JCO ROUNDTABLE

Stability of Orthodontic Treatment
Part 2

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 How are path of closure, occlusal plane angle, mandibular plane angle, and interincisal angle related to stability?

DR. LOGAN Posterior displacement with incisal interference on closure will tend to crowd the lower incisors. High occlusal plane angles due to orthodontic eruption of mandibular molars, particularly in high-angle cases, will tend to cause relapse of Class II relationships and open bites. High incisal angles due to overexpansion tend to decrease as teeth upright and crowd after treatment.

DR. HARFIN When correcting a Class II with loss of anchorage in a vertical growth pattern into a Class I occlusal relationship, the occlusal plane angle decreases, the mandibular plane angle also decreases, and the chin rotates up and forward. In deep-bite cases, as the occlusal plane angulation is increased, the upper incisor angulation decreases, the lower incisor angulation increases, the chin rotates down and backward relative to the lower incisor occlusal plane, and the mandibular plane angle increases.

DR. HELMHOLDT I find that if one or all of these factors are outside the normally accepted ranges, they become detrimental to long-term stability.

DR. COZZANI In some studies, changed occlusal planes and mandibular angles tend to revert to their original inclination. However, these changes have not been related to occlusal instability. Also, a correct interincisal angle is thought to help maintain overbite correction.

DR. WARREN A proper interincisal angle helps prevent relapse in patients who began treatment with deep bites and lower mandibular plane angles. But stability should be achievable for patients with varying occlusal plane and mandibular plane angles.

DR. GOTTLIEB What is the relationship of the TMJ to stability?

DR. WARREN A healthy TMJ is critical to stability. This includes proper seating of the condyle in the fossa, control of damaging habits such as grinding and clenching, and control or elimination of disease processes.

DR. HELMHOLDT TMJ dysfunction can cause

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. Helmholdt 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.

an adaptive asymmetrical or faulty closure, making it difficult to get CO and CR to coincide. This interdigitation is rather important to stability.

DR. LOGAN Displacement of the condyles is relevant to maxillary, mandibular, sagittal, and transverse stability.

DR. COZZANI In an adult patient, any modification of condylar integrity (resorption or apposition) could have an occlusal effect; in a growing patient, a deficit or a surplus of growth in one or both condyles could, as well, have an occlusal effect. It is crucial to recognize the "at risk" patient.

DR. HARFIN There is a close relationship between craniomandibular disorders and the final position of the mandible. We have to investigate carefully the presence or absence of TMJ problems before starting orthodontic treatment, especially when we are treating adult patients. Some of them have lost posterior teeth, and the mandible presents a centric occlusion that is far away from centric relation. This a very important chapter in our diagnostic protocol. We have to achieve not only an ideal dental position, but muscular and TMJ normalization, to maintain our results. A stabilization retainer worn at night is sometimes necessary to keep the masticatory muscles and the TMJ relaxed.

DR. GOTTLIEB How do you evaluate the TMJ in your initial examination?

DR. HARFIN Clinically, signs and symptoms of TMJ dysfunction, including pain scale scores, range of mandibular motion, and presence or absence of TMJ sounds, are subjectively and objectively evaluated and recorded before starting treatment. We also evaluate the TMJ on x-rays, and if there is a preoperative disc displacement, we evaluate the TMJ through magnetic resonance imaging.

DR. WARREN I evaluate the TMJ by asking questions, palpating the muscles if necessary, and reviewing the radiographs.

DR. HELMHOLDT At the clinical exam, an inquiry is made into any TMJ problems. I check the amount of mandibular opening and any deviations. I then palpate the joints for signs of crepitus.

Dr. Gottlieb

DR. LOGAN My exam is similar to Dr. Helmholdt's.

DR. COZZANI I use a questionnaire during the consultation. I restate each question and modify the answers if necessary. Particular attention is given to the psychological attitude. Then, I auscultate both TMJs (any sound is recorded); I palpate both TMJs and the masticatory and neck muscles (eventual pain and tenderness are recorded); I record opening, lateral, and protrusive movement lengths, as well as the movement smoothness; and I record evident prematurities and mandibular shifts. If TMJ becomes an issue, the patient is referred to an expert.

