Proper quality orthodontics vs the new mechanical “systems”

The nearly cult-like obsession with several new mechanical “systems” presented to our specialty nowadays (inevitably with company salesmen standing just behind) appears to have turned the world of orthodontic education upside down. Relevant and long-respected aspects of diagnosis and treatment planning, and execution of treatment, appear to have become relegated to a less important status subservient to mechanics and archwire selection. The apostles of these appliance systems suggest that new therapeutic nonextraction alternatives are now viable because of the proposed bracket designs used together with ultralight forces from nickel-titanium wires. These appliances are claimed to elicit biologic engineering leading to bone growth and “alveolar development.”

Should we who like to deliver a tailor-made treatment plan aligned to the unique needs of each patient, and do not believe that the one-size-fits-all therapeutic approach makes sense, be regarded as relics of a bygone era or is it your opinion that the established biologic truths are still valid?

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It is a fact that several influential lecturers on the international circuit demonstrate a purely mechanistic approach to orthodontic treatment planning. Even in cases with marked crowding, already proclined mandibular incisors, and/or the 6 mandibular anterior teeth well above the functional occlusal plane, these “experts” bond attachments to all teeth and take a nonextraction approach. Superelastic round or rectangular archwires without bends are used to level and align the arches. This will by necessity lead to lateral expansion of the mandibular canines and premolars and to increased mandibular incisor proclination, as evidenced by the cephalometric headfilms and tracings presented by these leaders.1 After debonding, the tooth movements are recommended to be permanently retained with maxillary and mandibular fixed retainers bonded from first premolar to first premolar.

Unfortunately, there exists no long-term evidence that such treatments produce assured and stable outcomes several years out of retention. While the introduction of superelastic archwires and preprogrammed straightwire appliances generally are claimed by clinicians and orthodontic companies to represent progress in orthodontics, the opposite may well be true, since the quality of the orthodontic services rendered may be reduced.1–3 The pursuit of the new mechanical systems without reservation by many young orthodontists is both surprising and unfortunate.
Due to efforts by leading experts in our specialty over many years, there exists significant long-term follow-up clinical research and experience-based information on what represents proper orthodontic treatment that benefit our young and adult patients. In the following response, I will discuss the need for:

- Evidence-based treatment planning
- Archwire bending
- Intrusion of the mandibular rather than the maxillary incisors
- Transpalatal arches as supplements to labial archwires
- Differentiated long-term, rather than permanent, retention
- Tooth recontouring toward ideal morphology

**Evidence-based treatment planning**

There is a reason why teeth are positioned exactly where they are in the oral cavity. Even in a malocclusion, there is an equilibrium between forces from the inside and from the outside of the dentition.4–6

Edward Angle believed that the environment could be modified by orthodontic treatment, that orthodontic treatment regenerated new bone, and that it would be possible to produce stable ideal occlusions without tooth extractions. However, we know now that it is not the bone, but the functional and resting soft tissue forces that determine final tooth positions of the dentition, and that premolar extractions are required in some cases.6–12 There is ample evidence in the literature that expansion of a normal mandibular arch, particularly in the canine region, is unstable, and little or no evidence to the contrary.6,13–15 The reason that transverse expansion across the canines is almost never maintained is probably due to lip pressures at the corners of the mouth.6

The mandibular incisor position in space is also controlled by a balance of muscle forces, and these teeth may lie within a narrow zone of stability.4,5 Moving mandibular incisors forward more than 2 mm is problematic for stability, probably because lip pressure seems to increase sharply at that point.6 Until explicit evidence from controlled clinical studies demonstrates that more pronounced mandibular incisor proclination is compatible with long-term stability in orthodontic patients after removal of the retention appliances, such incisor movements must be regarded as experimentation. It should not be the object of a conscientious orthodontist to undertake clinical experiments with his/her patients.

