention periods.

DR. WARREN I agree that open bite is the most likely to recur.

DR. LOGAN Closed bite, open bite, and diastemas are all likely to recur if you wait to treat in the permanent dentition, and less likely to recur if treated in the mixed dentition. Closed bite can recur with relapse of a Class II relationship. Extraction of maxillary and mandibular first bicuspids can lead to an end-to-end anterior occlusion. Anterior tooth-size disharmonies are a common cause of diastemas reoccurring.

DR. GOTTLIEB How can such tendencies be minimized?

DR. HELMHOLDT I strive toward a little overcorrection of rotations, and where possible I place lingual fixed retention on corrected rotations and diastemas. Also, with proper timing, the removal of deciduous cuspids, when indicated, will allow the incisors to erupt in good alignment, and this natural process will help insure good alignment during the life of the patient without mechanical correction or support.

DR. LOGAN I also slightly overcorrect all initial rotations, but early treatment or prevention of a rotation before it happens will reduce the incidence of rotations post-treatment. I use bonded lingual retainers for lower incisors and for previous maxillary rotations. For more severe rotations or spacing, a Hawley is worn at night over the bonded wires as insurance should a bond become loose.

Lingually placed maxillary lateral incisors should have the roots torqued to the facial. In Class II cases, I rotate the maxillary molars with a lingual elastomeric chain from molar to bicuspid. If the molar is not well rotated, there is more of a tendency to relapse back to the Class II. In leveling the lower curve of Spee, and for intrusion of the incisors, I do not bracket the canines



Dr. Gottlieb

until an intrusion arch is used first, to prevent dumping the incisors.

In extraction cases, I create space for crowded anterior teeth before including them in the strapup. If a full strapup is used at the start, the teeth are “round-tripped”, and the anterior teeth may end up in places that may not be so esthetic.

DR. COZZANI A correct diagnosis is crucial, as is long-term retention. Circumferential supercrestal fiberotomies have been shown to partially reduce rotational relapse of the maxillary incisors. Habits should be taken into consideration if applicable, because all pernicious habits can create post-treatment instability.

DR. HARFIN Muscle equilibrium is very important in maintaining a “quiet” muscle-teeth relationship. Every habit causing a muscle-teeth imbalance can be considered pernicious for post-treatment stability. Not only do we have to correct the habits, but we also have to determine the real causes that produce and increase these habits. Otherwise the habits return and, of course, the post-treatment instability. We consider the following habits in our clinical history at the beginning of treatment: airway problems such as large tonsils, obstructing adenoids, and nasal constriction; tongue posture problems; lip habits and incompetent lips; and finger- and thumb-sucking.



Dr. Cozzani

DR. WARREN In my practice, I use different methods to close an open bite and maintain it closed, including tongue spurs, tongue-thrust therapy (usually in-office continuous instruction), orthognathic surgery, archwires, elastics, and retention. As Dr. Harfin said, the key to success in maintaining a good overbite relationship in these cases is to eliminate the habit that had created the open bite and can recreate it. Post-treatment instability can be caused by many habits. Tongue thrust leads to open bite and spacing; clenching and grinding can lead to an increase in overbite and shifting of individual teeth; lip biting can cause splaying of upper anterior teeth. Once patients have completed active orthodontic treatment, they do tend to slip back into old habits. It helps to instruct the patient in the correct position for the tongue during swallowing.

For closed bite, I focus on gaining sufficient bite opening by obtaining a proper interincisal angle. This can be done by uprighting molars, extruding posterior teeth, and intruding incisors where indicated.

For diastemas, I close the diastema early in treatment, do a frenectomy where indicated after space closure, and retain the maxillary central incisors closed with a bonded palatal wire for at least one year.

For rotations, I establish and maintain correction or even overcorrection early in the treat-

ment of a case and proper torque of the anterior teeth by the end of treatment.

DR. HELMHOLDT Most habits become extinct by the time proper correction is achieved. If the newly created oral environment is in balance, the tongue and lips, acting reflexively, will adapt. And with compassion and education, any detrimental extraoral habits will also cease.

DR. GOTTLIEB Under what circumstances would you start treatment before a pernicious habit is corrected?

