JCO-Online Copyright 2012

Lingual Orthodontics: A Status Report, Part 4: Diagnosis and Treatment Planning

VOLUME 17 : NUMBER 01 : PAGES (26-35) 1983

JOHN C. GORMAN, DMD
JAMES J. HILGERS, DDS, MS
JOHN R. SMITH, DDS, MSD

Is lingual orthodontics just another passing orthodontic fad? Is it really worth the extra effort? Can we treat our lingual cases to a high standard of excellence?

Perhaps time will be the ultimate judge in answering these critical questions. In analyzing these concerns, however, one overriding fact must be kept in mind. The prevailing reason for lingual orthodontics is to bring new patients into the office! We are all painfully aware that the predictions of an unbalanced supply and demand in orthodontics are factual. Members of the Lingual Task Force and other clinicians have experienced an influx of new adult patients into our practices since offering the lingual alternative.

We are now able on a selective basis to offer a service to a segment of our population that in many cases would not otherwise have sought orthodontic treatment. To that extent we believe that lingual orthodontics is worth the additional effort and is not just another fad. However, not every patient seeking invisible braces is a suitable candidate. The indiscriminate utilization of this developing technology could well bring about its demise, and relegate lingual orthodontics to the history books as a passing fancy.

The purpose of this article is to provide guidelines for the careful selection of patients, based upon the experiences of the Task Force members after initiating lingual therapy on a total of 300 patients.

The more we become involved with the lingual appliance modality, the more we become convinced that proper case selection and diagnosis are the key factors in being a "winner" with this new and exciting approach. As with any new concept, it is human nature to apply old, established principles to new techniques. For want of sound scientific and clinical data on how the new approach will work, we assume that those principles that work on the labial approach will hold true on the lingual, and many do. But, as is so often true in orthodontics, it is in the finishing and detailing of our cases that we are able to look back and see some of our errors. However, considering the radical departure from our conventional orthodontic concepts, the transition has been extraordinarily comfortable, albeit challenging. Orthodontics is a dynamic process that unfolds slowly and deliberately. As we finish more and more cases, it is imperative that we reevaluate and set new standards. In this series lies the current "state of the art" concerning what we have discovered thus far.

Diagnosis

Case diagnosis is conducted in a manner similar to established procedures. As we are dealing primarily with the non-growing adult patient, additional diagnostic input may be required from the periodontist, restorative dentist, and orthognathic surgeon, as well as some additional psychological acumen on the part of the orthodontist. The determination to treat the case with lingual, labial, removable, or otherwise cannot be made until all the facts are compiled.

The treatment plan is based upon the diagnosis, the advantages and limitations of the various modes of treatment, the cost and time factors, and, of course, the patient's desires. A common pitfall is to allow the patient to dictate the treatment plan. Patients who previously would not accept orthodontic treatment in any mode frequently demand to be treated with invisible braces regardless of whether they are suitable candidates for this approach. In some instances, it is difficult for the orthodontist not to acquiesce, since this was the patient's primary motivation for seeking orthodontic care. It takes considerable discipline to convince many patients that they should have orthodontic therapy, but that their problem cannot be treated best with the lingual approach. Patient selection and management have thus become key factors in lingual orthodontics.

Patient Selection

The prospective lingual patient must be made aware that this is a new approach and, as such, will require significantly greater chair time. While the expertise of the orthodontist and staff will improve rapidly, lingual therapy is demanding on both the patient and the office.

The most important factors in selecting patients for lingual treatment seem to be their personalities and reasons for seeking treatment.

After the patient is informed of the treatment rationale and effects of the lingual appliance (speech, soreness, bite opening), their

attitude should be one of understanding and a desire to do whatever is necessary to accomplish the optimum results. Inadequate personality screening, and failure of the patient to understand the possible side effects and the necessity to adapt to the presence of unfamiliar hardware on the lingual surfaces, can result in having to remove the appliance. When the orthodontic problem is minor and primarily cosmetic, the adjustment to speech changes, loss of chewing efficiency, and tongue soreness may be more than the patient had bargained for.

