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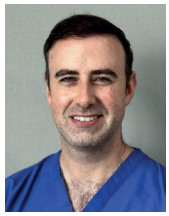

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Finishing and detailing with the pre-adjusted edgewise labial fixed appliance: the why, the what and the how

Abstract: Finishing and detailing is typically undertaken towards the end of orthodontic treatment. It should, however, be considered at the start of treatment and then evaluated at the end of each treatment stage. An appraisal of the disharmony between the planned and observed facial, skeletal and occlusal objectives is required with ongoing refinement to achieve the treatment goals. With the pre-adjusted edgewise labial fixed appliance, finishing and detailing may involve bracket repositioning, archform adjustment, localized wire bending, elastic traction, partial debonding, occlusal adjustment as well as restorative and periodontal input. It should also take into consideration the retention plan.

CPD/Clinical Relevance: This article summarizes what is involved in finishing and detailing with the pre-adjusted edgewise labial fixed appliance in regard to aesthetics, function and stability, and critiques the evidence available in relation to these aspects.

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From an orthodontic perspective, finishing is described as the art of addressing individual perceptions and minute details during the final stages of fixed appliance therapy.[1] In the same context, detailing encompasses locating each tooth in its optimal position in all three planes.[1]

Pre-adjusted labial fixed appliances incorporate first, second and third order tooth movements in the appliance prescriptions to produce the respective 'in-out', tip and labio-lingual torque. These movements occur gradually throughout treatment, with archwire progression leading to greater engagement of the bracket slot. Accurate placement of brackets and other attachments is fundamental to finishing and detailing and, although it may seem counterintuitive, finishing and detailing therefore has its origins at the start of treatment.[2]

The intention of accurate attachment placement is to locate the teeth in their optimal positions and thereby achieve Andrews' six keys of static occlusion, as well as functional occlusal goals (Table 1).[3,4] Several variants of the pre-adjusted edgewise appliance exist with different prescriptions.

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Andrews' six keys	Roth's functional goals
Molar relationship Mesiobuccal cusp of upper first permanent molar lies in the groove between mesial and middle buccal cusps of the lower first permanent molar Distal surface of the distobuccal cusp of the upper first permanent molar makes contact with mesial surface of the of mesiobuccal cusp of the lower second molar Mesiopalatal cusp of upper first permanent molar lies in the central fossa of the lower first permanent molar	**Maximum intercuspation** Should occur with the mandible in centric relation Should be a cusp-embrasure occlusion between upper and lower teeth
Crown angulation All teeth mesially angulated	**In straight protrusion** Anterior teeth should serve as a gentle glide path to disocclude posterior teeth
Crown inclination Incisors labially inclined Progressively-increasing lingual inclination of posterior teeth	**In lateral excursion** Maxillary canines should act as a guide plane to disocclude teeth on non-functioning side
No rotations	**Occlusal forces** Should be equal in magnitude on all posterior teeth and the force should be directed down the long axis of each tooth
No spaces	**Lower incisors** Should have slight clearance from the palatal surface of the upper incisors
Curve of Spee Flat or slightly increased	**Maxillary canines** Should have mesial inclination to effect canine lift

Table 1. Andrews' six keys[3] and Roth's functional goals.[4]