DR. GOTTLIEB How does a tooth-size discrepancy contribute to post-treatment instability?

DR. HELMHOLDT If it is generalized, it can alter normal interdigitation, adversely affecting stability. If feasible, I treat interarch tooth-size discrepancies with reproximation procedures.

DR. COZZANI If a Bolton discrepancy is present—in other words, if the mandibular teeth are small—and all spaces are closed, prematurities and slides can develop. If the Bolton discrepancy

is limited to the incisor-cuspid area, incisor guidance and cuspid rise will not be possible.

DR. LOGAN It is also not uncommon to have a persistent maxillary midline diastema due to a Bolton tooth-size disharmony.

DR. HARFIN Tooth-size discrepancy is one of the problems we see rebound the most if it is not compensated for during treatment. That is why we think tooth-size discrepancy should be analyzed as one part of the diagnostic records. It is also important to remember that significant changes occur in the maxillary and mandibular dental arches, including a clinically significant increase in tooth-size-arch-length discrepancy, over time. These changes should be considered part of the normal maturational process and should be taken into consideration when planning treatment and retention options for adolescent and adult patients.

DR. WARREN If you have a tooth-size discrepancy, it would be an advantage to extract a mandibular incisor. This would ameliorate the problem and solve mandibular incisor crowding at the same time. If this is not possible, then after ideal alignment of the mandibular arch, there will be spaces in the maxillary anterior area, promoting instability. In order to prevent this in cases where the problem is peg-shaped maxillary lateral incisors, I bond a palatal retaining wire on the maxillary central incisors and refer the patient to restore the maxillary mesiodistal width to eliminate the spacing.

DR. GOTTLIEB How is facial pattern related to stability of results?

DR. HARFIN The vertical dimension of the face is the most difficult to keep stable. Aggressive overcorrection is advisable, and the establishment of positive overbite and overjet is essential to the long-term stability of the treatment outcome. Pretreatment vertical facial pattern, at least on its own, is not likely to be predictive of the amount of post-treatment instability.

In my experience, treatment of open bite with a vertical pattern by expanding the maxillary arch, where the mandible tends to move up and forward with a slight decrease in anterior facial height and intrusion of the posterior teeth, creates a favorable perioral environment that is more stable. Myofunctional therapy can help produce normal nasal breathing, with widened tongue space and an adequate airway. It is important to recognize the interrelationship between changes in the vertical dimension and anteroposterior changes.

DR. HELMHOLDT Normal facial pattern—good end result and good stability; aberrant facial pattern—compromised end result and, thus, compromised stability. The dilemma becomes one of inadequate treatment, hoping to satisfy a layman's esthetic wants; or of overambitious treatment, attempting to satisfy some professional esthetic standard.

DR. LOGAN Brachyfacial types tend to have increases in overbite and overjet. As the mandibular incisors upright and crowd, dolichocephalics tend to show a recurrence of open bite.

DR. COZZANI Usually treatment is discontinued before the end of growth. Therefore, if a hyperdivergent patient keeps growing, the development of an open bite and a Class II is possible, while for a hypodivergent patient the development of a deep bite can be expected.

DR. WARREN High-angle patients with open bites are less likely to be stable than low-angle patients with open bites. Conversely, low-angle patients with deep bites are more likely to get an increase in overbite during retention than high-angle patients.

DR. GOTTLIEB Loss of anchorage is thought to contribute to instability. How do you diagnose various levels of anchorage requirement?

DR. HELMHOLDT With proper records that allow for a correct diagnosis and treatment plan. The best treatment in the most skilled hands will fail if the diagnosis is wrong. Differentiating anchorage requirements is of paramount importance; I find that cases of supposed lack of recip-

rocal movement are merely failures to recognize and identify that movement.

DR. COZZANI I utilize a system that takes into consideration crowding, midlines, curve of Spee, and profile (incisor position), developed at Boston University by Gianelly. It allows me to make a treatment plan as well as to check the anchorage requirements and their changes at every appointment.