According to Dr. Gorman, "Approximately one-third of the patients I examine who have come seeking invisible braces choose to have conventional appliances after the pros and cons are explained. This is certainly no indictment of the lingual appliance if we agree that the primary goal of lingual is to attract new patients."

Since additional chair time will be required, particularly during the initial learning period, it is important to begin with patients with whom you and your staff will enjoy spending a great deal of time.

As some additional guidelines in patient personality evaluation, the orthodontist should ask himor herself:

1. Does this patient seem to be easygoing and adaptable?
2. Is this a person with whom you will feel comfortable in using this new approach?
3. Is this patient unrealistic in his/her demands, permitting treatment only their way?
4. Is there a genuine give-and-take attitude that allows for honest evaluation of goals and the methods for achieving these goals?

As experience is gained in conversing with these prospective patients and as confidence in lingual mechanotherapy increases, the number and latitude in personality types will also increase. We would stress, however, that at this stage of development, the personality type is a prime factor in case selection and should be ascertained as early as possible. This may mean that the orthodontist should plan on spending 10 to 15 minutes more at the initial examination of the patient.

Time and Cost Factors

1. Examination, diagnosis, consultation, and treatment planning time will be increased by 30 to 45 minutes.
2. Laboratory procedures for the indirect appliance setup will appreciably increase the fixed costs.
3. Orthodontist and staff time will increase by 30-50%.
4. It may be necessary to finish some patients with a conventional labial appliance.
5. A fully articulated positioner appliance may be required for detailing the lingual case.

Given these factors, it is apparent that a treatment fee of 30-50% more than the orthodontist's usual adult patient fee is realistic, reasonable, and fair.

We find that patients seeking invisible braces as a result of news media attention are aware of these additional cost factors and, by and large, are prepared to compensate the practitioner for his or her additional time land expense. Each clinician must evaluate these cost considerations individually, and it may require the completion of several cases before a reasonable evaluation can be made. Lingual orthodontics will tax the skills of the practitioner to the utmost, and appropriate compensation--commensurate with the additional time, costs, and tribulations-- seems to be in order.

Treatment Planning

To arrive at a definitive treatment plan and reach a conclusion as to labial versus lingual, it is first necessary to review the characteristics, known to date, that distinguish conventional fixed appliances from lingual appliance mechanotherapy.

1. Periodontal Considerations

As with all orthodontic cases, the status of the periodontium must be carefully evaluated. This is more important with lingual and adult patients. A periodontal examination should be performed as part of the diagnostic procedures. Short lingual clinical crowns can present a contraindication to optimum lingual bracket positioning. The periodontist may, in certain cases, be able to provide additional clinical crown length through reduction of inflammation orappropriate surgical procedures.

Lingual brackets are bonded appreciably closer to the gingival crest than their labial bracket counterparts. While the natural cleansing action of the tongue seems to maintain the lingual appliance with less plaque relative to the labial appliance, the lingual appliance can cause gingival hypertrophy. The etiological factors leading to this hypertrophy are under study. Certainly gingival irritation caused by the bracket and bonding resin flash are factors. Indications are that an equally significant, if not more significant, cause is the diminished gingival stimulation around the brackets, wire, and gingival ball clasps. This may lead to a cycle of gingival swelling resulting from disuse atrophy and further gingival insult as the hypertrophic tissue contacts the brackets, ligatures, resin, etc. Proper cleansing and stimulation of the gingiva and close monitoring of the patient thus become even more critical with the lingual patient.

Patients with a history of periodontal problems or in whom oral hygiene motivation is questionable may not be the best candidates for lingual therapy. A close working relationship with the periodontist can overcome these concerns.

2. Restorative Considerations

The likelihood of encountering more extensive restorative and prosthetic work is naturally increased in the adult patient. The bonding materials will adhere only to etched enamel, other plastics, and some porcelains (using an intermediate silane primer). The practicalities of replacing porcelain-fused-to-metal crowns or other metallic restorations with provisional plastic crowns to permit lingual bonding must be closely evaluated.

