



## Review Article

# Finishing and detailing in straight wire orthodontics – beginning of the end

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### ABSTRACT

Finishing and detailing is one of the most crucial phases during orthodontic treatment as it perfects the occlusion. Finishing procedures are usually considered from the pre-planning phase and involve good diagnosis, appropriate treatment plan, and its implementation. In this stage, the orthodontist reviews a checklist of changes that need to be made to achieve ideal results in the areas of esthetics, occlusion, stability, and periodontal health. This article intends to provide comprehensive knowledge and an overview of the various procedures carried out during the finishing and detailing stage of the treatment.

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## 1. Introduction

Orthodontic finishing is characterized as an art made up of individual perceptions and minute details. It is described as the final stage of fixed orthodontic mechanotherapy, during which fine detailing takes place to idealize individual positions of the tooth. Detailing is the achievement of the optimal location of each tooth in all three planes, with particular regard to individual in-out, rotation, tip and torque changes.<sup>1</sup> Finishing distinguishes the true master of the specialty from the ordinary orthodontist. It is the tiny details that make the difference and are the essence of finishing. When a new orthodontic case is initiated, it is essential to have a vision in order to obtain optimal results, and this is achieved right at the outset during the diagnosis and treatment planning phase. Finishing procedures are considered from the beginning of the treatment phase, as a part of the overall treatment regimen. Finishing is typically the final step, prior to the discontinuation of the active therapy, which ensures that the teeth and associated structures are placed in a way to achieve greater stability,

improved esthetic properties, optimized stomatognathic system functions and improved periodontal health.

The key criteria that play a major role in deciding the amount of work to be performed in the finishing stages of treatment are appliance mechanics, initial bracket positioning and needful repositioning, arch forms, arch wire coordination and force levels. In any given case the actual amount of work done during finishing and detailing phase can be increased by:

1. Variation in the shape and size of the patients' teeth compared to the average measurements used for pre adjusted appliance.
2. Inaccuracies or shortcomings in the appliance designs relative to its measurement goals.
3. Inaccuracies in appliance placement relative to the design of the appliance.
4. Failure to allow sufficient time for bracket system to express itself.

In a pure straight wire system, if all the other variables remain the same, finishing and detailing would not be better than bracket placement. Thus, finishing and detailing is the

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beginning of the end in a pre-adjusted system, therefore we have to start with the end in mind.

## 2. General considerations in Finishing and Detailing

Rebecca Poling<sup>2</sup> described a comprehensive detailed method of evaluating the orthodontic patient in the finishing stage of treatment. She also described a system of written notations to guide the orthodontist to achieve excellent finishing. The basis of this system of finishing is the “Detailing Form”, which is used during the final detailing appointment. It is divided into six sections: three for recording examination findings and three for wire adjustment notations and procedures that need to be completed.

### 2.1. Extra oral objectives

Evaluation of overall facial symmetry, lip and occlusal plane horizontal symmetry is done and notations of symmetry, incisor display at rest and smiling are made in the first section of the Detailing Form. Coincidence of the dental midlines with the facial midlines is checked and any cant to the occlusal plane or slant to the dentition is noted and wire changes to correct such a cant should be written in the wire changes section of the Detailing Form. Patient’s profile, functional habits such as tongue thrusting, lip biting, thumb sucking, mouth breathing, bruxism, clenching and temporomandibular joint are evaluated and notations should be made in the respective sections of the Detailing Form.<sup>2</sup> The extra oral objectives are based on esthetic principles, with the majority of them relating to smile. Incisor display detailing should be restricted to proper leveling and alignment of incisal edges. During the finishing phase, the gingival display and symmetry may be altered within a narrow range of 1 mm by selective intrusion or extrusion of any of anterior teeth.<sup>2</sup> In patients with dental cant, corrections in the finishing phases are difficult but achievable. An intrusive force can be given on the area that needs to be intruded. If the rotation of the anterior segment needs to be around the center of resistance, two cantilevers with a couple force may be given to achieve intrusion of one side and extrusion of the opposite side. Another method of achieving rotation around the center of resistance is by placing a cantilever in an auxiliary tube of the anterior segment.<sup>3</sup> Anterior cross elastics and cantilever springs can be used to slightly tip the teeth to correct midline discrepancies. Slight tooth morphology discrepancy corrections can be achieved by contouring the incisal edges of the upper anterior teeth. In patients with prominent maxillary incisor lingual fossae, height of the mesial and distal ridges may be reduced to achieve better posterior occlusion.<sup>4</sup>