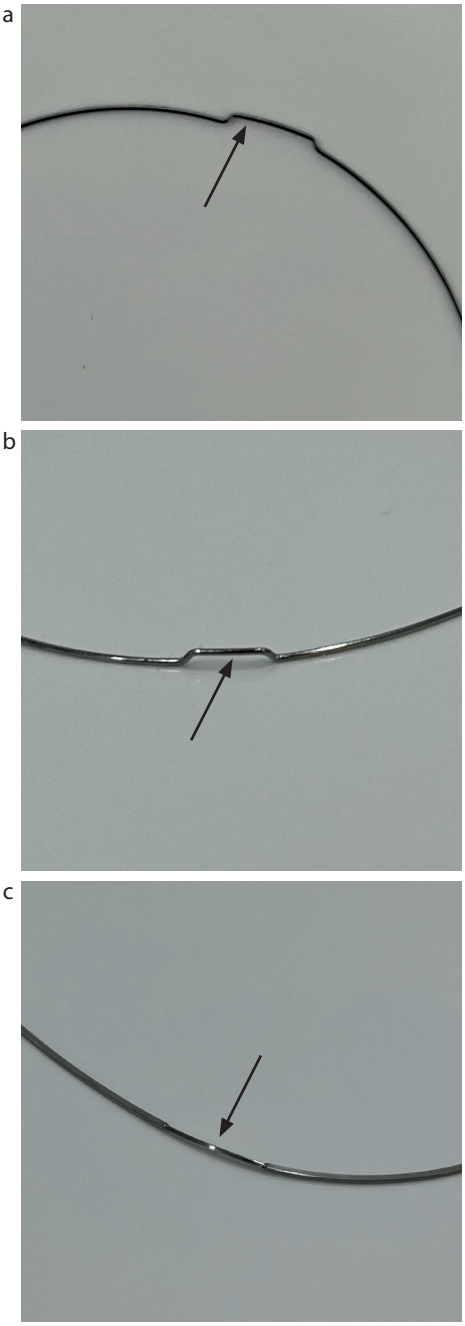


Figure 1. (a) First, **(b)** second and **(c)** third order bends (arrowed).

Although the in-built prescriptions of the attachments assist considerably with achieving a high standard of treatment outcome, discrepancies are often observed between what is intended and what is achieved in terms of aesthetics, function and stability.

This article summarizes why finishing and detailing are important, what is involved in these processes, and how they can be achieved in practice. The evidence with regard to each of these aspects is also presented.

Aesthetics

Why

Achieving optimal facial and dental aesthetics are key driving forces for patients seeking orthodontic treatment.[5] The significance of aligned, healthy teeth and smile aesthetics in the context of facial attractiveness is well established. People with attractive smiles are regarded as friendly, intelligent, sociable and interesting, with superior interpersonal relationships, mental wellbeing and confidence.[6]

What

Features that influence smile aesthetics may be categorized as follows:[7]

- Macro-aesthetics: facial ratios and proportions. These dimensions are altered more substantially by growth modification or orthognathic surgery than by orthodontic fixed-appliance treatment alone.[8]
- Mini-aesthetics: overall attributes of the smile. These relate to incisor and gingival displays at rest and on smiling, smile symmetry, smile arc, buccal corridors and occlusal cant.
- Micro-aesthetics: dentogingival details. These incorporate the shape and size of teeth, dental midlines, golden proportions of teeth, contact points, embrasures, attached gingiva, black triangles, interdental papillae and gingival margins.

Many of these factors and their influence on smile aesthetics have been studied in isolation. Orthognathic surgery in patients with antero-posterior skeletal discrepancies tends to improve facial attractiveness, whereas aesthetic improvement after functional appliance therapy appears to be less profound even though facial proportions are brought closer to normal values.[8,9]

Those with pleasing smile aesthetics tend to display 2–4 mm of the maxillary central incisors at rest, and their full crown height on smiling with minimal gingival display.[10,11] Symmetrical smiles have been

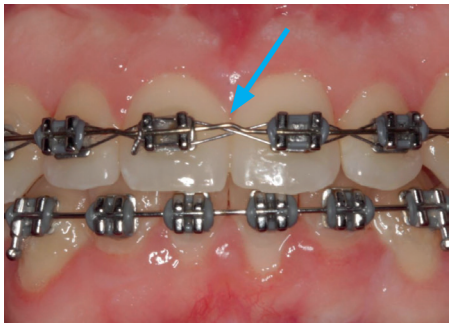


Figure 2. Second order bend to correct tip of UR1.

