Functional Finishing

The concept, the tools, the techniques

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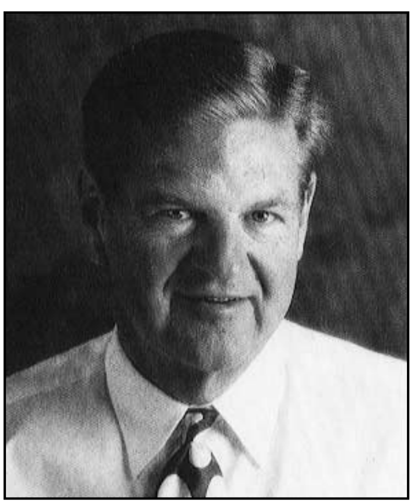

There is an old adage in orthodontics that just about says it all when it comes to finishing cases. It states simply, "If it were as easy to finish a case as it is to start one, orthodontics would not be a specialty." This tongue-in-cheek aphorism implies the expertise necessary to make our finishing systems match up to our goals in orthodontics – function, esthetics and stability. Idealizing a case tests all the skills of the orthodontist; diagnostic acumen, spatial acuity, feedback mechanisms, technical skills, perception of rebound and patient persuasion are required to put the finishing touches on a tough case. Every misplaced bracket position is magnified, the price paid for every diagnostic glitch, and adjustments made for every interfering cusp.

We are proposing a new model for idealization that is called *functional finishing*. Just as the name implies, this approach relies heavily on functional adaptation in the finishing stages rather than dominance mechanics. It is my contention that most cases finish a little easier when the patient's individual muscular pattern is harnessed, augmented and utilized to seat and detail the occlusion. The purpose of this article is not to concentrate so much on *how an ideal bite occludes* but to focus more on some of the *techniques one can use to get it there*. I must assume that you know where "there" is. It would be arrogant to imply that I could give you all the answers to very complex problems in this article, but I certainly can give you some food for thought and point out some technical resources. Think, if you would, about the various factors impeding us when idealizing an occlusion – the very things that prevent us from being where we would like to be. A minimal overview of these would include:

Bracket Placement – There is a trend in orthodontics based upon the theory that if you place the perfect bracket in the perfect position on every tooth, finishing is a fait accompli. This is a contradiction in itself. Brackets do come off during treatment and are not always replaced perfectly, bracket bases do not always adapt perfectly to the anatomical contour of the crown, cement lines do occur, cuspal interferences do limit theoretically ideal bracket placement and cost factors do come into play. Add to this the fact that the best time to start most adolescent cases is when the permanent teeth are still in the eruptive process, and the goal of the perfect bracket and the perfect placement becomes an abstract dream, not a practical reality. In short, no matter how much we put into our appliance, even with indirect bonding, adjustments, however slight, will always be needed. *Of course, I agree that the closer we can come to achieving the ideal bracket and placement, the farther along the path to perfection we will be.* I am not trying to impugn this thinking, simply to state that other factors come into play. It is the basis of my belief in helping develop the Bios™ System. Brackets and placement *do matter*, but because perfect bracket placement is not always possible, adjustments and adaptation are necessary. Bracket quality and precise placement plainly help reduce the number of adjustments.