### 2.2. Intra oral objectives

#### 2.2.1. Intra arch objectives

Evaluation of maxillary and mandibular anterior and posterior teeth for the alignment of incisal edges, crown torque, parallelism of facial surfaces of the premolars, facial cusp lengths, flatness of the occlusal table and curve of Spee, alignment of central fossae and functional cusps should be done and the notations should be made in the Detailing Form. Archwires are centered and marked with a black marker in the upper arch and red marker in the lower arch. Usually, 0.019x0.025” or 0.017x0.025” TMA wires are used as they are flexible and will engage the slot adequately to deliver the desired movement.<sup>2</sup> Each tooth must be evaluated with reference to its first-, second- and third order positions. Teeth should have tight interproximal contacts without rotations and the cusp tips and fossae should follow perfect arch form.<sup>5</sup> A mesial out rotation of the mesiobuccal cusp of the upper first molar is considered to be ideal and the buccal surface of that tooth should be parallel to the palatal suture.<sup>6</sup> The posterior marginal ridges should be at the same level as they are good indicators for parallel roots.<sup>7</sup> The buccal surfaces of maxillary canines and first premolars should be parallel to the mid sagittal facial line. The final intra arch objective is to achieve a gentle curve of Spee.<sup>8</sup>

Notations for any periodontal procedures such as gingivectomies or frenectomies to improve incisor display, gingival esthetics or stability are made on the lower portion of the Detailing Form.<sup>2</sup>

#### 2.2.2. Inter arch objectives

Angle’s classification of occlusion, overjet, posterior transverse relationships, crossbite tendencies, curve of Spee, overbite, spacing are evaluated and notations should be made in the respective sections of the Detailing Form. The final and most important evaluation step is to view the occlusion with a mirror looking up under the buccal cusp tips and incisor edges of the maxillary teeth and checking the meshing of the mandibular buccal cusps and lower incisal edges into the fossae of the maxillary arch. Changes that need to be made to improve interdigitation should be noted in the wire changes section of the Detailing Form.<sup>2</sup> The first molars and canines are the most important teeth to be evaluated regarding the interocclusal relationship. Achieving a Class I canine relationship should be the main objective, but is difficult to achieve when a significant Bolton’s discrepancy exists. Cusp-to-fossa relationship in molars and cusp-to-interproximal space relationship in premolars is considered ideal and should be achieved. In the anterior segment, overjet and overbite play a major role in achieving proper interocclusal relationship. The inter canine and inter molar widths are to be coordinated to prevent excessive buccal overjet or cross bite tendencies. In this stage, the midlines should be coincident and any discrepancy of 1-2 mm or more is indicative of inaccurate

occlusal relationship.<sup>9,10</sup>

### 2.3. Radiographic objectives

A panoramic radiograph is obtained to assess root angulations and parallelism. The root positions as seen on the panoramic radiograph are the foundation of occlusion and determine the interrelationships between patient's esthetics, function, health and stability. The location and degree of root angle bend notations are drawn on the form. Usually, a "V" bend in the maxillary wire would bring excessively divergent roots together and a "tent" bend moves them apart.<sup>2</sup> Root angulation problems observed in the finishing panoramic radiograph might also be related to abnormal tooth morphology and/or bracketing errors. The finishing panoramic radiograph is also helpful in evaluating root resorption. If external apical root resorption is observed, the time spent on the finishing stage is usually reduced.<sup>11</sup>