DR. COZZANI I would start treatment when the patient and parents understand that some post-treatment instability can be possible if the pernicious habit is maintained or if it develops again. I want them to understand and sign a statement that the case is at stability risk.

DR. HARFIN If the esthetic and functional problem is very urgent, we start treatment, even in growing patients. I have seen through the years that some habits are easier to correct if the treatment has already started and the malocclusion is being corrected. This could be associated with the patient's motivation.

DR. HELMHOLDT I would start treatment if there were a compelling or urgent reason to do so, whereby normal growth and development were being thwarted or the malocclusion was being unduly exacerbated.

DR. LOGAN Constriction of the palate, in many cases, makes it difficult to have a proper tongue posture without thrusting. In these cases, usually a Hyrax widening procedure is indicated. Later, mandibular anterior tongue spurs on a lingual arch can be used to train the tongue into the palate on swallowing. These procedures are most effective and stable if started before the eruption of the bicuspid. Severe Class II relations generally have lip habits, and the protrusion has to be corrected before the lip habit will stop.

DR. WARREN I usually begin orthodontic treatment and correction of a pernicious habit at the same time. To correct a thumb habit, I will

place spurs on mandibular incisor bands. To allow the thumb habit to continue while I am trying to decrease overjet or improve overbite would be counterproductive.

DR. GOTTLIEB Are cases treated early more stable?

DR. COZZANI No.

DR. HELMHOLDT I agree.

DR. WARREN Cases treated early are more stable only as regards rotations of teeth. A fully corrected Class II is stable when treated during the growth period. Class III malocclusions treated early can be a problem.

DR. HARFIN Early orthodontic treatment will not resolve all potential orthodontic problems or totally inhibit adverse skeletal growth patterns. However, by identifying problems at an early stage, it is possible to redirect skeletal growth, improve the occlusal relationship, enhance the patient's esthetics and self-image, and, perhaps of even greater importance, achieve results that are unattainable later with the eruption of the teeth and the cessation of growth. If we can profit from growth, the case will remain more stable. The key is to intercept the problem and perform the orthodontics at the right time, knowing exactly what the aim of this treatment phase is.

DR. LOGAN Prevention of lower anterior labial soft-tissue loss is possible with early extraction of deciduous canines and/or correction of anterior crossbites. Early extraction of selected deciduous teeth, incisors, and canines can minimize rotations and ectopic canine eruptions. Enucleation of second bicuspid can reduce anterior facial height and cause favorable counterclockwise rotation of the mandible. Conservation of "E" space or early extraction of one or more Es, causing distal eruption of the first bicuspid, can prevent anterior rotations from occurring. Supporting structures adapt early to the fully erupted tooth positions. The less time the teeth are in unfavorable positions, or if they never were adversely placed, the more retention problems are



Dr. Harfin

lessened. Therefore, I think cases started early are more stable.

DR. GOTTLIEB Are Class II cases treated early with functional appliances more stable?

DR. COZZANI No.

DR. WARREN I'd say probably less so.

DR. HELMHOLDT I seldom, if ever, use functional appliances because they make treatment success too vulnerable to patient compliance.

DR. LOGAN My experience with stability of Class II correction with functional appliances has not been very favorable. The Class II correction was achieved by dental compensations and/or anterior displacement of the condyles. These dental compensations and condylar displacement tend to relapse over time. A true orthopedic change is better achieved with extraoral traction, and the chance of relapse is less than in Class II cases treated by functional appliances. Maxillary bicuspid extraction, particularly of second bicuspid, is a very stable means of correcting adolescent and adult Class II cases that exhibit protrusive maxillary incisors.

DR. HARFIN The stability of early treatment with functional appliances depends on the patient's growth pattern and whether you can take advantage of this. In our treated cases, we have observed that the tendency to instability increas-

es when the orthopedic response is poor and when the dentoalveolar compensation is strong.

Growth and development comprise the infrastructure of clinical diagnosis and treatment planning. The two major issues have been growth prediction and growth stimulation induced by functional appliances. The stability of results in orthodontics and in combined orthognathic-orthodontic treatment are similarly linked to growth and development.

DR. GOTTLIEB Are Class II, division 2 cases more stable than division 1 cases?