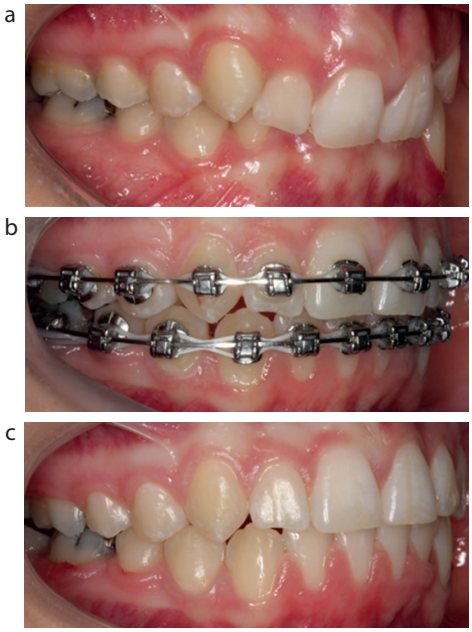


Figure 3. Full torque expression: **(a)** pre-treatment (undertorqued); **(b)** mid-treatment; and **(c)** post-treatment.

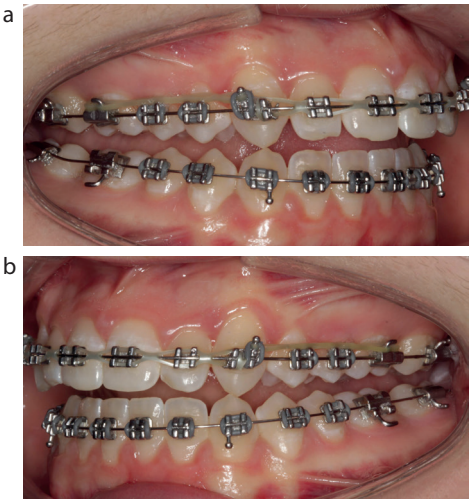


Figure 4. (a,b) Checking functional occlusion prior to debonding of fixed appliances.

judged to be more aesthetically pleasing than those with asymmetry, particularly with respect to coincidence of dental and facial midlines where a discrepancy of over 2 mm compromises aesthetics.[12,13]

Facial attractiveness reduces as the smile arc deviates away from the ideal contour which should follow the curvature of the lower lip. Attractiveness also decreases with increasing buccal corridor show and increasing occlusal cant.[14,15]

A smile is considered more attractive when the teeth are aligned, with a pleasing hue and there are no discrepancies in the shape, colour and level of the gingivae with no black triangles.[16,17]

How

To achieve optimal smile aesthetics, consideration needs to be given to these macro, mini and micro features. As finishing starts at the beginning of treatment, the following need to be considered from the outset:

- Facial and dental aesthetics: Comprehensive examination and treatment planning includes an assessment of facial and dental aesthetics. As macro-aesthetics in this context are influenced principally by orthognathic surgery or functional appliance therapy, they are not typically considered finishing or detailing procedures and will not be discussed further here.
- Incisor display: To increase incisor display in cases of localized gingival excess, laser gingivectomy or crown lengthening may be used.
- Gingival display: Botulinum toxin A could be administered to the upper lip elevator muscles to reduce gingival display in cases with 'gummy smile' owing to hyperactive lip musculature.[18]
- Buccal corridor width: Upper arch expansion may be indicated as part of treatment to reduce the width of buccal corridors.
- Smile arc and occlusal cant: Compensatory adjustments to bracket positions may be made in cases of flat or non-consonant smile arc or where an occlusal cant exists.
- Individual dental anatomy: Precise bracket positioning in all three planes (mesiodistal, vertical and angular) for every tooth, taking specific regard of teeth visible in the smile. Alterations should be made to account for incisor wear or enamel fractures.
- Bracket positioning errors or insufficient expression of the bracket prescription: Where these are observed, archwire bends should be incorporated (Figures 1 and 2). Full-dimension archwires are required for full torque expression (Figure 3).
- Bracket prescription modifications: Specific adjustments to the bracket prescription for individual teeth, e.g. inverting a bracket on an in-standing upper lateral incisor reverses the prescription from palatal root torque to labial root torque to ensure that the root is palpable labially and the crown inclination is in line with the adjacent incisors.[19]
- Tooth size and shape: Measurement of both the true mesiodistal dimensions of the anterior teeth and their apparent widths as observed in the smile to take account of the Bolton ratio (77.2% ± 1.65%) and golden proportion (1.618:1), respectively.[20,21] Restorative build-up or interproximal enamel reduction can be performed to ensure that the upper canine–canine mesiodistal width complements that of the lower for optimal aesthetics.

