

Review Article

Criteria for evaluation of finishing and detailing in orthodontics

ABSTRACT

Finishing is perhaps one of the most deceiving and difficult phases of orthodontic treatment. The finishing procedures are considered from the beginning stages of the treatment as a part of total scheme of treatment. The great deal of emphasis is placed on achieving perfect finishing and detailing of the orthodontic treatment, so that the results are pleasing to the eye and are more stable and conducive to improved function and health. Thus, the aim of this article is to provide comprehensive knowledge about different criteria about finishing and detailing in orthodontics.

Keywords: Detailing, finishing, orthodontic treatment

INTRODUCTION

The finishing and detailing procedures, right from the beginning stages of treatment, are considered a part of the total scheme of the treatment. A clear vision of end goals should be the objective of any orthodontic treatment sequence. Orthodontic finishing is described as an “art” comprised of individual perceptions and small detailing. Finishing distinguishes the true master of the profession from the average orthodontist. It is the small details that make the difference and these details are the essence of finishing.^[1] Finishing is the last step of ensuring that the teeth and related structures are positioned in such a way that they will lead to a better stability of results, enhancement of esthetics, optimized functions of the stomatognathic system, and improvement of the health of the periodontium.^[2] The orthodontist considers the multiple aspects of esthetics, occlusion, function, periodontal health, root alignment, and stability. Every feature of these characteristics is examined, and desired changes are noted resulting in a plan that guides the orthodontist to achieve excellence in finishing. It acts as a final checklist to obtain the goals of orthodontic treatment.

Received: 21-Mar-2020 Revised: 22-Sep-2020
Accepted: 01-Oct-2020 Published: 19-Jan-2021

Access this article online	
Website: www.orthodrehab.org	Quick Response Code 
DOI: 10.4103/ijor.ijor_10_20	

This system of finishing and detailing can improve the efficiency of the individual orthodontist and help us render quality service to our patients.

DESCRIPTION OF VARIOUS EXISTING METHODS

Andrews six keys to normal occlusion

Key 1: Molar relationship

Distal surface of the distobuccal cusp of the upper first permanent molar occludes with the mesial surface of the mesiobuccal cusp of the lower second molar.

The closer the distal surface of distobuccal surface approaches the mesial surface of mesiobuccal cusp of lower second molar, the better opportunity for normal occlusion.

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How to cite this article: Kondle M, Kangane S, Ambekar A, Joshi Y. Criteria for evaluation of finishing and detailing in orthodontics. Int J Orthod Rehabil 2020;11:180-8.

Key II: Crown angulation (tip)

The gingival portion of the long axis of all crowns is more distal than the incisal portion; crown tip is expressed in degrees, plus, or minus.

The degree of crown tip is the angle between the long axis of the crown (as viewed from the labial or buccal surface) and a line bearing 90° from the occlusal plane.

A “plus reading” is denoted when the gingival portion of the long axis of the crown is distal to the incisal portion. A “minus reading” is assigned when the gingival portion of the long axis of the crown is mesial to the incisal portion.

Key III: Crown inclination

The third key to normal occlusion is crown inclination is expressed in plus or minus degrees, representing the angle formed by a line which is 90° to the occlusal plane and a line that is tangent to the bracket site (which is in the middle of the labial or buccal long axis of the clinical crown, as viewed from the mesial or distal).

A plus reading is given if the gingival portion of the tangent line (or of the crown) is lingual to the incisal portion, a minus reading is recorded when the gingival portion of the tangent line (or of the crown) is labial to the incisal portion. Anterior teeth have positive crown inclination, whereas posterior teeth have negative crown inclination.

Key IV: Absence of rotations

The fourth key to normal occlusion is absence of undesirable rotations.