DR. HARFIN There are various reasons why we can lose anchorage during treatment, some of them related to the patient, such as missed appointments and broken appliances, and some related to failures in treatment planning. The anchorage requirements must be related with the facial biotype, esthetic requirements, amount of crowding, molar and canine relationships, treatment objectives, etc.

DR. WARREN The more crowding, the more Class II; the greater the curve of Spee, the more procumbent the incisors; and the greater the facial convexity, the greater the anchorage requirements.

DR. GOTTLIEB Do you minimize the use of Class II mechanics to avoid loss of anchorage?

DR. HARFIN No, because anchorage can be achieved by other methods, such as extraoral appliances—a headgear or Nance plate—or non-toothborne devices. We prefer a three-dimensional surgical template over mini-implants. The advantages are minimal trauma, enhanced osseointegration, and effective anchorage maintenance.

DR. COZZANI If patient compliance and the treatment plan allow, I try not to use Class II elastics—not only to avoid mandibular anchorage loss, but also to have better vertical control.

DR. WARREN I mostly use Class II mechanics when I have a mandibular extraction space to close. I use cervical and straight-pull headgears to help control anchorage.

DR. HELMHOLDT Extraoral traction offers

Dr. Cozzani

the only available means for moving teeth without reciprocal forces acting on other teeth. I use a cervical bow assembly to conserve anchorage, and when I think compliance will be favorable. However, when Class II mechanics are necessary to augment extraoral traction, I attempt to "set up" the lower arch to control or retard reciprocal movement.

DR. LOGAN In addition to headgear, I use lingual or Nance holding arches and existing molar implants. In some cases, though, you may want to lose anchorage. Most extraction cases are best treated with a loss of various degrees of anchorage. Cases that require 10mm or more arch shortage are rare, but would require no loss of anchorage.

DR. GOTTLIEB Would you consider skeletal anchorage in a Class I bimaxillary protrusion case?

DR. COZZANI Yes, if the case requires maximum anchorage and patient compliance is not absolute, or if an adult patient makes that choice.

DR. LOGAN It depends on where the anterior teeth are best placed. Most Class I bimaxillary protrusion extraction cases don't need total anchorage to achieve facial esthetics.

DR. WARREN To get the maximum reduction in a Class I bimaxillary protrusion case, I would

Dr. Harfin

use a headgear for anchorage and Class III elastics with the headgear.

DR. HELMHOLDT Skeletal anchorage with implanted miniscrews is an advancing clinical technique that I think has merit, and I anticipate giving serious consideration to implant anchorage as the technique becomes more refined and more generally accepted by potential patients.

DR. GOTTLIEB Do non-compliance appliances such as the Herbst tend to flare the lower incisors in Class II cases? If so, how can that be prevented?

DR. LOGAN Don't use a Herbst if you don't want to flare the lower incisors.

DR. HELMHOLDT I use non-compliance appliances only when my back is to the wall. Any distal force from these appliances creates an equal and opposite mesial force that might flare the incisors. This common, undesirable side effect can't be mitigated completely with heavy archwires or lingual incisor crown torque.

DR. COZZANI I don't think you can completely avoid mandibular incisor flaring when you use this type of appliance. But there are means to reduce this side effect, such as involving the majority of mandibular teeth. Hansen and colleagues' long-term studies demonstrate that the provoked flaring decreases with time.[12]

DR. HARFIN Some non-compliance appliances do flare the lower incisors. We have to prevent this by using additional sectional rectangular archwires, not by placing brackets in the anterior segment until the Class II correction is achieved, which would provoke more protrusion. In extreme cases in which we cannot protrude, we place a fixed retainer in the lower anterior segment.

DR. GOTTLIEB How do you view Andrews's Six Keys to Occlusion as requirements for post-treatment stability?

DR. COZZANI They do not assure your case stability, but at least they dictate occlusal treatment goals in a verifiable way.