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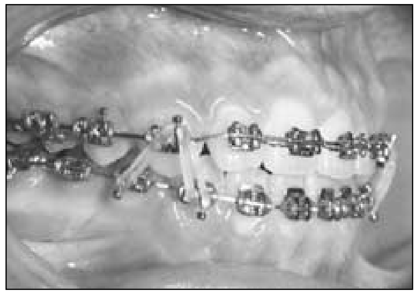
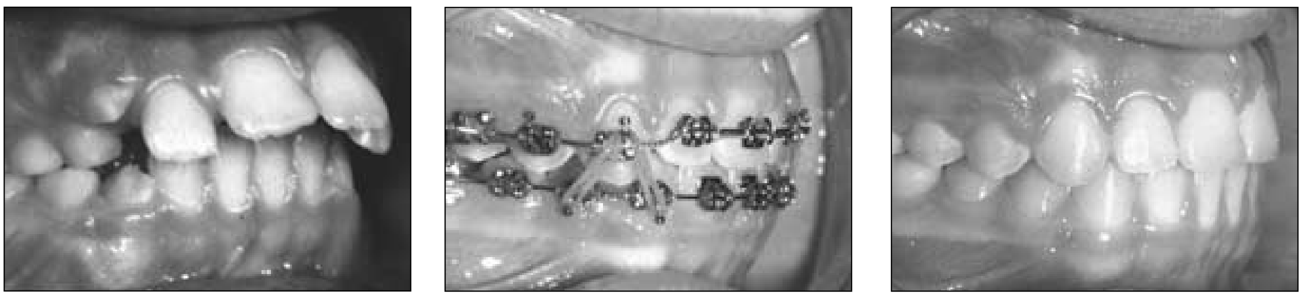
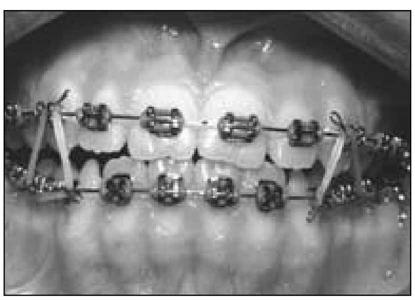
1. To achieve an ideal or functional occlusion, each case must go through a phase known as the *ideal orthodontic occlusion.* When starting with a Class II malocclusion, the upper buccal segments should slightly override the lower buccal segments. The bite should be opened adequately so that incisal interference doesn't limit this movement. This implies a step-up in the ideal arch from the cuspids to the incisors.



2. When functionally finishing the overcorrected position of the teeth, a final seating into the ideal occlusion should occur. The upper incisors and lower incisors are engaged to occlude with the correct overbite and overjet relationship, and the buccal segments are seated downward to "lock in" the bite as rebound occurs.



3. In severe malocclusions (left), it is important to counteract the tendency for rebound in the supporting soft tissues and the TMJ when the teeth or bones are altered significantly (middle). This override in the buccal segments assists in mitigating this rebound (right).



4. The two divergent growth and functional patterns, brachyfacial and dolicofacial, require different finishing methodology. In dolicofacial patterns, the focus is on adding an adjunctive posterior vertical elastic that acts to keep the teeth in contact at all times. This enlists the inclined planes of the teeth as a positive force in the finishing process.

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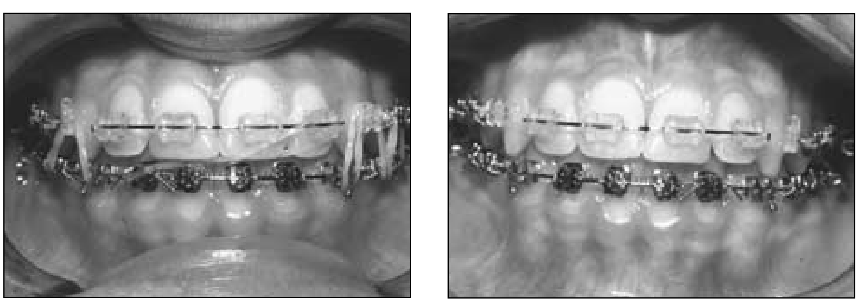

5. Midline shifts (left) and vertical seating of the buccal segments are often resolved by sectioning the upper arch and using various seating elastics. In this case, a triangular elastic on the right, an anterior cross elastic and zigzag elastics on the left were used. This corrects the midline rapidly (right) and helps avoid some of the dissonance that can occur when using two continuous ideal arches.

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Adjustments take time; time costs money.