Key V: Tight contacts

The contact points should be tight (no spaces)

Key VI: Flat curve of speed

Occlusal plane should be flat intercuspation of the teeth is the best when the plane of occlusion is flat.^[3]

Roth's concepts of finishing

Roth added the goals of gnathological finishing as part of orthodontic treatment. He found that Andrew's brackets were very well suited to achieve these objectives. Hence, with slight modifications, he accepted these brackets. He further elaborated on the relapse tendencies of the teeth as follows:

- Teeth will move after appliance removal, no matter where they are placed
- The cause of space will return or express after appliance removed
- Teeth that are slightly tipped distally in the buccal segment will tend to settle better than teeth that are

already mesially angulated

- As teeth in the buccal segments settle, they will tip mesially and rotate mesially
- As band spaces close, there is corresponding loss of torque of the anterior teeth
- Teeth adjacent to the extraction sites are found to tip and rotate into the extraction site
- Maxillary lingual cusps will tend to migrate downward until they find an occlusal stop against the opposing teeth (since the maxillary lingual cusps are centric supporting cusps of the upper teeth). He tried to build over treatment in his appliance to neutralize these relapse tendencies.

Roth accepts the six keys to normal occlusion and added his functional requirements^[4]

- Consideration of lower incisors to a-pog value, for facial esthetics, for planning anchorage control, and for selection of mechanotherapy
- Tips of the upper incisors 2–2.5 mm below the lip embrasure of the upper and lower lips, when the lips are closed with no lip strain
- No > 1 mm of attached gingiva showing upon a full smile
- Approximately 2.5 mm overjet-overbite relationship (.0005” clearance with the lingual surface of the upper incisor.)
- A flat occlusal plane, at the end of therapy that would return to a 1–1.5 mm curve, at its deepest point, after appliance removal and settling of the occlusion
- A curve of Wilson that would allow seating of centric cusps, but clearance upon excursions
- Lower incisors aligned contact point-to-contact point with the roots in the same plane, when observed from the occlusal, and a mesio-axial inclination of 2°.

Lower canine crowns angulated mesially 5°, with the incisal tip 1 mm higher than the incisal edge of the lateral incisors. The lower cuspids should have a slightly exaggerated mesial rotation in extraction cases.^[5]

Dougherty's criteria for finishing and detailing

In 1976, Dougherty outlined 17 factors to be considered in finishing and detailing

1. Correction and overcorrection of the A-P jaw relationship
2. Establishing correct tip of the upper and lower anterior teeth
3. Establishing correct torque of the upper and lower anterior teeth
4. Coordinating arch widths and arch form
5. Establishing correct posterior crown torque
6. Establishing marginal ridge relationships and contact

points

7. Correction of midline discrepancies
8. Establishing the inter-digitations of teeth
9. Checking cephalometric objectives
10. Checking the parallelism of roots
11. Maintaining the closure of all spaces
12. Evaluating facial and profile aesthetics
13. Checking for tmj dysfunctions such as clicking and locking
14. Checking functional movements
15. Determining if all habits have been corrected
16. Correction of rotations and overcorrection where needed
17. Establishing a relatively flat plane of occlusion.^[6]

American board of orthodontics criteria for a finished case

The ABO objective grading system for scoring of a finished case places emphasis on seven features of a dental cast and 1 on the panoramic radiograph.

- i. Tooth alignment
- ii. Marginal ridges
- iii. Bucco-lingual inclination
- iv. Occlusal relationships
- v. Occlusal contacts
- vi. Overjet
- vii. Interproximal contacts
- viii. Root angulation.

Tooth alignment

- Anterior region: In the maxillary and mandibular anterior regions, proper alignment is characterized by the co-ordination of alignment of the incisal edges and lingual incisal surfaces of the maxillary incisors and canines [Figure 1], and the incisal edges and labial incisal surfaces of the mandibular incisors and canines [Figure 2].
- Maxillary posterior region: The central grooves (mesio-distally) of the premolars and molars should all be in the same plane or alignment [Figure 3]

- Mandibular posterior region: The buccal and buccal cusps of the molars and premolars should be in the same mesiodistal alignment.

Marginal ridges

They are used to assess the proper vertical positioning of the posterior teeth. In patients with no restorations, minimal attrition and no periodontal bone loss, the marginal ridges of adjacent posterior teeth should be at the same vertical level or within 0.5 mm of the level. The objective is to obtain flat bone level and good occlusal contacts [Figure 4].