DR. HARFIN The Six Keys are a good guide for evaluating static treatment results. Some of the keys, such as the placement of the upper first molar cusp into the lower first molar fossa, can be predictors of post-treatment stability. We have to complete them with a functional protocol to achieve the best stability.

DR. WARREN The Six Keys have served as a valuable guide to ideal treatment results, but stability can be achieved with results that vary from this ideal.

DR. LOGAN I agree that they are only a guide.

DR. HELMHOLDT I like Andrews's Six Keys to Occlusion. There are other schools of thought and philosophies on occlusion, but most seem to indicate that occlusion is a potent factor in stability.

DR. GOTTLIEB Is the amount of force a factor in instability of results?

DR. COZZANI Within certain limits, I don't think so.

DR. LOGAN There are no evidence-based reports on this relationship.

DR. WARREN I believe excessive force tends to cause damage to the roots and the periodontium. A case with such damage will, of course,

lack stability in the long term.

DR. HELMHOLDT Orthodontic force creates mobility through osteolysis and osteogenesis, and excessive stress beyond the adaptive or resilient capacity of the periodontium will result in periodontal loss or some periodontal destruction, and thus some potential instability, along with the possibility of root resorption.

DR. HARFIN If treatment results are obtained with great amounts of force over a short period of time, the initial malocclusion may rebound. Excessive force may lead to root resorption, which is more likely to lead to instability. We also have to correlate force with the amount of periodontal attachment. It is unthinkable to use the same amount of force in a patient with 90% attachment as in a patient with 20% attachment.

DR. GOTTLIEB Can a one-prescription-fits-all bracket system achieve stability for all?

DR. LOGAN No. Because of the uniqueness of each patient, it is rare that the finishing archwires don't require some sort of bends in each plane of space. Despite what the manufacturers say, even the passive self-ligating brackets don't have the brains to determine the best positions of the teeth.

DR. COZZANI If correct finishing is considered a prerequisite for stability, I must conclude that stability cannot be reached without individualization of treatments.

DR. HELMHOLDT Each case is unique, with its own dynamic, biologically changing system, and so each case must be treated on its own merits with specially prescribed mechanotherapy, without overlooking the fact that mechanical simplicity bears no relation to diagnostic simplicity. The prejudice of the operator is not an adequate justification for mimicking a particular technique, and neither is some combination of measurements, no matter how "scientific" they may appear.

DR. HARFIN The preadjusted orthodontic appliance has improved the efficiency and effectiveness of the orthodontist in achieving good

Dr. Helmholdt

final results for patients in general. However, it is ridiculous to think that all our patients would respond in the same way to the same type of brackets, and that in all of them we could reach excellent results. The orthodontist is limited by individual patient variations from the prescription of the preadjusted appliance, as well as by the clinician's ability to precisely place the appliance.

DR. WARREN Extraction cases, particularly in the mandibular arch, seem to work out better if I modify my strapup to allow for better root positions around the extraction sites. The other modification I make is in high-angle cases: I try to prevent mesial tipping of the first molar roots and excess uprighting of the crowns by not using any tip in the molar brackets or tubes.

DR. GOTTLIEB Do you test stability by removing the archwires before removing appliances?

DR. WARREN No, I think that the teeth need to be retained in position immediately upon removal of orthodontic appliances.

DR. COZZANI I agree. It has been demonstrated that the first 24-36 hours are crucial for relapse of rotations and crowding.

DR. LOGAN It can also make for a very unhappy patient by necessitating retreatment. Cases

that have had previous rotations of incisors will almost invariably have rotations reoccur if the archwires are removed to test stability. I bond lingual wire retainers before any archwires or appliances are removed.

DR. HARFIN It depends on the case, its initial malocclusion, its final result, the length of treatment, preexisting habits, and whether the patient has TMJ disorders.

DR. HELMHOLDT I sometimes remove the archwires if my value judgment indicates that some settling may be beneficial, especially if the mechano-force system may have overpowered the inherent growth pattern.

DR. GOTTLIEB To promote stability, do you prefer to overcorrect to a super-Class I occlusion or to "sock in" the posterior intercuspation?