In cases where there is a loss of several teeth, extreme tipping, and multiple or complex bridgework, the lingual appliance may be contraindicated. As a rule, if the clinician believes that the case poses multiple technical problems if treated with a labial approach, then these problems are magnified greatly when treated with a lingual mode. This does not mean, however, that certain alterations from the ideal cannot be made, if a close liaison is established with the other dental professionals in a team approach. It is important that the other members of the dental team fully understand the patient's and the orthodontist's objectives in electing the lingual option.

3. Lingual Crown Height

Lingual clinical crown heights on the average patient are approximately 30% shorter than the available crown on the labial surfaces. The most critical crown heights in the majority of cases appear to be those of the maxillary incisors and mandibular bicuspids. As mentioned in Part 3 in this series, 7mm of lingual crown height is necessary on the maxillary incisors in order to achieve optimum bracket placement. It is axiomatic that if the lingual brackets cannot be placed to finish with proper overbite, then the case would be better treated in a modality other than with the lingual appliance. Additionally, short clinical crowns reduce the latitude of positioning required to minimize second order bends. Although it may be possible to place a bracket, one should consider the practicality and excessive time required to maintain second order relationships when short crowns are presented.

Lingual crown height limitation is, of course, a simple diagnostic determination that should be made immediately at the initial examination. Particular attention should be given in the following instances:

Extreme brachyfacial types with short alveolar and crown height dimensions
Partially erupted teeth in the young adolescent patient
Crown heights that have been diminished by excessive wear, trauma, or restorative work
Diminutive teeth, i.e., peg laterals

Additional Treatment Plan Considerations

The old rule of letting the problem, not the appliance, determine the treatment plan still holds true. However, certain characteristics of the present lingual appliance design must be considered, first in deciding if the case should be treated lingually, and second in establishing some sort of difficulty factor.

The primary changes induced by the lingual appliance can best be categorized as those dynamic effects on vertical, anteroposterior, and transverse planes.

1. Vertical

The most immediate and readily apparent appliance-induced change is the bite opening resulting from the lower incisors occluding on the maxillary incisor bracket bite planes. This bite opening produces both positive and negative effects. In the low angle brachyfacial patterns, the bite opening is usually desirable. Many deep bite cases have low mandibular plane angles, and benefit from posterior extrusion. The posterior disclusion, resulting from the anterior bite plane opening, permits a rapid eruption of the molars and bicuspids, with posterior occlusion reestablishing in approximately 3 to 4 months (Fig. 1). The incidence and degree of anterior intrusion as a result of the lower anteriors occluding on the maxillary incisor brackets is under study.

While this bite plane effect and posterior disclusion most often brings about initial relief of TMJ symptoms, the long-term effects of this posterior extrusion and the loss of incisal guidance on the temporomandibular joint apparatus have yet to be determined.

In the mesiofacial and dolichofacial types, where bite opening may not be desirable, the lingual appliance may induce unwanted results that are difficult to control. The use of high-pull headgear thus becomes a critical part of the treatment plan to maintain posterior control. According to Dr. Gorman, "It is amazing to find that adults accept this unsightly appliance (headgear), when the primary reason for wanting the lingual appliance was cosmetic. Often they will wear their headgear at work if they are convinced that it will produce a better result in less time. From my experience with the use of headgear in lingual treatment it appears that the ability to make the appliance invisible on demand is the important factor for the patient."

If a decision is made to treat a high angle case, it may be desirable to place a conventional fixed appliance on the lower arch and limit the lingual appliance to the maxillary incisors and bicuspids. By utilizing a high-pull facebow and Class III elastics, the lower arch can be aligned and leveled without posterior extrusion. Extrusion of the maxillary molars can then be limited with the

combined use of high-pull mechanics and a molar-to-molar transpalatal arch.

At first glance it would appear that the anterior open bite case would be an ideal candidate for lingual appliance therapy, since there would be little or no anterior occlusion. This concept, however, is misleading and is the antithesis of what proves to be the case. The lingual appliance has a tendency to restrict the tongue space. If the maxillary arch is narrow to begin with, the tongue can be forced out of the palatal vault and into the upper and lower arch inter-space. The natural tongue positioning and speech patterns are changed slightly, with the result that some open bite conditions can be exacerbated during lingual therapy.