Buccolingual inclination

It is used to determine the buccolingual angulation of the posterior teeth. In order to establish proper occlusion in maximum intercuspation and avoid balancing interferences, there should not be a significant difference between the heights of the buccal and lingual cusps of the maxillary and mandibular molars and premolars.

- Maxillary arch: The straight edge should contact the lingual cusps of the maxillary molars and premolars. The buccal cusps should be within 1 mm of the surface of the straight edge [Figure 5]
- Mandibular arch: The straight edge should contact the buccal cusps of contralateral mandibular molars. The lingual cusps should be within 1 mm of the surface of the straight edge [Figure 6].

Occlusal relationships

The occlusal relationship is used to assess the relative antero-posterior position of the maxillary and mandibular posterior teeth.

- The maxillary canine cusp tip should align with or within 1 mm of the embrasure or contact between the mandibular canine and adjacent premolar
- The buccal cusps of the maxillary premolars should align with or be within 1 mm of the interproximal contacts between the mandibular premolars and first molar

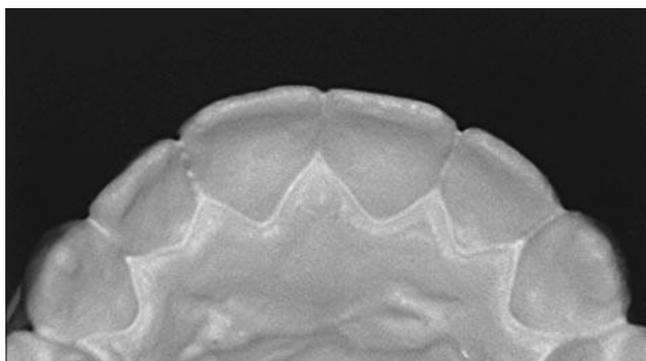


Figure 1: Maxillary anterior region

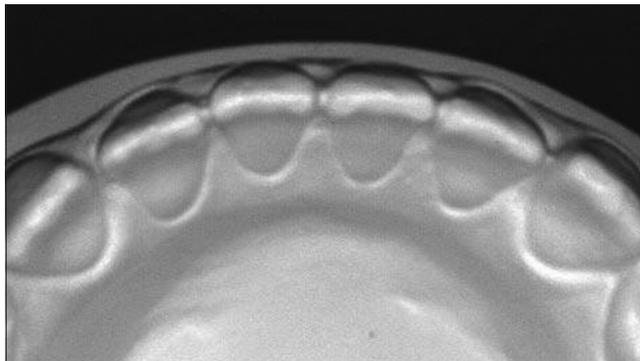


Figure 2: Mandibular anterior region

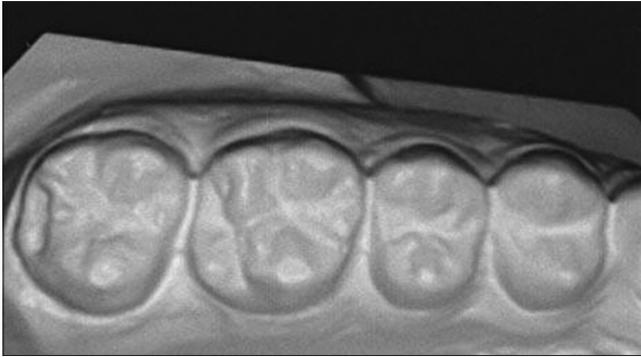


Figure 3: Maxillary posterior region

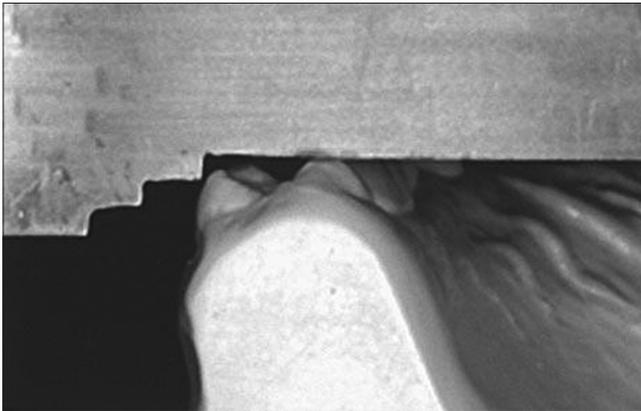


Figure 5: Buccolingual inclination in the maxillary arch



Figure 7: Occlusal relationship between the maxillary and mandibular canines, premolars, and molars