Function

Why

The finished occlusion should be well interdigitated and free of displacing occlusal contacts as these may predispose to relapse, compromise periodontal health and promote temporomandibular joint problems.

What

Any occlusal scheme is acceptable, provided occlusal interferences are eliminated.[22] These are:

- Canine guidance: unilateral working side contact of maxillary and mandibular canines only during lateral excursion which disoccludes all other teeth.
- Group function: simultaneous contact of the canine and posterior teeth on the working side during lateral excursion.
- Balanced occlusion: bilateral, simultaneous occlusal contacts on working and non-working sides during excursive movements.

Distinction should be made between non-working side contacts, where teeth come together without incident, and occlusal interferences that compromise function or cause dysfunction.[22]

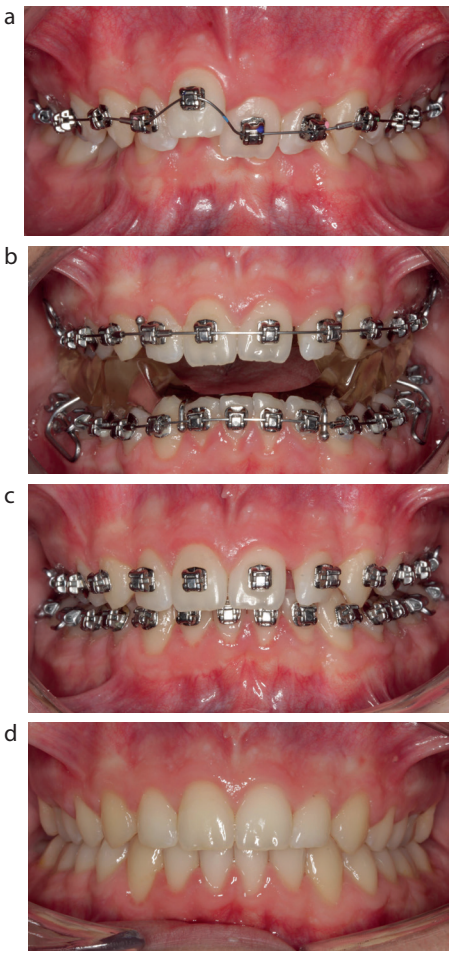


Figure 5. Bracket repositioning: UR1 repositioned. **(a)** Initial bonding, **(b)** initial alignment, **(c)** repositioned and **(d)** finish.

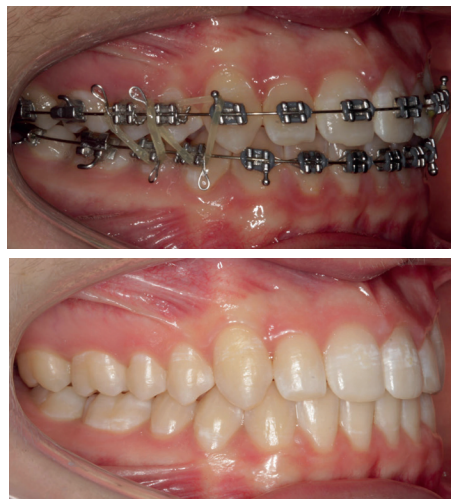


Figure 6. (a) Settling elastics with finishing archwires (0.016 inch stainless steel) and **(b)** post-treatment.

Figure 7. (a) Sectioned archwires used in conjunction with settling elastics (not shown). **(b)** final occlusion.