2. Anteroposterior

Because of the vertical opening and the immediate rotation of the mandible (down and back), the lingual appliance also induces a Class II tendency. This may be desirable in certain cases, but in most instances it exerts additional pressure on the orthodontist to control anchorage. Again, headgear wear becomes critical, and the decision to extract in the maxillary arch (maxillary first bicuspids) may become more frequent than in a like case treated with conventional labial mechanics.

Although bite opening, space closure, and generalized alignment of the teeth occur rapidly, Class II corrections can be laborious and fraught with difficulties, if not carefully treatment-planned. A common scenario has been the relatively rapid alignment of the individual arches, but a resulting anterior open bite and a developing Class II dental relationship. This can occur as the result of the mandibular rotation and the posterior disclusion that remove two prime anchorage factors-- the inclined plane occlusion and the musculature.

Since we have not found Class II correction in this type of situation to be exceptionally effective using the lingual appliance, a definitive treatment plan for Class II correction must be thoroughly analyzed. Options to consider may be: (a) maxillary first bicuspid extraction only, (b) differential extractions of maxillary first bicuspids and mandibular second bicuspids, (c) headgear therapy, and (d) surgical correction.

When Class II elastics are planned, it is important to prepare the mandibular arch level with adequate anchorage and an archwire of sufficient stiffness to prevent any mesiocclusal movement of the lower molars. It is desirable to band second molars whenever possible, and to extend lingually placed Class II elastics as far anterior and posterior as possible to help reduce the more vertical vector.

3. Transverse

With the initial posterior disclusion, the expansive nature of the lingual appliance, and a tendency to cause mesiobuccal molar rotation during space closure, intermolar dimension becomes more important to control. Therefore, transverse considerations gain additional importance.

The recent addition of transpalatal arch bars to the treatment plan has, by and large, resolved many of these transverse problems. Other cause-and-effect considerations are worth mention. Lighter, more resilient archwires are being used throughout treatment. Retraction on resilient wire can produce several adverse effects, particularly in the transverse planes. Interarch retraction forces on more flexible wire can cause a "bowing" effect, resulting in the bicuspids being displaced buccally and the molars rotating to the mesiobuccal (Fig. 2). Once the maxillary first molars rotate to the mesiobuccal, this can cause a functional interference between the molars, inducing additional vertical opening and further aggravation of the anteroposterior discrepancy (Fig. 3).

This same "bowing" effect can also occur in the vertical direction, potentially causing loss of anterior torque control, tipping, and further bite opening (Fig. 4). One technique utilized to offset this bowing effect (Dr. Smith) is to place a compensating lingually directed curvature in the closing archwire form (Fig. 5).

Fortunately, most of these problems can be prevented by proper treatment planning and archwire sequencing as well as a degree of patience in allowing the more resilient archwires to exert their influence before proceeding to the next wire. Retraction and space closure with lingual must also follow well-established principles, requiring anchorage preparation and transition to archwires of sufficient stiffness.

Utilization of posterior buccal segments has been most beneficial in lingual mechanotherapy. The use of first molar buccal brackets or tubes with built-in distal offset can, however, create a first molar rotation and second molar buccal flaring (Fig. 6), when added to the tendency for mesiobuccal rotation of the first molars during space closure. Consideration should be given to using a buccal attachment without distal offset and/or compensating bends in both the lingual and buccal segment archwires. In addition, Dr. Robert Borkowski, one of the early lingual evaluators, has been able to minimize these "bowing" effects by ligating together the buccal segments after leveling and aligning and prior to retraction mechanics.

As mentioned previously, the use of a transpalatal arch bar will also aid greatly in controlling undesirable transverse changes (Fig. 7).