DR. COZZANI I don't think so.

DR. HELMHOLDT I don't think so, either. Both types of cases present the same correction and retention challenges, but, obviously, a slightly different treatment approach.

DR. LOGAN I would say division 2 cases are more stable because of a more favorable growth pattern and/or posterior displacement of the mandible. Also, maxillary laterals show less relapse when they are initially positioned labially rather than lingually.

DR. WARREN Class II, division 2 cases are more stable in terms of crowding and less stable in terms of overbite. Usually, low-angle cases with strong masseter muscle pull have a tendency to increase overbite in retention.

DR. HARFIN Normally, patients with a brachyfacial biotype are more stable than severe dolichofacial patients. Class II, division 1 cases treated with upper bicuspid extractions seem to be more stable.

DR. GOTTLIEB Are Class II, division 2 cases more stable when treated with extractions or when treated nonextraction?

DR. COZZANI I don't think there is a difference, but most of them should be treated nonextraction due to the vertical pattern.

DR. WARREN True Class II, division 2 patients have a deep overbite relationship, a flat

profile, and a low mandibular plane angle. Extraction is usually contraindicated in such patients. However, if mandibular crowding is moderate to severe, then stability would be enhanced by extractions.

DR. LOGAN If the Class II cannot be corrected by modifying growth, these cases can be quite stable with maxillary second bicuspid extractions, or one maxillary second bicuspid in subdivision cases. There is a tendency for extraction sites to reopen in retention with first bicuspid extractions in division 2 cases.

DR. HELMHOLDT Extraction or nonextraction is simply a means to an end, and it's the orthodontist's responsibility to use one or the other procedure to accomplish the best and most stable end result in the shortest time, based on the proper and correct diagnosis.

DR. HARFIN In my opinion, we have to distinguish adult patients from growing patients. In young patients, we can manage the direction of growth to a certain extent, but in adults we can only correct the dentoalveolar problem. When Class II cases are treated as the patient is growing, they are more stable. With appropriate orthodontic mechanics, most Class II patients can be treated satisfactorily with or without premolar extractions.

DR. GOTTLIEB Are adult cases more stable?

DR. HELMHOLDT No.

DR. COZZANI I'd say probably yes, but as far as I know there is no definitive evidence.

DR. HARFIN Every treated case continues to change after treatment. Normal maturational changes, together with post-treatment tooth alterations, conspire against long-term stability in adult patients. The need for prosthetic rehabilitation and periodontal problems are constant issues in adult patients. So we cannot consider them more stable. On the other hand, we do not have the growth factor that can play against treatment stability.

DR. LOGAN In general, adult cases are much less stable. Rotations, diastemas, and any Class II or Class III relations or maxillary constrictions are extremely unstable without orthognathic surgery. Even with orthognathic surgery, they can show relapse. Most adult first bicuspid extraction cases will show some space opening in both the maxilla and mandible. Cases with maxillary second bicuspid extractions have less tendency to show space opening than with first bicuspid extractions, because of the more favorable, larger size of the first bicuspids.

DR. WARREN Because adult cases tend to be less stable, I recommend permanent retention for adults. The relapse that I see most frequently is the opening of extraction sites or spaces adjacent to extraction sites, unless bonded wires are placed across these sites.

DR. GOTTLIEB How does the timing of treatment to take advantage of growth spurts affect post-treatment stability in male and female patients?

DR. COZZANI So far, the majority of long-term studies demonstrate no difference in antero-posterior and crowding stability in female or male patients treated early or late. Recently, the University of Michigan and the University of Florence published a few reports in which a new and interesting theory based on cervical vertebral maturation is described.¹⁻³ Long-term results could confirm this vision.

DR. HARFIN It is well known that the growth spurt happens earlier in girls than in boys. If we want to perform interceptive orthodontics and benefit from growth, we have to be sure to be acting before the growth spurt in either sex. This requires a definitive skeletal diagnosis.

DR. HELMHOLDT When to treat is as important as how to treat. I typically begin toward the end of the mixed dentition and the initial growth spurts, recognizing that the most dramatic changes in the correction process are probably attributable to growth and not tooth movement.