DR. COZZANI To "sock in" the posterior intercuspation.

DR. LOGAN I've had Class II cases that remained slightly super-Class I.

DR. WARREN I also prefer to "sock in" the posterior intercuspation because when my patients return, it is the cases with the ideal occlusions that seem to hold up the best.

DR. HARFIN Some types of Class I have demonstrated good stability, but from my point of view, "socking in" the posterior intercuspation has more chance of stability.

DR. HELMHOLDT Yes, I believe that's preferable if it can be accomplished under the circumstances of patient compliance.

DR. GOTTLIEB Can a 90% correction of any irregularity—Class II, rotations, midlines—remain stable?

DR. HELMHOLDT Yes, if retained properly and for a recommended period of time, depending on the nature of the case.

DR. LOGAN With fixed retention, yes.

DR. HARFIN In my experience, the results remain stable enough if they reach 90% of the correction, as long as a functional balance has been obtained. Rotations and crowding are the most likely to need overcorrection. Of course, all of this is related to the retention method and time.

DR. WARREN Midlines and Class II can be stable with 90% correction, but it seems a partially corrected rotation will rarely hold up.

DR. GOTTLIEB How important is it to finish in CR?

DR. HELMHOLDT Quite important, especially to enhance periodontal health and to ensure healthy jaw joints and a stable dentition.

DR. COZZANI CR is the only reference point to develop a treatment plan, to control treatment progress, and, in finishing, to check for occlusal stability and prematurity, cuspid rise, and incisal guidance. At the end of treatment, a prematurity that provokes a lateral shift or a posterior prematurity that creates a pivot and a consequent counterclockwise mandibular rotation could produce functional problems.

DR. HARFIN Ideal occlusal contacts and localization of contacts in centric and eccentric occlusion are needed to maintain occlusal stability. In my experience, however, the number of contacts in centric occlusion increases significantly during the retention phase. Other factors, such as the role of incisal guidance in maintaining occlusal stability, canine-protected occlusion or group function, and the role of bruxism and other parafunctional habits in occlusal trauma, are also important in maintaining stability.

DR. GOTTLIEB Is a large difference between CR and CO conducive to instability?

DR. COZZANI A centric slide greater than 4mm has been associated with TMJ problems.

DR. LOGAN Most cases that have a 3mm mandibular retrusive range remain stable. Cases with a greater difference sometimes revert back to a full Class II.

DR. HARFIN The tissues and structures of the stomatognathic system adapt in different ways, but in a coordinated manner, to functional forces. This adaptive capacity differs from individual to individual and tends to balance function and stability. Our aim is to finish cases in a coincident CR and CO; if not, adaptation can lead to instability, depending on the amount of discrepancy.

DR. WARREN I work to achieve a good centric occlusion during orthodontic treatment and not to have CO exactly equal CR as gnathologists would. However, I do believe that utilizing a "Sunday bite" to correct a Class II relationship would not be stable.

DR. GOTTLIEB Should finished cases be routinely equilibrated to improve stability?

DR. HELMHOLDT Only if there are traumas or interferences in centric and/or excursive occlusion.

DR. HARFIN Finished cases should have equilibrated and distributed occlusal contacts, which seem to contribute to the establishment of occlusal stability. Finished cases should not always be equilibrated—only if the occlusal contacts are not in an equal distribution.

DR. COZZANI A moderate shift, within 2mm, is probably physiologic.[13]

DR. WARREN I do not routinely equilibrate my patients post-treatment. I do equilibrate as necessary during active orthodontic treatment.

DR. LOGAN I would only add that prominent lingual ridges of maxillary incisors should be routinely equilibrated, as they will cause tooth-size problems. Patients of Indian and Asian descent are more likely to have these ridges.

DR. GOTTLIEB Is the eruption of third molars a cause of instability?

DR. HARFIN The effect of third molars on the stability of orthodontic treatment has been studied extensively. The controversy surrounding third molars has focused on the pathologic problems they may cause and the risks and benefits of their removal. Our results suggest that the eruption of third molars after treatment of Class I brachyfacial patients is not a primary cause of instability, but we don't confirm the same situation in Class III patients. It is important to evaluate the lack of space, mesial inclinations, lower incisor crowding, etc.