TMJ Considerations

Many clinicians have reported relief of joint symptoms following lingual appliance placement. This apparently occurs because of the disarticulation of posterior interferences, creation of freedom of movement of the "locked" mandible, and changes in muscle position and length due to different posturing of the mandible. This would be consistent with the placement of a simple bite plane, which many clinicians have long advocated for initial treatment of TMJ dysfunction cases.

It will be several years before more definitive cause-and-effect relationships between the lingual appliance and the TMJ can be established. We can only suggest that a sophisticated evaluation of the TMJ be completed prior to considering treatment with a lingual appliance. The net effect of bite opening, posterior extrusion, and mandibular rotation must be carefully considered. In those cases where the health of the temporomandibular joint complex is in question, splint therapy and conservative treatment approaches are recommended.

Extraction Versus Nonextraction Considerations

As mentioned, the lingual appliance lends itself well to expansion and bite opening. The broad range of cases that lend themselves to this mode of treatment, especially Class I deep bites, are excellent candidates for invisible braces. In Class II cases, or when an open bite tendency exists, extractions should be considered. An ideal extraction case for lingual mechanics would be one in which anchorage is not critical and Class II correction could be achieved principally as a result of the extractions. Cases of lower second and upper first bicuspid extractions have responded well to lingual mechanotherapy.

Maxillary first bicuspid extraction cases, where distal molar movement is not required and where retraction of upper incisors would tend to close the bite, have also proved to be ideal for lingual appliances.

Again, given the design factors of the lingual appliance, it would appear that, in general, the indications for extraction are greater with lingual therapy than for like cases treated with conventional labial fixed appliances.

In extraction cases, additional thought must be given to the mode of retraction and anchorage considerations. As lingual treatment is serving to provide an esthetics approach, many patients electing this modality will not tolerate the transient anterior spacing with cuspid retraction. Therefore, retraction of the entire maxillary anterior segment as a unit, and the additional anchorage preparation to accomplish this, becomes a treatment planning consideration.

This esthetic concern is also a factor when treating a maxillary first bicuspid extraction case. We must remain sensitive to the cosmetic concerns of the lingual patient. These patients have, after all, opted to expend additional time and money for a cosmetic treatment approach. The opening of a "large black hole" (first bicuspid extraction) temporarily defeats the esthetic advantage of invisible braces and can be psychologically traumatic to these patients. A temporary pontic, placed in the extraction site, has proved to be more than worth the little additional time required for this valuable service. While plastic denture teeth can be attached to the lingual archwire, this presents a stability problem with round wires. Dr. Smith has developed a very successful and simple method to fill extraction sites. A cold cure acrylic cantilevered pontic, of the proper tooth shade, is fabricated on the model, with a thin veneer on the buccal of the second bicuspid that is then bonded to the second bicuspid (Fig. 8). As retraction progresses, the pontic is reduced in width, until the space is inconsequential. The bonded pontic is then removed.

Guidelines For Case Selection

To summarize the patient selection criteria and influences of appliance design parameters on treatment planning, the following guidelines, based upon our clinical experience thus far, may be of assistance in the case selection process:

Ideal Lingual Cases

Nonextraction

Deep bite, Class I with mild crowding, good facial pattern
Deep bite, Class I with generalized spacing, good facial pattern
Deep bite, mild Class II, good facial pattern
Class II division 2 with retruded mandible
Cases requiring expansion
Consolidation (diastema) cases

Extraction

Class II, maxillary first bicuspid and mandibular second bicuspid extractions
Maxillary first bicuspid only extractions
Mild double protrusions with four first bicuspid extractions, wherein anchorage is not critical More Difficult Lingual Cases

Surgical cases

Class III tendencies

Class II, four first bicuspid extractions
Mesiofacial patterns and/or moderate mandibular plane angles
Cases with multiple restorative work Cases Contraindicated for Lingual Therapy
Acute TMJ dysfunction
Mutilated posterior occlusions
High angle/dolichofacial patterns
Extensive anterior prosthesis
Short clinical crowns
Critical anchorage cases
Severe Class II discrepancies
Poor oral hygiene or unresolved periodontal involvement
Unadaptable or demanding personality types Conclusions

The foregoing discussion has centered on the general diagnostic and treatment planning considerations of lingual orthodontics for patient selection. The specific mechanotherapy approaches for lingual treatment and the ramifications on the actual treatment plan will be presented in Part 5 in this series.