Dr. Helmholdt

DR. LOGAN I'm assuming that this question addresses Class II cases. The earlier the correction, the more stable the correction. Tissue rebound seems greater in the older individual. Early correction of lip habits favors stability.

DR. WARREN Utilizing the growth spurt affects the quality of the patient's result and allows treatment without bicuspid extractions. Any time you can achieve a balanced facial appearance without extractions, your overall result will be more stable.

DR. GOTTLIEB We have seen a trend away from bicuspid extraction and toward nonextraction and expansion. Can such treatment produce stable results in Class I crowded cases?

DR. COZZANI Long-term studies have shown that more crowding develops in patients treated nonextraction.^{4,5}

DR. HARFIN Some Class I cases treated without extractions have a favorable prognosis based on an exhaustive diagnosis and wearing fixed retainers for a long period of time. In other cases, we have to reshape the teeth by interproximal enamel reduction. Our main concern is facial esthetics, and we therefore base our treatment aims on the patient's profile. Of course, the amount of crowding is an important factor, as well as the possibility of aggravating a bimaxillary protrusion and lower anterior vestibulation

in cases of weak mucoperiosteal tissue. The patient's age and sex and the facial and periodontal biotype are also important. When the patient presents only 4 or 5mm of crowding (with good oral hygiene), however, interproximal enamel reduction has to be considered.

DR. HELMHOLDT Not being too influenced by trends, I will extract or not extract based on procedures that will be most expeditious for treatment and most beneficial for the patient, and will contribute to the stability of the final result. Most credible evidence indicates that anything more than mild expansion is subject to relapse.

DR. LOGAN Class I cases that are overexpanded are less stable. The teeth generally have been crowded for several months or years, and the teeth that are moved to unstable positions will try to upright themselves. That's what we call "rotation memory".

DR. WARREN Routine expansion of dental arches, other than by fixed palatal expansion in the appropriate situation, is not normally stable.

DR. GOTTLIEB Can the final archform exceed that of the malocclusion? If so, by how much?

DR. LOGAN An archform that is expanded due to a collapse of the bicuspids and/or first molars can be expanded successfully to achieve a good archform. Lingually inclined mandibular and maxillary incisors can be expanded. Any expansion in the mandibular canine area, unless it is a bicuspid extraction case, will usually not be stable. However, uprighting of lingually placed mandibular canines can be stable.

DR. HARFIN In crossbite corrections, sometimes just the uprighting of the teeth creates an increase in arch length. If the nature of the expansion is orthopedic—in other words, achieved by rapid maxillary expansion, as Dr. Warren noted—I consider it more stable than only a dentoalveolar change to gain arch length.

DR. WARREN I would add that I try to maintain the mandibular archform the patient presents with, unless the archform has been collapsed or

the teeth are just inclined lingually. In these cases I correct the archform and/or upright the teeth.

DR. COZZANI The mandibular arch tends to maintain its form. Long-term studies have shown more archform relapse in patients whose archform was modified.^{6,7}

DR. HELMHOLDT There is no substantiated research to show that we can expand the mandibular dental arch more than 3-4mm with permanent results.

DR. GOTTLIEB In your experience, how stable are borderline extraction cases that are treated nonextraction?

DR. WARREN Borderline extraction cases can be treated nonextraction and be stable. The techniques espoused by Dr. Norm Cetlin and air-rotor recontouring can make this possible.

DR. COZZANI As I said earlier, long-term studies have shown more crowding in patients treated nonextraction. Therefore, stability could only be guaranteed with permanent retention.

DR. LOGAN I agree that with reproximation of the incisors and fixed retention, these cases can be very stable. Actually, both extraction and nonextraction cases are more stable with proper reproximation. I have been very pleased with the GAC Intensiv Ortho Strip System, which allows reproximation to be started much earlier on rotated teeth, compared with diamond discs, to minimize "round tripping".

DR. HARFIN In my experience, borderline cases treated without extractions remain stable when a skeletal change can be achieved—in cases of orthopedic expansion of the maxilla or molar distalization. If this is not possible, we produce a dentoalveolar change that requires fixed retention to remain stable. Of course, habits have to be corrected. Again, we strongly emphasize the diagnosis based on the patient's profile.