Need for Overcorrection – If we think we are going only from a malocclusion to an ideal occlusion, we are leaving out a very important factor: the transition between the two. I like to refer to this transition phase as the *ideal orthodontic occlusion* – the individual tooth positions the orthodontist must achieve if the occlusion is to be overcorrected, then settled. This ideal orthodontic occlusion is not the textbook perfection of Angle; it's what happens before we get there. In short, the farther we need to go in orthodontics, the greater the need to overcorrect in anticipation of rebound. While a Class I malocclusion with muscular balance does not need much overcorrection, the severe Class II, division 1 with gross muscular imbalance needs a great deal of overcorrection. Assuming we start out with a Class II deep bite, the overcorrected ideal orthodontic occlusion will show the incisors edge to edge, a step-up between the upper cuspids and incisors, and the upper buccal segments slightly overriding the lowers in a super Class I relationship. It is at this point that the functional finishing process starts.

Functional Considerations – We are all aware that we can finish the vertical growth patterns almost ideally, then watch them fall off the mark in a few short weeks. Conversely, when we can just get close in the strong muscular patterns, the occlusion seems to improve day-by-day. The stronger muscular patterns allow more leeway in the finishing process. Most often, the answer to treating vertical problems lies in conservative mechanics and adding posterior vertical elastics early in treatment as an adjunct to musculature. When strong musculature is absent, the inclined planes of the teeth do not work to help seat the occlusion.

Filling the Slot – Precise movement of teeth in a preadjusted appliance means filling the slots in order for torque, tip and angulation to be expressed. This implies rigidity in the archwires as bracket tolerances are minimized to dominate tooth positions. This leaves very little leeway for functional adaptation and places a great onus on bracket position and appliance configuration. It makes more sense to have the preadjusted appliance overtorqued slightly, to fill the slot when it makes sense (e.g., Class II, division 2, extraction cases; adult cases) and to downsize the wire (increasing bracket tolerances) when not needed. The peripheral advantage of not filling the slot in all cases generally means lighter wires, more functional adaptation and more "play" within the system. *Filling the bracket slot does not necessarily mean more control in seating the occlusion, just more control in each separate arch.*

Tooth Size and Shape Discrepancies – The smallest tooth size discrepancies can greatly effect our ability to seat an occlusion. Small upper lateral incisors come to mind because they are so obvious, but small tips, rotations, angulations and malposed contact points can subtly change the entire footprint of the arch. This is why it does not make too much sense to resolve small Bolton discrepancies at the outset of treatment. It's much easier to analyze and correct these in the finishing process once these orthodontically induced disharmonies have been expressed at the later stages of treatment.

Unilateral and Midline Problems – Quite often the most difficult problems to resolve in the final detailing of the occlusion come from discrepancies of uncertain origin. Seeking additional rigidity in the system can further aggravate the problems, because a "locking" of the occlusion can occur, preventing simple correction of the problem.

The Concept

Orthodontists have been taught, on the whole, that control is the answer to idealizing an occlusion. This implies precise torque control, perfect arch coordination and continuous arch mechanics. It is a holdover from earlier times in orthodontics when state of the art was banding, control meant completely filling every slot and torque meant you torqued the wire.
I remember finishing cases in this mode and recall the importance of wire-bending skills. I am not suggesting that this skill is unimportant, merely that it is a bit incongruous in this day due to changes in technology. *I find that accentuating the settling process as an aid in functional adaptation is just as important.* It is ideally what the positioner is meant to do.
Whether using a positioner or not, most would agree that it is important to obtain the best result possible with your appliances before relying on the positioner.
That is what this article is about. The approach involves, to a certain extent, *giving up control* of the case in the final stages of treatment. Stated more accurately, it means giving control back to the patient's own functional (muscular) pattern and not trying to overpower the occlusion at this critical juncture in treatment. We want to keep what we've accomplished orthodontically while allowing a more natural settling process to occur. Functional finishing is based on several principles:

Begin with Torque Control, Finish Without it – The concept of torque control throughout treatment proposes that in most cases it is beneficial to have a torque control wire (square, rectangular) engaged in the bracket slots at the very outset of treatment. Highly elastic edgewise wires have had an immense impact on our ability to fill the slot in even the most crowded of cases. I am constantly amazed at the deflection that a cooled rectangular Copper Ni-Ti™ can achieve as the initial archwire. Round wires do have a distinct advantage in finishing, however. They can serve to allow the teeth to settle vertically (losing torque control) while maintaining arch form and first order adjustments. This is contrary to the way many of us think. Traditional orthodontic doctrine dictates beginning with round wires and finishing with edgewise wires.