**Need for archwire bending**

Individualized archwire bends should be used to: (1) secure early and full correction of all rotations in the original malocclusion; (2) effectively torque all maxillary and mandibular teeth into the most desirable axial inclinations16–18; and (3) make sure all teeth are positioned in a correct vertical position relative to one another (Figs 1, 3 to 5). If an orthodontist claims that he or she can treat malocclusions without archwire bending, the cases are incompletely finished.1,2

A common problem with self-ligating brackets is undercorrection of rotations.2 This is due to the slack of the wire in the bracket. Slight undercorrections of previously rotated teeth are not so easy to detect clinically as one may think. This is important because a broken contact will be the starting point for crowding relapse later on.2,19 The fine details must be checked toward the end of treatment by careful comparison with the pretreatment plaster casts. In the maxilla, a mouth mirror is necessary to check the incisor region.2 If these steps are not taken, an undercorrected case may look good, or even excellent, on clinical examination in the orthodontist’s chair.
Intrusion of the mandibular incisors

In analogy with recent concepts of treatment planning in general and esthetic dentistry, the most significant treatment planning decision is to determine where the maxillary central incisors should be positioned in space with the lips at rest. This correlates with the anterior tooth display when the patient is speaking normally. Normative values for maxillary incisor display with relaxed lips (and thus during speech) are now available for all age groups. In most deep-bite cases, the mechanical intrusion should be of the mandibular, and not the maxillary, teeth (see Fig 1). It is emphasized that it is not possible to effectively intrude mandibular incisors with continuous archwire, such as in the straightwire concept.

Lindauer et al recently published a clinical and cephalometric analysis of the effects of a maxillary intrusion arch. Although the intrusion arch was successful in correcting the deep overbite over a relatively short treatment period, the maxillary incisors were significantly intruded, and there was a corresponding decrease in the lip-to-maxillary incisor measurement (from a mean of 5.4 mm (SD 2.0) to 3.0 mm (SD 1.4) as measured in relaxed lip posture). The significant decrease of about 2 mm of maxillary incisor display when a maxillary intrusion arch is used should be an alarming finding when patients with deep overbite and little incisor show are treated orthodontically.

Effective mandibular incisor intrusion can be achieved with mandibular utility arches, segmented intrusion arches, and overlay base-arches (see Fig 1). The rate of intrusion can be controlled by recording the position of the maxillary central incisor incisal edges relative to fixed points on the mandibular appliances (Figs 1e to 1f). Continuous leveling archwires produce less true mandibular incisor intrusion, more premolar extrusion, and more incisor proclination. Such proclination of mandibular incisors may be correlated with long-term overbite relapse.
Transpalatal arches as supplements to labial archwires

In the majority of Class II cases, a proper derotation of the maxillary first molars should be part of a correct and sound treatment plan. A complete and controlled derotation of the maxillary molars in all Class I and II cases is difficult, if not impossible, with labial archwires only, due to the insufficient power of the terminal ends. The superiority of a transpalatal arch (TPA) in proper molar control is obvious (see Figs 1d and 3d). The reason is the solidity of the heavy (0.036 inch) TPA, which dominates the labial arch force systems (see Fig 1d). Even over-derotation of the molars can be obtained clinically by adding rotation adjustment bends in the TPA.

Increasing the length of the wire, as compared to the traditional Goshgarian design, will increase springiness and range, and lower the load-deflection rate and make the forces more constant and precise. The TPA design (see Figs 1d and 3d) used in our office produces lower and more constant moments of derotation. The 2 small, distal-directed loops give the arch obvious flexibility, which makes the engagement into the attachments easier with less activation loss. It takes less time to derotate molars with this design than with traditional Goshgarian arches.

The Class II correction in young patients becomes more difficult when only labial archwires are used, compared to the use of a high-pull headgear together with the TPA. The TPA is used to add buccal root torque to the first molars, to derotate the molars, and to expand the intermolar distance as required. Both the high-pull headgear and the custom-made TPA exert intrusive effects on the molars and the maxillary complex. This vertical control is an important ingredient in the treatment of sagittal discrepancies. The explanation is that the mechanical inhibition of vertical maxillary growth leads to a greater anterior component of the available mandibular growth.