DR. HELMHOLDT Where the supporting and surrounding structures can adapt to the necessary nonextraction changes, then this method will

work. The problem is to be able to recognize such cases before treatment.

DR. GOTTLIEB How stable are one-lower-incisor extraction cases?

DR. LOGAN Very stable, particularly considering that the most rotated incisor is usually the one that's removed. In children who are congenitally missing one incisor, the remaining incisors erupt with minimal rotations and good future stability.

DR. COZZANI I do not have enough cases treated with one lower incisor extraction; however, the few I have are very stable. Moreover, long-term studies have indicated that these cases are the most stable of all.⁸

DR. HARFIN Riedel⁸ and Little⁹ showed that single-lower-incisor extraction is one of the treatment modalities with the best long-term results. Of course, it requires precise diagnosis and treatment planning. The ideal cases are adults with Class I canine and molar relationships and 5 or 6mm of crowding. Another favorable situation is a patient with a Class III tendency and mild-to-moderate open bite, as described by Faerovig and Zachrisson.¹⁰ The real question is: When and why do you decide on the extraction of a lower incisor instead of two bicuspids? This approach would be recommended in some periodontal patients with severe crowding, but we must extract the more labial incisor with less periodontal attachment.¹¹

DR. HELMHOLDT These cases are very stable if there's an upper and lower anterior tooth-size discrepancy, and if foreshortening the lower dental arch doesn't create an unacceptable overjet.

DR. WARREN I find the key to stability of a successful lower-incisor extraction case is proper uprighting into the extraction site of the roots of the adjacent teeth and, of course, a good bonded wire, at least across the extraction site.

DR. GOTTLIEB In terms of stability, do you believe the trend toward nonextraction has gone too far?



Dr. Logan

DR. HELMHOLDT Yes, especially if it's to fulfill family preferences, or for some sentimental or emotional or other subjective reason, or for the operator's self-promotion in being some kind of a hero in straightening teeth without taking any out. But anterior expansion risks a strong possibility of relapse to the original archform. The so-called "extracted look" is no more undesirable than the "protrusive look" of injudicious nonextraction. Furthermore, the "nonextraction" term is many times misleading, simply because the mechanotherapy in these cases frequently will impact the second molars or, most frequently, the third molars, thereby necessitating their removal. One still has an extraction case, just different teeth at different times, and probably a surgical removal!

DR. LOGAN I agree. Excessive expansion of the mandibular incisors and of the canines can result in uprighting of the teeth and crowding in retention. In many of these cases, if the teeth don't upright, the patients appear to the lay public as having "too many teeth".

Since I started my orthodontic residency at Northwestern in 1959, I have seen the fads in orthodontics swing from mostly nonextraction by expansion to first bicuspid extractions back to the emphasis on nonextraction treatment. In theory, first bicuspid extraction was the silver bullet to prevent relapse. Many orthodontists at that time judged finished first bicuspid extraction cases by

how little anchorage was lost, regardless of the arch-length shortage. Later, both orthodontists and the public became aware of the orthodontic “dished-in” or “not enough teeth” look, and long-range stability was shown to be comparable with that of nonextraction treatment.

Fortunately for my career, at Angle Society meetings in Southern California, I was able to review cases of many of the greats of orthodontics—Ricketts, Nance, Steiner, and Tweed, to name a few—in retention and out of retention. Of all the cases, I was most impressed with those of Hayes Nance. He treated cases that many orthodontists would have considered nonextraction, and others that could be judged as maximum anchorage first bicuspid extractions, with second bicuspid extractions. His finished cases looked like natural dentitions and had well-balanced smiles. Because of the favorable finished tooth sizes, they had excellent overbite and overjet, esthetic buccal corridors, few diastemas, and rarely any opening of extraction sites. His cases with lingual arches holding the “E” space also showed fewer later crowding problems than with the orthodontists who waited until all the permanent teeth were in.

DR. WARREN Patients come to my office for retreatment from time to time. The patients who were treated nonextraction are in the great majority and require the greatest amount of correction, usually involving the extraction of bicuspid. On the other hand, well-treated extraction cases seem to require minimal fine-tuning to be satisfactory again.