- The mesiobuccal cusps of the maxillary molars should align with the buccal grooves of the mandibular molars [Figure 7]
- Cases finished in Angle's class II: In a class II situation [Figure 8], the buccal cusp of the maxillary first molar should align with the embrasure or interproximal contact between the mandibular second premolar and first molar. The buccal cusp of the maxillary second molar should align with the embrasure or interproximal contact between the mandibular first and second molars.

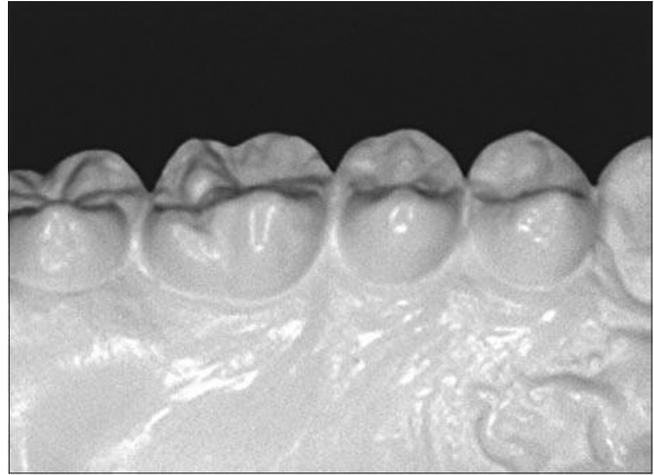


Figure 4: Same vertical level of marginal ridges of the adjacent posterior teeth

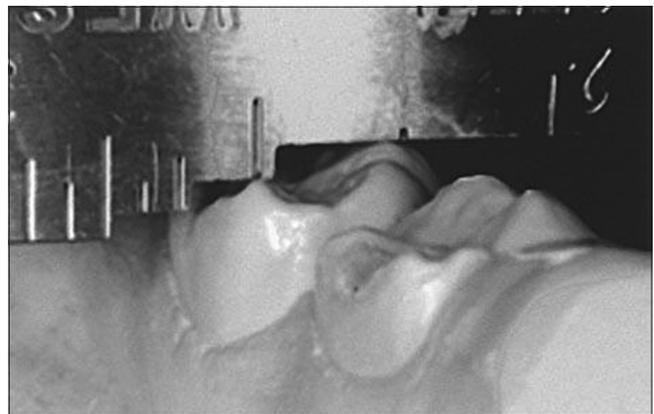


Figure 6: Buccolingual inclination in the mandibular arch



Figure 8: Angle's Class II occlusal relationship

- Cases finished in Angle's class III: In a class III relationship (when mandibular premolars are extracted), the buccal cusp of the maxillary second premolar should align with the buccal groove of the mandibular first molar [Figure 9]. Occlusion distal to the maxillary

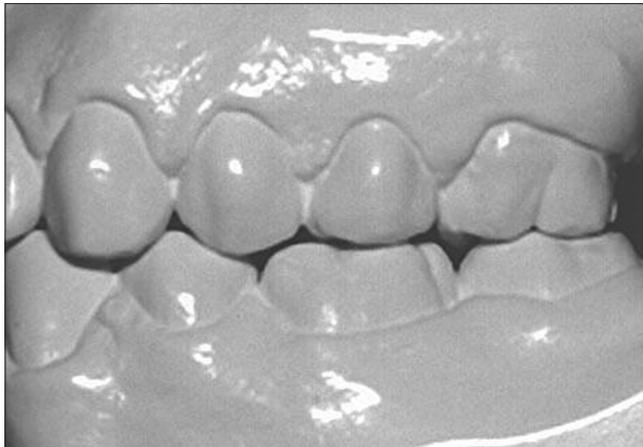


Figure 9: Angle's Class III occlusal relationship

second premolar and mandibular first molar are adjusted accordingly.