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6. In this case, the upper buccal segments are being seated vertically using a stabilizing lower ideal arch (.016 x .022 TMA) and a light, bendable round upper wire (Australian .014). This allows for first order bends in the upper arch and at the same time lets the buccal segments roll inward slightly, reducing lingual cusp interferences. Note the patient is wearing short triangular elastics (doubled elastic) to aid in this process.

7. When torque control is still needed in the upper arch, a continuous yet flexible archwire (.016 x .022 Turbo Ni-Ti™, .016 x .022 Force 9®) is used. The short triangular elastics force the upper arch to flex in the seating process. These highly flexible archwires are not used when detailing bends are required, as they are not bendable.

8. In this Class II malocclusion (left), the upper buccal segments are overcorrected using Class II vertical elastics. The occlusion is then settled vertically by using a flexion arch on the upper and a stabilizing arch on the lower with short triangle elastics (middle). The lower rigid ideal arch maintains lower arch integrity while the vertical elastics allow the upper buccal segments to engage in the final occlusion (right).

9. Small first-order bends (detailing bends) are made in a .016 x .022 Titanium Niobium/FA archwire using a narrow optical plier. This wire affords the timesaving advantage of intraoral arch bending without deformation of arch form. This wire is excellent for perfecting inter-tooth relationships once arch form has been successfully established.

10. Precise 1mm bends can be made in the Titanium Niobium/FA archwire using Ormco's Intraoral Arch Bending Plier/Universal (803-0324). The plier is closed completely so that symmetry in arch form is maintained.

11. Detailing lower arch using a .016 x .022 Titanium Niobium/FA archwire. All the bends were introduced intraorally.

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Functional finishing would propose just the opposite in many cases. *That is, begin with edgewise, finish with round.* A good example of this phenomenon would be downward rolling of the upper buccal segments following expansion of the upper arch. This can be accomplished much more easily with a round wire (giving up torque control) than an edgewise arch (depending upon torque control).

Working a Flexible Arch Against a Rigid Arch – It is very beneficial to maintain strict torque control in one arch (usually the lower) and free the opposite arch (usually the upper) somewhat to seat against it. This concept implies an ideal or torque-control type of wire in the stabilized arch and a flexion or yielding wire in the opposing (or moving) arch. The lower arch is typically the stabilizing arch because it is the anchorage unit and lower incisor inclination is so critical in most cases.

Simplifying First and Second Order Bends – The final detailing of an arch is defined by many subtle bends in the archwire. Using new wire technology, this can be accomplished with minute intraoral bends that do not require constant removal of the wire to make them. In the past, intraoral bending of the archwire, although utilized, had the negative side effect of arch form change. Final detailing requires a wire that is very malleable.

Retaining in a Way that Allows the Adaptive Process to Continue –
The retention process should be one that allows for further settling of the occlusion. Again, the focus is away from rigidity and toward a functional process that allows the patient's musculature to become progressively more dominant in forming the final occlusion.

The Tools

Titanium Niobium/FA – A breakthrough in wire technology has led to the development of Titanium Niobium/FA™ archwire. It is a sister wire to TMA®, yet possesses a malleability that lends itself to easy placement of first and second order bends. The wire, even in its larger sizes, allows occlusal function to express itself while maintaining torque control and arch-form integrity. We see distinct advantages to this archwire in the finishing process.