DR. COZZANI I also feel that the trend toward nonextraction has gone too far. Because nonextraction treatments are easier, orthodontists and GPs practicing orthodontics will tend to treat that way. Moreover, from the practice management point of view, nonextraction is the easiest selling solution.

DR. HARFIN My own belief is that the trend is not going too far, but that our way of thinking has changed in recent years. The factors considered in diagnosis, such as profile and periodontal con-

siderations, are different. For instance, nowadays there is a tendency to have a more protrusive profile, compared with the profiles that we saw 50 years ago. Orthodontists need to be aware of the differences in the two treatment modalities to avoid accentuating undesirable profile characteristics. Therefore, the real problem isn’t extraction or nonextraction, it is a problem of diagnosis related to facial esthetics. We have to remember that bicuspid or incisor extraction doesn’t guarantee long-term stability. A large number of studies at the University of Washington confirm this.⁵

DR. GOTTLIEB How stable is lateral expansion of the posterior segments?

DR. HARFIN A global approach, considering morphological and functional aspects of the problem, is required to achieve stability. In my experience, the efficiency and long-term stability of the expansion depends on the nature of the expansion forces used, the condition of the periodontal tissue, and the degree of maturity of the facial skeleton. In young patients, the transverse dimension of the face, particularly the maxilla, is modified most easily, with results that appear to be stable over the long term. But the expansion should be accomplished by sutural adjustment in the craniofacial complex, not just by alveolar remodeling and dental tipping. This is why we prefer rapid maxillary expansion, not only for correcting crossbites, but also to increase arch length with good long-term stability. We have seen remarkable effects that remained stable, such as closure of a mild or moderate open bite by reorientation of mandibular growth, and in young Class III patients before the use of the facemask.

DR. WARREN Lateral expansion of maxillary posterior segments accomplished with a fixed palatal expansion appliance is very stable. Maxillary expansion with a transpalatal wire or a Quad Helix can also be stable, but less so.

DR. LOGAN The older the individual, the less stable the lateral expansion of the posterior segments. Rapid palatal expansion is generally sta-

ble. Surgical expansion can be unstable unless it is retained with a lingual arch.

DR. COZZANI In crossbite cases, the maxillary arch expansion is quite stable, but I doubt that the same stability can be reached long-term in the mandibular arch.

DR. HELMHOLDT The literature seems to indicate that the intercanine width and intermolar width should be maintained as originally presented to minimize retention problems. In addition, expansion in the molar area offers little increase in arch length, and cuspid expansion will increase arch length, but not without risk.

DR. GOTTLIEB Is there a “quiet zone” between the tongue and the outer envelope of lips and cheeks?

DR. COZZANI There should be, but so far, to my knowledge, no one has been able to document the presence of this area where the teeth are kept in position by counteracting forces. If the question implies that in that “quiet zone” teeth should be stable, I think there are factors to be taken into consideration such as supercrestal fibers, pernicious habits, and probably unknown others.

DR. HARFIN There is not a “quiet zone” if an imbalance of the musculature is present due to form alterations that lead to functional alterations. For example, in cases of maxillary constriction, the imbalance between tongue and cheeks is important, and the functional correction needs to be accomplished by maxillary expansion.

DR. HELMHOLDT There is a “zone of balance” in which supporting tissues and the contiguous musculature adjust continuously to maintain a balance with environmental forces.

DR. GOTTLIEB Does the Fränkel appliance retrain the musculature to permit stable expansion?

DR. HARFIN As McNamara has said, the gold

standard for functional therapy is the Fränkel appliance. This appliance is more demanding than other current functional appliances, but produces a direct effect on the orofacial musculature and creates an environment that encourages maximal skeletal development with minimal sagittal dentoalveolar change. The separation of the cheeks permits an arch expansion with a subsequent increase in arch length.

DR. COZZANI A well-designed and -built Fränkel appliance keeps the muscular envelope away from the teeth. In fact, there are reports of increased mandibular intercuspid width obtained with the Fränkel appliance. However, I do not know what happens in the long term once the appliance is discontinued.

DR. LOGAN Since I don't use the Fränkel, I can't answer this question. But I would say that enough space is rarely created by molar expansion to gain significant arch length anteriorly.