Figure 8. 0.016 inch stainless steel archwire used in finishing stage of treatment, customized and coordinated to the pre-treatment archform.

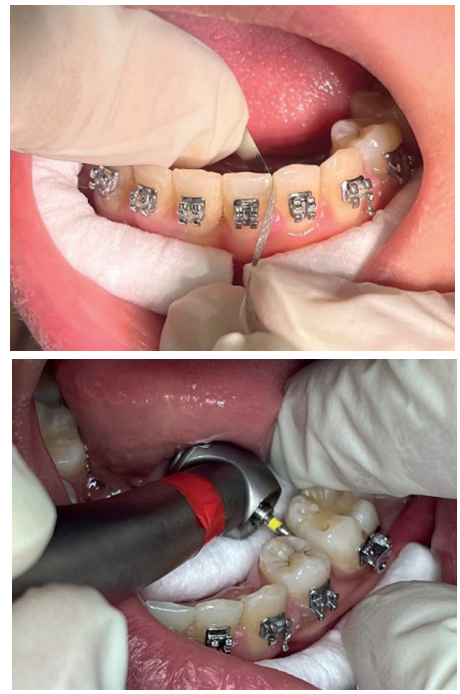


Figure 9. IPR with **(a)** handheld strip and **(b)** air rotor.

How

The static and functional occlusion must be checked prior to debonding to ensure the presence of a well-interdigitating static occlusion and a dynamic occlusion free of interferences (Figure 4). Adjustments at this stage may be necessary because, although following debonding, the naturally occurring occlusal, soft-tissue and periodontal forces have the potential to bring about spontaneous improvement in occlusal interdigitation, for most, the functional occlusion remains unchanged.[23] Articulator mounting of casts is not required.[24] The following may be necessary:

- Bracket repositioning (Figure 5) and archwire bends to address premature displacing contacts with or without occlusal equilibration.
- Settling elastics, sectioning of archwires and/or partial debonding to maximize occlusal interdigitation (Figures 6 and 7).

Stability

Why

Following orthodontic treatment, teeth tend to revert towards their pre-treatment positions.[25] Finishing and detailing should optimize the prospect of stability. Rotated teeth are particularly prone to relapse as is any marked change in the labio-lingual position of the lower labial segment and expansion of the lower intercanine distance.[26]

What

The teeth should be positioned in a zone of equilibrium between the lips, cheeks and tongue.[27] To garner long-term stability, the following should be checked and realized during finishing:

- Maintenance of the pretreatment lower archform, particularly of the lower labial segment and intercanine distance.
- Maximal contact areas of the lower incisors.
- Full alignment of initially rotated teeth.
- Overbite reduction to within normal limits.
- Well-interdigitated buccal segment occlusion.

These factors will help to inform the retention plan, which should be customized for the individual patient considering pre-treatment features of the malocclusion.

How

- Finishing archwires should be customized and coordinated to maintain the original archform (Figure 8).