DR. COZZANI It has been demonstrated that only a very small percentage of incisor crowding relapse can be ascribed to the so-called "third-molar push".

DR. HELMHOLDT I'm rather convinced that the presence of third molars in any stage of eruption has little or no influence on the stability of the anterior dentition, and all the credible research and literature corroborate that thinking. The possibility of mild-to-moderate incisor crowding is evidence that nothing about human morphology is stationary.

DR. WARREN When a patient is not retained, however, I do believe that erupting third molars can cause instability in the treated or untreated occlusion.

DR. GOTTLIEB Does the use of a positioner for final settling of the occlusion help with stability?

DR. HARFIN Preformed positioners cannot compensate for individual variations in tooth size, arch width, or archform. In my opinion, they should only be used temporarily. On the other hand, custom-made positioners can incorporate minor corrections in tooth positions and occlusal relationships. They are very useful in patients with TMJ disorders, and we often use them in adult patients, with or without loss of periodontal attachment. The great disadvantage with both types, however, is the need for patient compliance.

DR. LOGAN Patients are more cooperative with removable retainers after a positioner is worn, because they will fit better. Soft tissues are less hypertrophic, and the case is settled in more.

Dr. Logan

The downside of the use of a positioner is the relapse that can occur if it is not worn well, and the need for a skilled technician with whom you can communicate well. When my patients wear positioners, they wear them approximately nine days before retainers are placed.

DR. COZZANI In my personal opinion, it is much easier to accomplish any tooth movement with fixed appliances. If I am not able to accomplish what I have planned in that way, I might use a positioner, but I would not expect a great result.

DR. WARREN I also try to achieve as ideal tooth positions as possible using an edgewise orthodontic appliance. Any settling is done with the retainers, which can be gradually and slightly trimmed to allow for settling.

DR. GOTTLIEB Does retention promote stability?

DR. LOGAN Not completely—only fixed retention, as long as it is maintained. Retainers are like diamonds—*forever*.

DR. HELMHOLDT Empirically, it can, because of the inherent adaptation of the contiguous tissues right down to the cellular level, as long as there's not a flagrant violation of the biological limits of the stomatognathic system. I use fixed retention, if possible, for an indefinite period of time.

DR. HARFIN In general, permanent fixed retention promotes stability when we have achieved good results regarding rotations, crowding, intrusion, etc. Open-bite cases must be combined with myofunctional therapy. The retainers should be worn at least two or three years after treatment, but in some adult patients with reduced periodontal attachment, my recommendation is that they use them permanently. We have to teach patients how they can best maintain their post-treatment results. Remember that the retention plan begins during the pretreatment consultation.

DR. COZZANI Well-designed retention, fixed or removable, maintains treatment results. Once retention is discontinued, it is difficult to foresee what is going to happen. Therefore, long-term retention is often desirable. When my patients ask me, "For how long?" my answer is always, "As long as you want your teeth straight". During the initial examination, I make clear that my responsibility is to straighten the teeth, while theirs is to maintain them straight.

DR. WARREN Retention does promote stability, especially at the most critical time—in the first few months following treatment. In my practice, removable retainers are worn full-time for one month and then at night. Retainer wear is gradually decreased until they are being worn every third night as a checking appliance. I have my young adult patients wear their retainers for three years after the third molars have either erupted into place or have been extracted. Adults are retained as long as possible. I also use bonded wires, which ensure that the patient is retained.

DR. GOTTLIEB In your experience with cases more than five years out of retention, which remained stable and which did not?

DR. HARFIN Our findings indicate that crowding and incisor irregularity increase more frequently in the mandible than in the maxilla post-treatment. Mandibular incisor relapse is almost inevitable unless fixed retainers are worn for a

long period of time. Overexpansion in the lower arch has been a factor in mandibular incisor relapse, which is often seen in the first three to 12 months after treatment, and in some patients continues for decades. In addition, vertical-dimension malocclusions are very difficult to keep stable.