DR. HELMHOLDT I don't use the Fränkel appliance, either, but if it can effect some musculature changes, they may be lost in time, because muscle physiology indicates that striated muscles will eventually return to their resting length. We can move teeth, but the muscles don't forget their neutral zone!

DR. GOTTLIEB Do strong-acting muscles of mastication cause collapse of the posterior segments post-treatment?

DR. HELMHOLDT Potentially yes, because in a “tug of war” between teeth, bone, and muscles, muscles usually win out.

DR. LOGAN I would say “possibly”, but I don't know of any evidence-based studies that strong-acting muscles of mastication can cause collapse of the posterior segments.

DR. COZZANI Well-developed muscles have a limited possibility to accommodate to a stretched position. Therefore, masseter, medial pterygoid, and temporal lengths should be respected. In other words, it is possible, in cases where these

muscles are well developed, that excessive extrusion of posterior teeth could be unstable after treatment.

DR. HARFIN If the cheek musculature is very strong, if the occlusion is not stable enough, and if the tongue function is not balanced, that may lead to collapse of the posterior segments. This is why it is so important to normalize not only the positions of the teeth, but the neuromuscular pattern, too.

DR. WARREN Strong-acting muscles of mastication will cause a collapse of an expanded dental arch unless the expansion is done with a fixed palatal expansion appliance, orthognathic surgery, or distraction osteogenesis. Even with these methods, certain cases, such as cleft lip and palate, still present problems in maintaining expanded arch width.

DR. GOTTLIEB Does strong orbicularis oris muscle activity cause lower anterior irregularity post-treatment?

DR. LOGAN It can.

DR. WARREN But not if the incisors are properly positioned in the dental arch.

DR. HARFIN We have seen in our patients that the orbicularis oris muscles are very important, as much if they are very strong as if they are weak. In the case of strong lip muscles, they can cause instability if the lower incisors are too protruded after treatment or if the tooth discrepancy is not well corrected or retained.

DR. COZZANI Anecdotal and oral reports claim that a strong orbicularis oris could provoke some incisor irregularity, particularly when those teeth are proclined or protruded beyond a certain limit during treatment. Unfortunately, to my knowledge, no one really knows this limit and the way to evaluate the orbicularis oris action on the teeth.

DR. HELMHOLDT If the force of the orbicularis oris is greater than the countervailing forces of the tongue, the teeth will move until all the lit-



Dr. Warren

tle “pushes and shoves” are in balance. Thus, incisor crowding is usually a by-product of naturally occurring adaptive changes.

DR. GOTTLIEB Is there a lower incisor angulation that you do not want to exceed to avoid relapse in that area?

DR. HELMHOLDT I stay rather close to an IMPA of around 90° and an interincisal angle of around 130°.

DR. COZZANI I wish I could precisely define a limit with a number or a formula. Just because I can't, however, does not mean that I am advocating excessive proclination of lower incisors to solve mandibular crowding. As a rule of thumb, in my patients, I try to maintain the position of the lower incisors if possible.

DR. WARREN The lower incisor angulation I can accept finishing with, and expect stability, will depend on the patient's initial lower incisor angulation as much as on a set cephalometric norm. For example, if a patient comes to treatment with a mandibular incisor angle of 33° and no crowding, there is no reason to expect that this would not be stable, if the angulation can be held to this or even decreased slightly. I do not feel that an orthodontist should extract with one eye on a cephalometric norm to achieve stability. On the other hand, if one pushes the mandibular

incisors forward well past given cephalometric norms in order to treat a patient nonextraction, I am sure that this will indeed result in relapse and even gingival recession and bone loss.

DR. HARFIN There isn't an amount of lower incisor angulation that fits all. We have to take into account the facial and periodontal biotype, chin shape, pretreatment amount of crowding, etc. Of course, the more protruded the incisors are, the more chance of instability. The relationship of lower incisor protrusion to instability is also influenced by the orbicularis oris muscle strength, so it varies in each case.

DR. LOGAN It depends entirely on the skeletal facial type and muscular balance. High-angle cases in general will accept more lower incisor labial angulation without relapse than brachyfacial cases.

(TO BE CONTINUED)

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