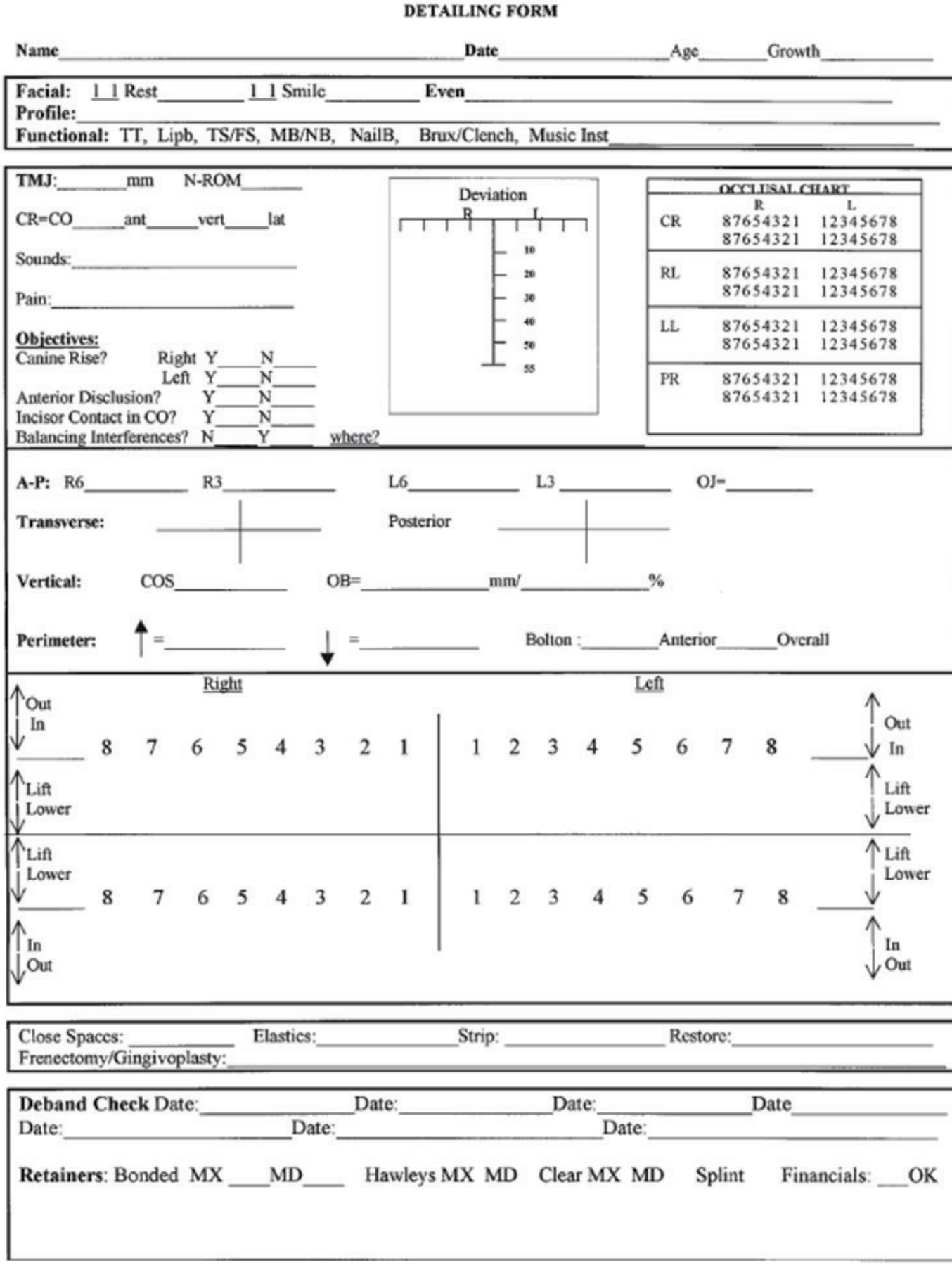
Ortodontia UFF

The Check List (before orthodontic appliance removal)