1. Although Titanium Niobium/FA is not intended to be an anchorage arch for Class II elastics, it is very effective in yielding to the occlusion when vertical elastics are used.
2. Torque control from tooth to tooth is maintained while detailing is accomplished.
3. Small first- and second-order bends can be made without changing arch form or removing the archwire for adjustment.

Intraoral Adjustments – A thin optical plier or intraoral arch-bending plier is used to make small adjustments in the archwire. The teeth affected are untied from the arch and the wire-bending plier placed vertical to the horizontal plane of the wire (to prevent introducing unwanted torque in the wire). When a precise bend is made in the wire, the plier should be closed all the way to minimize any arch form change. In this

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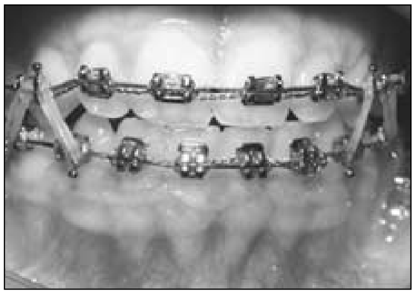
12. Occlusal view of beginning lower arch (left) and after detailing with intraorally placed bends in a .016 x .022 Titanium Niobium/FA archwire (right). This archwire maintains lower arch integrity when using vertical seating elastics. It should not be used, however, with horizontally biased elastics due to its pliant characteristics.

13. Class II vertical elastics are used in functional finishing to keep the posterior segments in contact at rest position. They serve as supplementary muscles. The placement of the hemi-hooks on the brackets dictates the overall working angulation of the elastics. It is ideal to have both the long and short portions of the elastic running in the Class II direction. Class II vertical elastics are not started until the buccal segment teeth are on the downhill incline in the Class I direction.



14. Short triangle elastics are laced from the distal of the lower 1st bicuspids, over the mesial of the cuspids and down to the mesial of the lower cuspids. These elastics are especially beneficial in seating a flexion upper arch against a rigid lower arch. It also helps seat the entire upper arch without using anterior box elastics, which can give rise to root resorption.

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way, it is possible to make adjustments in the arch that are appropriate in size for the movement needed. Titanium Niobium/FA most often serves as the torque control, stabilizing wire in the lower arch, where small first-order bends are commonly needed in the incisor region.

Flexion Wires – Flexion wires are light round or rectangular archwires that yield both to the forces of occlusion and the overriding pressure of vertical seating elastics. If passive torque control is still needed in the upper arch, common flexion wires of choice would be Force 9® or Turbo Ni-Ti™. When arch form only needs to be maintained (i.e., no arch bending or torque control required), the wire of choice would be a .016 round Orthos™ Ni-Ti. If torque control is not required and some arch bending is needed, an .014 or .016 Australian wire can be used. The main characteristic required of this wire is that it be flexible enough to allow a seating of the occlusion without loss in arch form or tooth alignment. It allows a seating of the cusps when used in conjunction with vertical seating elastics and compensates for the overcorrection during the settling process.

The Techniques

Overcorrection – A good example of this involves the wearing of Class II elastics. If we retain cases coming directly out of Class II elastics wear, we don't have time to accommodate for rebound. We haven't found centric relation (due to muscle splinting), aren't sure what periodontal rebound will do and haven't allowed for the bone adaptation process. This all takes time. It is advisable to stop all horizontal elastics (Class II or Class III) at least three months prior to appliance removal. This

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15. When cuspids are not engaged in an anterior wire (left), they move lingually, breaking the mesial proximal contacts (center). This can be counteracted by including the cuspids in the anterior sectional wire, which maintains the in-out relationship between the upper cuspids and the upper lateral incisors (right). The last extension of the zigzag elastics is then carried to the mesial of the upper cuspids to help seat them.

16. Box elastics used in conjunction with triangular elastics reseat the incisor segments and reestablish proper coupling in this area.

"The farther we need to go in orthodontics, the greater the need to overcorrect in anticipation of rebound."