Occlusal contacts

Occlusal contacts are measured to assess the adequacy of posterior occlusion in the premolar and the molar regions. The buccal cusps of the mandibular premolars and molars [Figures 10,11] and the lingual cusps of the maxillary premolars and molars [Figure 12] should be contacting the occlusal surfaces of the opposing teeth. Functional cusps should have optimal intercuspation.

- Mandibular premolar – 1 functional cusp
- Mandibular molar – 2 functional cusps
- Maxillary premolar – 1 functional cusp
- Maxillary molar – 1 functional cusp.

Overjet

Overjet is used to assess the relative transverse relationship of the posterior teeth and the antero-posterior relationship of the anterior teeth.

- Anterior region: The mandibular incisal edges should be in contact with the lingual surfaces of the maxillary anterior teeth. In the anterior region, the mandibular canines and incisors will contact the lingual surfaces of the maxillary canines and incisors [Figure 12]
- Posterior region: The mandibular buccal cusps and maxillary lingual cusps are used to determine the proper position within the fossae of the opposing arch. If the proper overjet has been established, then the buccal cusps of the mandibular molars and premolars will contact in the center of the occlusal surfaces, buccolingually, of the maxillary premolars and molars [Figure 13].

Interproximal contacts

Interproximal contacts are used to determine if all spaces within the dental arch have been closed. Persistent spaces between teeth after orthodontic therapy are not only unesthetic, but



Figure 10: Buccal cusps of mandibular premolars and molars

can lead to food impaction. The mesial and distal surfaces of teeth should be in contact with one another [Figure 14].

Root angulation

Root angulation is used to assess how well the roots of the teeth have been positioned relative to one another. If roots are properly angulated, then sufficient bone will be present between adjacent roots, which can be important if the patient is susceptible to periodontal bone loss at some point in time. The roots of the maxillary and mandibular teeth should be parallel to one another and oriented perpendicular to the occlusal plane [Figure 15].^[7]

Finishing procedures in bioprogressive therapy

Ricketts – “one of the greatest values of the visual treatment objective (vto) is establishing of specific end results from the very beginning.”

The vto considers the morphological and functional variations due to the facial type and proposes the necessary torque for the facial type and proposes the necessary torque for incisor alignment, arch forms, and tooth positioning depending on the angulation of the individual's facial axis.

Ricketts interpreted angle's line of occlusion to include a line drawn through the contact points of the posterior teeth and slightly below them through the contact embrasures of the anterior.^[8]

The line is suggested as the line to which our brackets can be placed on the individual teeth in order to allow the cusp/marginal ridge function that our occlusal stops produce.^[9,10]

FUNCTION INFLUENCES FINISHING AND RETENTION

- The proper location and function of the condyles in the temporomandibular joint are essential to the health and stability of the occlusion
- A normal airway which effects the basic respiratory