Name:	Age:		Orthodontist:
1- Oral Health	Answer		Comments
a. Absence of tooth decay	( ) Yes	( ) No	
b. Absence of decalcification	( ) Yes	( ) No	
c. Absence of periodontal recession	( ) Yes	( ) No	
d. Absence of root resorption	( ) Yes	( ) No	
e. Root Parallelism	( ) Yes	( ) No	
2- Aesthetic			
a. Facial – Frontal			
I- Symmetry	( ) Yes	( ) No	
II- Proportional Facial Thirds	( ) Yes	( ) No	
b. Facial - Profile			
I- Total - Orthognathic profile	( ) Yes	( ) No	
II- Lower Third – "S" Line	( ) Yes	( ) No	
c. Dental Esthetic			
I- Lips at rest: 3 - 5 mm	( ) Yes	( ) No	
II- Smile			
1- Incisal edges of upper teeth - smile arch	( ) Yes	( ) No	
2- Gingival outline and exposure: 0 a ± 2mm	( ) Yes	( ) No	
3- Incisors display in smile: 10-12mm	( ) Yes	( ) No	
4- Shapes, Positions and Sizes: Proportional.	( ) Yes	( ) No	
5- View in esthetic proportions: 100:60%.	( ) Yes	( ) No	
3- Occlusion			
a. Occlusal view	( ) Yes	( ) No	
I- Correct contact points	( ) Yes	( ) No	
II- Absence of rotations	( ) Yes	( ) No	
III- Marginal ridges (leveling)	( ) Yes	( ) No	
b. Lateral view – P > A			
I- Molar relationship	( ) Yes	( ) No	
II- Occlusal relationship	( ) Yes	( ) No	
III- Occlusal contacts	( ) Yes	( ) No	
IV- Anterior upper torque and Overjet	( ) Yes	( ) No	
V- Lower occlusal plane (flat or smooth curve)	( ) Yes	( ) No	
c. Frontal view			
I- Upper Incisors M-D (inclinations to midline)	( ) Yes	( ) No	
II- Lower Incisors M-D I. (Slightly to midline or vertical)	( ) Yes	( ) No	
III- Midline (0 to 2,5mm to the face)	( ) Yes	( ) No	
IV- Posterior upper torque	( ) Yes	( ) No	
V- Posterior lower torque - progressive	( ) Yes	( ) No	
4- Function			
a. Centric relation = M. I. (CR=CO, No slide)	( ) Yes	( ) No	
b. Incisor guidance (Overjet and Overbite = 2 - 3mm)	( ) Yes	( ) No	
c. Canine guidance (Non posterior interference)	( ) Yes	( ) No	
d. Healthy TMJ	( ) Yes	( ) No	
5- Stability			
a. Maintenance of intercanine distance	( ) Yes	( ) No	
b. Maintenance of the lower arch form	( ) Yes	( ) No	
c. Lower incisors A-P positions (maintained or uprighted)	( ) Yes	( ) No	
d. Mandibular plane maintained	( ) Yes	( ) No	
e. Lower retention - defined	( ) Yes	( ) No	
f. Upper retention - defined	( ) Yes	( ) No	
6- General Considerations			
a. Lower incisors stability	( ) Yes	( ) No	
b. 11/10 orthodontics (overcorrections)	( ) Yes	( ) No	
c. Atypical or unusual case	( ) Yes	( ) No	
d. Patient collaboration	( ) Yes	( ) No	
e. Other considerations			
7- Conclusions about the case			
a. Good or excellent treatment	( ) Yes	( ) No	
b. Observations:			

Mucha, JN

Figure 10. Sample finishing and detailing checklist.[32]



DETAILING FORM

Name_____ Date_____ Age_____ Growth_____

Facial: 1 1 Rest_____ 1 1 Smile_____ Even_____
Profile:_____
Functional: TT, Lipb, TS/FS, MB/NB, NailB, Brux/Clench, Music Inst_____

TMJ:_____mm N-ROM_____
CR=CO_____ant_____vert_____lat
Sounds:_____
Pain:_____

Objectives:
Canine Rise? Right Y____N____
Left Y____N____
Anterior Disclusion? Y____N____
Incisor Contact in CO? Y____N____
Balancing Interferences? N____Y____ where?

Deviation
R L
10
20
30
40
50
55

OCCLUSAL CHART

	R	L
CR	87654321	12345678
	87654321	12345678
RL	87654321	12345678
	87654321	12345678
LL	87654321	12345678
	87654321	12345678
PR	87654321	12345678
	87654321	12345678

A-P: R6_____ R3_____ L6_____ L3_____ OJ=_____
Transverse: Posterior
Vertical: COS_____ OB=_____mm/_____%
Perimeter: ↑=_____ ↓=_____ Bolton :_____Anterior_____Overall

Right Left

Out In _____ 8 7 6 5 4 3 2 1 | 1 2 3 4 5 6 7 8 _____ Out In
Lift Lower Lift Lower
Lift Lower _____ 8 7 6 5 4 3 2 1 | 1 2 3 4 5 6 7 8 _____ Lift Lower
In Out In Out