In summary, the use of a custom-made TPA may be a useful supplement to labial archwires to:

- Derotate maxillary first molars in Class I and II malocclusions
- Reinforce anchorage
- Control arch form
- Control torque of maxillary molars
- Achieve maximum effect of mandibular growth by restricting the eruption of the maxillary molars and the midface
- Use the palatal intrusion technique for torque of maxillary second molars

Differentiated long-term rather than permanent retention

Life-long retention with bonded retainers over 6 or 8 teeth in both dental arches is neither necessary nor without risks. As discussed elsewhere, there are advantages with a differentiated approach to orthodontic retention, in which 3-3 retainers bonded to the mandibular canines only, 4-unit retainers, short labial retainers, and different forms of wire extensions into the premolar fissures are used. Retention periods of up to 10 years are now recommended by most clinicians. The most obvious risk in using permanent retainers when each tooth in a segment is bonded is that the patient may not notice if 1 of the bonds comes loose after some time in retention. This creates an almost-experimental caries model.

For young and adolescent patients, in particular, the solid mandibular 3-3 retainer is more hygienic and much safer to use than retainers bonded to all 6 anterior teeth. Every patient will notice immediately when a mandibular retainer comes loose if it is bonded only to the canines. As the simplest and safest of the bonded retainers, the 3-3 retainer also is useful with many adult patients with little pretreatment crowding or spacing of the teeth.

The use of permanent retention should be restricted to those orthodontic patients who really need it. This category may include adults with advanced periodontal tissue breakdown, in whom the bonded retainers serve the dual purpose of preventing unwanted tooth movements and acting as a periodontal splint. Patients with marked median diastemas pretreatment and adults with pronounced anterior crowding may need permanent stabilization of the treatment results.

Tooth recontouring

The goal of contemporary orthodontic treatment should be a beautiful alignment of beautiful teeth surrounded by intact gingival papillae, beautifully displayed in the face during speech and on smiling, and a treatment result that is stable and remains esthetically satisfactory (around teeth and implants) in the long term.
Fig 2  Adult female patient, 32 years of age, with moderate bimaxillary crowding (a to g). Note intact gingival papillae between overlapping central incisors (a,d,f). The anterior tooth display with lips at rest is sufficient (b), but her smile is constricted due to the excessive lingual crown inclination of the maxillary canines and premolars (c). Maxillary arch form is tapered, with triangular maxillary and mandibular incisors (f,g) and oval premolars (d,e). Mandibular arch form is normal, with intercanine width of 25 mm. The case was treated nonextraction with bimaxillary stripping from premolar to premolar instead of leveling and alignment through proclination and lateral expansion (see Figs 3 to 5).

Fig 3  Maxillary arch from start to finish of patient in Fig 2, showing the recontouring of her premolars and anterior teeth by mesiodistal enamel reduction (a to d). Arch form and first molars were controlled with custom TPA (d,e). The slightly rounded maxillary arch form was retained with a 4-unit gold-coated retainer (f) and removable plate.
Since most teeth in adult patients show different signs of aging, recontouring of deviating crown morphology by grinding, buildups, or veneers is almost always necessary. The grinding may include (1) recontouring teeth with abnormal morphology to more “ideal” shape; (2) relocating the contact point in an apical direction; (3) lengthening the connector area (the zone in which 2 adjacent teeth appear to touch) according to the 50-40-30 rule; (4) making the connector area parallel to the facial midline; and (5) eliminating the “black triangles” between neighboring teeth. The esthetic appearance in adults with malocclusion can be substantially improved by the combination of orthodontic treatment and tooth recontouring (Figs 2 to 5).
The proper mesiodistal enamel reduction ("stripping") of maxillary and mandibular anterior and posterior teeth may actually produce a win-win-win situation for most adult and many adolescent patients with moderate crowding of the teeth. This implies that (1) all tooth crowns receive improved morphology; (2) open gingival embrasures between previously overlapping teeth are eliminated and there will be no dark triangles after the orthodontic correction; and (3) space is provided for leveling and alignment without the need for incisor proclination or lateral expansion of the dental arches (see Figs 2 to 5). Since the original biologic framework is not changed, there is an increased chance for improved long-term stability of the treated cases.

Conclusion

The present science-based arguments have challenged several of the new and popular trends in orthodontics. It has been emphasized that the proper quality of orthodontic care depends on careful treatment planning and the use of variable and customized mechanics. The prevailing myth that preprogrammed appliance-driven orthodontics with continuous labial archwires and no bending represents progress has been rejected.

References