Figure 11: Lingual cusps of maxillary premolars and molars

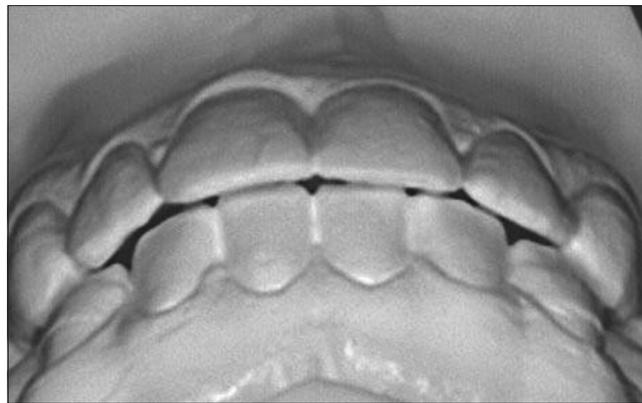


Figure 12: Overjet in the anterior region

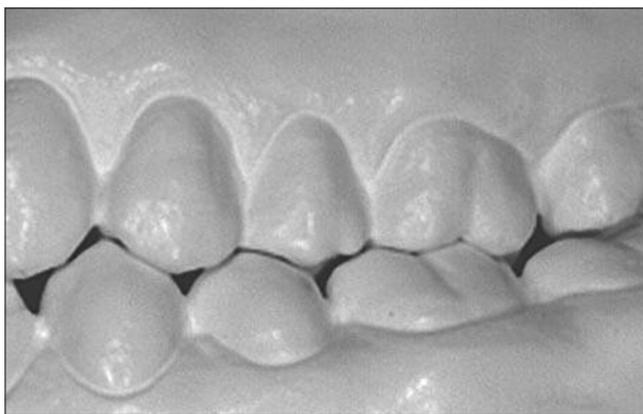


Figure 13: Overjet in the posterior region

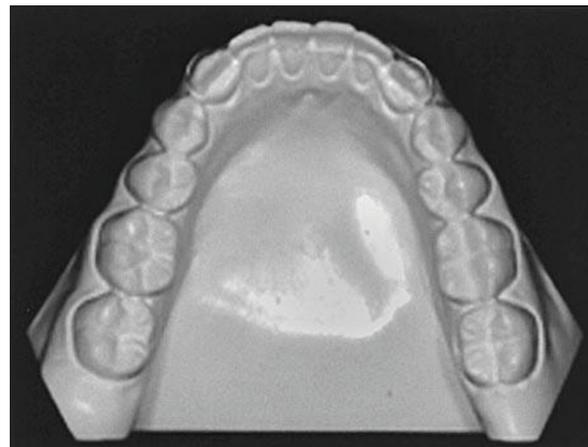


Figure 14: Interproximal contacts

process and influences the tongue posture and function is important to the stability of the denture

- Lip function and its variations have an influence upon the incisor alignment and stability
- The buccal and facial musculature along with the muscles of mastication, also critical influences finishing, and are considered during the original diagnostic criteria

Ricketts divides the extraction mechanics into the following four general procedures:

- a. Stabilization of upper and lower molar anchorage
- b. Retraction and uprighting of cuspids with sectional arch mechanics
- c. Retraction and consolidation of upper and lower incisors
- d. Continuous arches for the details of ideal and finishing occlusion.

FINISHING WIRES USED

Era of banded appliance

- 0.018 × 0.022" u/l ss wire
- Lower wire activated

- Class ii elastics used.

Era of bonded appliance

- 0.016 × 0.016/0.017 × 0.017" blue elgiloy/0.016 × 0.022" nitinol/0.017 × 0.025" nitinol – upper arch
- Class II elastics discontinued (at least 2 months before settling)
- Settling: 0.014/0.016" light round wire bent to ideal arch form placed for function to seat the occlusion.

DIFFERING CONCEPT OF OCCLUSION

There are many concepts of occlusion describing the proper fit and mesh of the teeth

1. Ideal occlusion
2. Normal occlusion
3. Reconstructed occlusion
4. Orthodontic finishing occlusion is represented by the occlusion that is desired at the time of band or active appliance removal.



Figure 15: Root angulation assessed on the panoramic radiographs

OCCLUSAL CHECKLIST IN FINISHING

- An occlusal checklist, including eight areas in each arch, is used in establishing the ideal finishing arch configuration and individualized tooth rotation in over treated orthodontic finishing occlusion.
- The patient at this stage is seen at 2-week appointments for the adjustments are more delicate and controlled.
- During the final 2-week adjustment, the cuspid and bicuspid bands may be removed to allow closing of the band space. Bonded appliance that eliminates the interproximal band material may not require the stage of final finishing.

Maxillary arch

1. Width across first and second molars
2. Distal rotation of first molar so that line drawn through distobuccal and mesiolingual cusps points to the mesial third of the opposite side cuspid
3. Mesial offset (large) on molar
4. Mesial rotation of lingual cusp of first bicuspid to seat in the distal fossa of lower first bicuspid
5. Premolar offset (2–3 mm) to avoid the first area of prematurity
6. Cuspid brought into contact with lower cuspid and premolar to establish cuspid rise
7. Lateral incisor left labial (until retainer) to allow overtreatment of buccal segments and the labial position of the lower laterals
8. Smooth arc across incisors.