The reader is again asked to bear in mind the dynamic developing nature of lingual orthodontics. The clinical observations forming the basis for this status report are limited in both number and duration. The opinions expressed will require the rigorous test of time, analytical analysis, and continued research to confirm, modify, or deny these observations.

Lingual orthodontics is a present-day reality and a viable treatment option in selected cases. We trust that the guidelines and rationale provided here will aid the orthodontist in utilizing this new resource in a methodical, selective manner.

Figures

Fig. 1 Bite Plane Effect. Treatment time - 3 months.

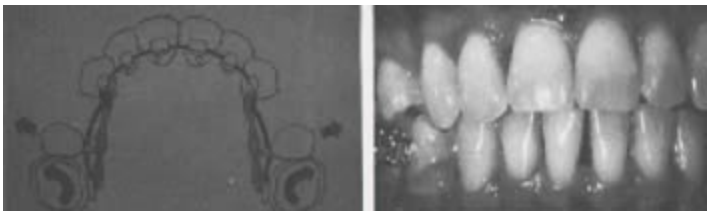

Fig. 2 Transverse bowing resulting from space closure on wires of insufficient stiffness.

Fig. 3 Molar rotation creating a functional interference and additional bite opening

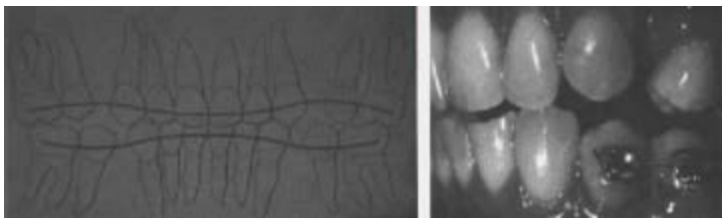

Fig. 4 Vertical bowing effects resulting from space closure on light, resilient archwires

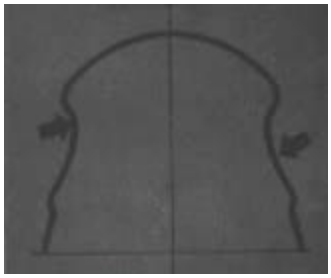

Fig. 5 Compensating closing archwire form-- Dr. Smith.

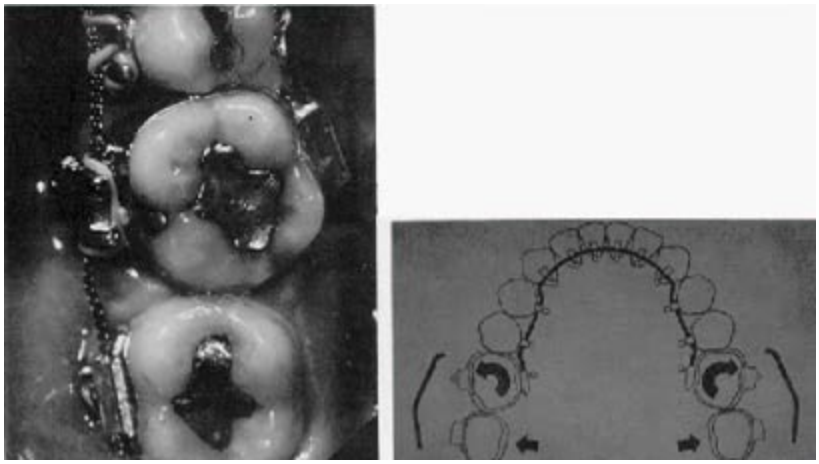

Fig. 6 First molar rotation and second molar flaring resulting from lingual closing mechanics and 1st molar distal offset buccal bracket.

Fig. 7 Transpalatal arch, lingual retraction arch, and bonded pontics.

Fig. 8 Temporary bonded pontics can provide a cosmetic appearance on extraction cases.