DR. HELMHOLDT The most stable cases five years out are those in which I've placed the teeth where the normal functional forces are in balance—in other words, the adjacent muscles and the soft and hard tissues surrounding the teeth have readjusted to the orthodontic correction. Any other end result has a tendency to be unstable.

DR. LOGAN Cases started in the mixed dentition are the most stable. Adolescent treatment is less stable, and adult treatment is the least stable.

DR. WARREN The cases that remained stable in my practice were the cases with the best treatment results and the patients who wore their retainers. The cases that tended not to be stable were tongue-thrust-related open-bite cases and patients who failed to cooperate during treatment or retention.

DR. GOTTLIEB Does permanent retention work?

DR. LOGAN Yes, because the teeth are unable to change positions. Bonded retainers are the most effective; Hawley retainers are the least effective.

DR. COZZANI Well-designed retention—fixed or removable—maintains treatment results.

DR. HELMHOLDT There is no permanent retention, just as there is no permanent anything! But fixed retention seems to work just fine because it helps resist all of the different little pushes on the teeth that go on constantly, and it lets the buccal segments settle unimpeded.

DR. WARREN I recommend permanent retention for my adult patients. I feel that adults are more prone to relapse, not due to any failure of the orthodontist, but because the teeth have been out of their correct positions for a longer period of time.

DR. HARFIN Permanent retention is one of our best tools in maintaining stability. It also fits the patient's needs and desires. I prefer to use fixed appliances, at least in the lower jaw, where relapse is more common, especially in patients with reduced periodontal attachment.

DR. GOTTLIEB Does permanent retention permit the violation of any expansion limits?

DR. HELMHOLDT Indefinite retention of excessive arch expansion is usually unwarranted, because it potentially subjects the periodontal structures to excessive stress.

DR. COZZANI We do have to consider the periodontal limits, as well as other functional limits and the eventual possible side effects of this regimen.

DR. WARREN While permanent retention can hold the teeth in a hyperexpanded position, the periodontal tissues will suffer. The consequence is buccal and gingival recession and bone loss.

DR. HARFIN It depends on the relationship of the teeth to the functional tissues. Expansion is more often seen in the posterior segments, and fixed retainers are usually worn in the anterior segments. So we do associate expansion with muscle-tooth relationships more than with retainer-tooth relationships.

DR. LOGAN I'd like to add that once the permanent retention is removed, some relapse will usually occur. It is not unusual to see the mandibular teeth remain stable for many years in a patient who stopped wearing retainers after several years, and then develop crowding within months.

DR. GOTTLIEB Can you visualize retention care as a continuing service, like eye care or dental care?

DR. COZZANI Absolutely, yes!

Dr. Warren

DR. WARREN In my practice, retention is an ongoing thing for the patients who continue to return. We replace and add bonding to retentive wires. We fabricate new retainers when retainers are worn, lost, or damaged. If teeth shift, I have numerous ways to bring them back to their original positions.

DR. HARFIN Retention care should be a continuing service for the patient. We recall our patients for at least 10 years for regular retention checks, with a gradual increase in the time between appointments. Our patients appreciate this recall so much that I can visualize it as a continuing service.

DR. HELMHOLDT To some degree, it's a lifelong process. I monitor cases in retention for approximately 15 months, then I dismiss, put the patient or parent in charge, and leave the door open in case they question future changes. If necessary, I retreat without fee if any unacceptable relapse is my fault; or I retreat with a fair fee if documented evidence indicates a lack of any aspect of compliance, unexpected growth dysplasias, or aberrancies or destructive habits.

DR. LOGAN After the first year of retention, I schedule appointments at six-month intervals. Rarely do I see any major retention problems in the patients who keep this schedule. I retreat a lot of patients who were told by their previous orthodontist, "We won't have to see you any more after a year of retention; just test the retainers periodically to make sure they fit." A recipe for relapse disaster.