Mandibular arch

1. Arch width across second molars
2. Distal of first molar rotated lingually until the distobuccal cusp approximates mesial sluiceway on the second molar
3. Large buccal offset at mesial of the first molar
4. Check inter-bicuspid width for necessary expansion
5. Proper buccal arch form and contour

6. Premolar offset to bring it in contact with distal lingual incline of upper canine (2–3 mm)
7. Mesial of cuspid tucked slightly behind lateral incisor, distal of the cuspid buccal
8. Over-rotation of incisors and smooth arc.

RALEIGH WILLIAM'S SIX KEYS TO ELIMINATION OF LOWER RETENTION

Raleigh Williams^[4] introduced six treatment keys, which emerged essential if lower retention was to be eliminated.

First key

The incisal edge of the lower incisor should be placed on 1 mm in front of the A–P line or on it. This is the optimum position for lower incisor stability, and it also creates the optimum balance of soft tissues in the lower third of the face.

Second key

The lower incisor apices should be spread distally to the crown, and the apices of the lower lateral incisors must be spread more than that of central incisors.

Third key

The apex of the lower cuspid should be positioned distal to the crown. The occlusal plane, rather than the mandibular plane, should be used as a positioning guide.

Forth key

All four lower incisor apices must be in the same labiolingual plane. Spreading the apices of the lower incisor roots distally causes a strong reciprocal tendency for the crowns to move mesially.

Fifth key

The lower cuspid root apex must be positioned slightly buccal to the crown apex.

Sixth key

The lower incisors should be slenderized as needed after treatment. Lower incisors that have sustained no proximal wear have round, small contact points, which are accentuated if the apices have been spread for stability.^[4]

Finishing in lingual orthodontics

The difficulties encountered at the finishing phase of lingual orthodontics derive from the following three main sources:

- a. Patient's characteristics
- b. Anatomy of the lingual surfaces
- c. Mechanics of lingual treatment.

It is proposed that a simplified and shorter finishing stage can be achieved by the following:

1. Being aware of and preventing the development of finishing problems
2. Setting up the case to minimize wire bending during the main treatment phases
3. Following a systematic finishing procedure.^[11]

SYSTEMATIC FINISHING PROCEDURE

After accomplishing the main treatment objectives, the case should be reevaluated giving due consideration to the initial goals with regard to esthetics, occlusion, periodontal health, root alignment, and stability.

Step I of finishing protocol

The first step in the finishing stage is therefore to reuse the initial resilient rectangular arch wire for a period on 3–4 months (copper NiTi 0.017 × 0.017" for 0.018" brackets), after steel ligations across the extraction spaces. This will regain control by full bracket engagement of the wire. Problems deriving from treatment errors, such as torque of the incisors, expansion, and some of the rotations will be corrected with this procedure.

Step II of finishing protocol

The second step in finishing a case is settling in the occlusion, with the establishment of correct inter-digitations, correction of minor midline, anterior-posterior, and vertical discrepancies. When rectangular wires have been in place for a long time, the teeth are often unable to settle into an ideally finished position. Settling in the occlusion is done by using a lower stabilizing arch, stainless steel or 0.0175 × 0.0175" TMA (titanium–molybdenum alloy, Ormco Corp), and an upper 0.014" round sectional wire from canine to canine or lateral incisor to lateral incisor. The posterior segments are ligated with figure-eight steel ligature wire to avoid accidental swallowing of brackets. This is accompanied by vertical elastics tied to lingual brackets or to clear labial buttons.

Step III of finishing protocol

The third step in the finishing procedure is final detailing and finishing bends. At this stage, finishing bends are preferred over bracket repositioning since accurate repositioning for a minor correction is difficult to achieve. As this is the final arch wire, it should not be necessary to reproduce these corrective bends in subsequent arches. When all desired changes have been noted, the orthodontist must decide whether to bend the detailing wire at the chair side or whether to do so during nonpatient time.

DISCUSSION

Contemporary orthodontic finishing can be defined as "The correction of errors made before finishing and detailing, over correction as needed and suturing of the case."