Close Spaces:_____ Elastics:_____ Strip:_____ Restore:_____
Frenectomy/Gingivoplasty:_____

Deband Check Date:_____ Date:_____ Date:_____ Date_____
Date:_____ Date:_____ Date:_____

Retainers: Bonded MX ____MD____ Hawleys MX MD Clear MX MD Splint Financials: ___OK

Figure 11. Sample finishing and detailing checklist.[33]

- Interproximal reduction may be used to increase the contact area of teeth, particularly in the lower labial segment, and/or eliminate black triangles (Figure 9).[28] Although this does not prevent post-treatment changes, it has proved to be as effective as a bonded retainer or positioner in the mandibular arch in the long term.[29]
- Circumferential supracrestal fibrotomy (CSF) has been shown to reduce rotational relapse by 30%, but does not obviate the need for a bonded retainer.[30,31]
- Buccal segment interdigitation can be improved through individual second order archwire bends for vertical marginal ridge discrepancies. Light stainless steel (e.g. 0.016 inch) archwires or sectioning of the archwires distal to the lateral incisors can be employed with or without vertical settling elastics.

Discussion

The current advice with regard to finishing and detailing has been presented, with pointers to what is relevant in relation to aesthetics, function and stability. Comprehensive checklists have been created to direct the orthodontist at the finishing and detailing stage (Figures 10 and 11).[32,33] While checklists may direct the clinician towards a high standard of orthodontic finish, it is important that the evidence on which these strategies are based is of good quality. The current evidence available in relation to finishing and detailing in now critiqued.

Orthodontic treatment overall has a positive influence on dentofacial and smile attractiveness, as perceived by both clinicians and laypersons, but the evidence underpinning this is significantly biased.[34] The precise extent to which orthodontic treatment improves facial and dental aesthetics remains uncertain. The means and measures by which dental and facial aesthetics are assessed would appear to need further refinement to capture this.

Evidence is also insufficient with regard to whether the occlusal changes brought about by orthodontic treatment have a positive influence on function of the dentofacial complex.[22] While clinicians should of course aspire towards the best possible occlusal finish for each and every patient, the only current evidence-based obligation for the clinician undertaking orthodontic treatment would seem to be the elimination or avoidance of introduction of occlusal interferences, which might predispose to TMD.

With regard to post-treatment stability, some evidence exists regarding the long-term stability of changes brought about by orthodontic treatment. Hierarchically, antero-posterior change is more stable than vertical change, which is more stable than alignment, which is in turn more stable than transverse change followed by extrusive movements to correct an anterior open bite.[26] Weak evidence suggests that stability may be improved by IPR and CSF,[35] but indefinite retention is still advised to maintain the treatment result and resist the effects of continued dentofacial growth on the occlusion.

Aside from the American Board of Orthodontics Objective Grading System (OGS) and the Peer Assessment Rating (PAR), indices that evaluate malocclusion typically assess treatment need rather than treatment outcome. By virtue of being measurable, occlusal aspects are the focus of these indices, with aesthetic, functional and stability components not being evaluated collectively. It would appear that such a unified index of metrics to assess finished case quality, with a robust evidence base to support it, does not exist. Further work is needed in this regard.

Conclusions

- Finishing and detailing should be considered from the beginning of treatment, so that the desired endpoint is kept in mind from the outset.
- Finishing and detailing may involve bracket repositioning, archform adjustment, localized wire bending, elastic traction, partial debonding, occlusal adjustment as well as restorative and periodontal input. It should also take into consideration the retention plan.
- Attention should be given to aesthetics, function and stability.
- Better quality evidence is required to demonstrate which procedures from this stage of treatment have the greatest impact on aesthetics, occlusal harmony and stability.

Compliance with Ethical Standards

Conflict of Interest: The authors declare that they have no conflict of interest.
Informed Consent: Informed consent was obtained from all individual participants included in the article.

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