DR. GOTTLIEB Is dental instability a natural, ongoing condition, or is it unnatural but prevalent because of some of the imbalances that we have been discussing?

DR. WARREN Nothing in the human body is stable. There are changes, many of them age-related, going on all the time. It is unrealistic for the orthodontist or patient to expect the mouth to act as if it were cast in stone while the rest of the body changes around it.

DR. HELMHOLDT Growth and development and aging, by definition, mean change. Whether the changes are insidious or innocuous, they are a natural, ongoing condition of the dentition throughout life. But misdiagnosis and mistreatment can create imbalances and, thus, unacceptable instability.

DR. HARFIN The original anomaly, type of treatment, and end-of-treatment alignment are major factors influencing dentoalveolar and skeletal post-treatment changes. My conclusion is that therapy-induced post-treatment changes can be reduced by setting a treatment goal that is within anatomic limits and functionally balanced.

DR. COZZANI My personal opinion is that dental instability is part of the aging process. Teeth are not fixed in the bone like nails in the wall, but have a natural, continuous movement that is partially due to a tendency for posterior teeth to mesialize and partially a response to environmental stimuli. I agree with Lysle Johnston that we are "playing a game against Nature".

DR. GOTTLIEB If relapse occurs, does retreatment achieve better stability?

DR. HELMHOLDT Yes, because the case might have collapsed because of factors not recognized in the original diagnosis, which could be

addressed in retreatment.

DR. WARREN In other words, retreatment can achieve stability if the reasons for the relapse are corrected. These can be as simple as the patient wearing retainers immediately after active orthodontic treatment, or as involved as performing extractions where none were done before.

DR. LOGAN Retreatment can be more successful if the teeth are reproximated, rotations are slightly over-rotated, and mandibular spurs are used in open-bite cases.

DR. HARFIN I often see that relapse occurs because of a functional imbalance related to habits, so the retreatment has to be focused from another point of view.

DR. COZZANI Long-term studies demonstrate that there is more tendency to relapse during the second and third decades of life.[14,15] Therefore, if you retreat patients in their 20s, it is possible that the tendency to relapse would be less.

DR. GOTTLIEB Any parting comments?

DR. HARFIN I strongly believe that some overcorrection, use of fixed retainers, avoidance of overexpansion, and a good functional balance are the keys to stability.

DR. HELMHOLDT I use a vast armamentarium for directing teeth into healthful, esthetic, and functionally stable positions—mostly with fixed edgewise appliances. Stability of orthodontic treatment should continue to improve as we achieve more definitive and accurate diagnoses and treatment plans and more sophisticated execution of mechanotherapy. But compassion for the patient, with attention to occlusion, stability, function, and esthetics, within the biological limits of the stomatognathic system, is still the mainstay of excellent orthodontic treatment.

DR. WARREN We all try to achieve stability in our practices, but in reality it can only be achieved for a percentage of our patients, and only with long-term retention. The technique that I believe is most effective in attaining stability for my patients is to obtain excellent treatment results. The better the occlusion that I achieve for my patient, the greater the stability.

DR. LOGAN If Einstein were an orthodontist today, he would say, "Orthodontic intellectuals would spend their time solving retention problems. Orthodontic geniuses would spend their time preventing retention problems."

REFERENCES

12. Hansen, K.; Koutsonas, T.G.; and Pancherz, H.: Long-term effects of Herbst treatment on the mandibular incisor segment: A cephalometric and biometric investigation, Am. J. Orthod. 112:92-103, 1997.
13. Pullinger, A.G.; Seligman, D.A.; and Gornbein, J.A.: A multiple logistic regression analysis of the risk and relative odds of temporomandibular disorders as a function of common occlusal features, J. Dent. Res. 72:968-979, 1993.
14. Little, R.M.; Riedel, R.A.; and Artun, J.: An evaluation of changes in mandibular anterior alignment from 10 to 20 years postretention, Am. J. Orthod. 93:423-428, 1988.
15. Sinclair, P.M. and Little, R.M.: Maturation of untreated normal occlusions, Am. J. Orthod. 83:114-123, 1983.