Andrews's strife to attain consistently good results case after case. At the time, Andrews attained his degree; there were no set goals for the orthodontist. An analysis of the cases displayed at various meetings and for the diplomate of the ABO showed a wide variation between different doctors. Every individual doctor seemed to have his own treatment goals, which varied considerable form every other doctor. In short, no one knew what the correct occlusal scheme to follow was. This according to Andrews was the first step into developing the SWA. The study of 120 untreated patients with ideal occlusion was carried out, and this gave birth to the six keys of optimal occlusion which Andrews published in the AJO in 1972. Major advantage of this method is the first universal finishing guidelines.

Roth added the goals of gnathological finishing as part of orthodontic treatment. He found that Andrew's brackets were very well suited to achieve these objectives. Exact similarity between where Andrews felt teeth should be positioned from an anatomical standpoint and where Roth felt teeth should be positioned from a gnathological standpoint. Major advantage over Andrews's keys is his concept of idealized tooth position to achieve centric relation closure, mutually protected occlusion, elimination of excursive interference came very close to Andrews concept based on his anatomical study. Hence, with slight modifications, he accepted these brackets. He further elaborated on the relapse tendencies of the teeth and need overcorrection principles.

ABO clarified and quantified the goals of static occlusion by providing a grading system for study casts and panoramic radiographs. Emphasis was placed on self-assessment of the seven features of dental casts. The advantage of ABO guidelines over Roth and Andrews is three-dimensional view on casts with both labial and lingual occlusion and checking root parallelism with help of panoramic radiographs. The disadvantage of ABO grading on casts and radiographs which require to take every visit during finishing stages and soft tissues is not considered.

Ricketts major advantage over ABO guidelines is one of the greatest value of the vto is establishing of specific end results from the very beginning and soft-tissue predication. The vto considers the morphological and functional variations due to the facial type and proposes the necessary torque for the facial type and proposes the necessary torque for incisor alignment, arch forms and tooth positioning depending on the angulation of the individual's facial axis. Ricketts interpreted angle's line of occlusion to include a line drawn through the contact points of the posterior teeth and slightly below them through the contact embrasures of the anterior.

Based on this 1976, Dougherty outlined 17 factors to be considered in finishing and detailing. These are one of the best finishing guidelines in PEA. The advantage of Dougherty factors detailed and every factors to prevent replase, soft-tissue consideration, root parallelism, jaw base relationship, and cephalometric factors considered which is not included in Andrews, Roth, and ABO guidelines.

The advantage of Raleigh Williams^[4] in 1992 introduced six treatment keys which emerged essential if lower retention was to be eliminated first time. Due to higher risk of replase in lower anterior, these keys are best criteria's in finishing lower anterior. Prime focus on lower incisor is given which is not included in Dougherty, Andrews, Roth, and ABO guidelines.

When treating a malocclusion with the lingual appliance, the finishing phase is probably the most challenging and difficult stage of treatment. In certain cases, it may take as much or more time and effort to finish the detailing of a case than to correct the major problems of the malocclusion. The time spent by individual clinicians in detailed finishing is an important factor in the variation of treatment duration. Labial and lingual techniques are similar in many respects with regard to finishing and detailing; with both techniques the clinician must consider all dynamic, cephalometric, esthetic, and functional factors.

CONCLUSION

Given the number of different variables in all three planes of space that has an impact on the finished orthodontic treatment result, the orthodontist must keep them in mind and take care from the beginning of treatment to minimize the errors in the different variables, so that he has to do the minimum amount of work during the actual stage of finishing and detailing and hence provides an efficient treatment to his patient. Dougherty outlined 17 factors to be considered

in finishing and detailing are one of the best finishing guidelines in PEA covering detailed every factors for perfect finishing considering soft tissue, jaw bases relationship, and prevent replase. Raleigh Williams six treatment keys which emerged essential if lower retention was to be eliminated, and these keys are best criteria in finishing lower anterior. ABO guidelines and Andrews considered tooth and occlusion factors. Roth added the goals of gnathological finishing as part of orthodontic treatment to Andrews keys.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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