When all the desired changes have been noted, the detailing wire is bent using an AEZ Arch Bending Plier. First, the root angle bends are placed followed by vertical and in/out bends. Finally, torque changes are made. When the patient returns in 4-6 weeks for a debond check appointment, occlusion is checked and desired changes are noted on the Detailing Form using another ink colour. Desired bends are made and the wires are inserted and completely tied in. When no more changes are needed, appliance removal is scheduled. After the appliance removal, centric contacts are to be checked with articulating paper and balancing interferences are to be removed.<sup>2</sup>

### 3. Finishing in Roth prescription

Roth<sup>12,13</sup> altered the prescription of the Andrews bracket in all three planes of space to achieve over corrections of the teeth prior to appliance removal. He also added the goals of gnathologic finishing as part of orthodontic treatment. In the finishing phase of the treatment, 0.021x 0.025" and 0.022x0.028" steel wires are used to achieve full bracket expression, anchorage control, and arch stabilization. Short class II or III elastics are used to create anteroposterior denture adjustments and the patients are reviewed at 2 weeks intervals.

In Roth philosophy detailing phase begins in the mandibular arch. Mandibular incisors should be in the same plane of space and should have divergent roots. Canines should have a mesioaxial inclination of 5° with distal root positioning. Canine tips should be 1mm higher than the incisal edges of the lateral incisors and they should have a slightly exaggerated mesial rotation in extraction cases. Premolars and molars should be upright and should have slight distal rotation. There should be no spaces and the arch form should be symmetrical. The widest point of the mandibular arch should be the mesiobuccal cusps of the

mandibular first molars and the first bicuspid. The curve of Spee should be leveled.

In the upper arch, the first molars should have sufficient distal rotation, mesioaxial inclination, and buccal root torque to fit with the lower molars. The incisal edges of upper centrals and laterals should be at the same level with no more than 0.5mm height differential. The widest point of the maxillary arch should be the mesiobuccal cusps of the maxillary 1st molars. Cusp tips of the canines should be approximately 1-1.5mm incisal than that of the occlusal plane to establish a cuspid guidance.<sup>12,13</sup>

### 4. Finishing in MBT prescription

The MBT prescription<sup>14</sup> was officially introduced in 1997 by McLaughlin, Bennett and Trevisi after reviewing Andrew's original findings and additional research from Japan. The finishing stage in MBT takes into account horizontal, vertical, transverse, dynamic, cephalometric and esthetic considerations.

#### 4.1. Horizontal considerations

Coordination of tooth fit between the anterior and posterior segments is a major consideration in horizontal plane. In 20% of the cases, the anterior and posterior teeth are well coordinated and require no adjustments. In 60% of the cases, an anterior mandibular tooth material excess exists and in 20% of the cases, there is an excess of upper anterior tooth mass relative to the lower anteriors. Tooth size discrepancy may be corrected either by reducing tooth mass in one arch with either proximal enamel reduction and or by addition of tooth mass with restorative materials in the opposing arch. In the finishing stage, segments of coil spring can be placed on the archwire for accurate positioning of small teeth. Composite build-ups should be done in the retention stage as this allows any gingival inflammation to resolve by itself.<sup>14</sup>

The inclinations of the maxillary anterior teeth are best evaluated with a lateral cephalogram. During finishing, examination of the incisal edges, cingulums, clinical lengths of the contralateral teeth and root prominences helps to decide if there is an alteration in the inclinations. Significant rotation corrections of the posterior teeth can be maintained by performing supracrestal fibrotomy two months before debonding. Reopening of spaces can be prevented by using figure 8 ligatures or light elastic threads. Class II or Class III elastics are usually used for the overcorrection of antero posterior position of the dentition. In Class II cases, the anterior teeth can be finished in an edge to edge position and held for 6-8 weeks with night time elastics and class III cases can be horizontally overcorrected by producing 3-4mm of additional overjet.<sup>14</sup>

#### 4.2. Vertical considerations

Bracket repositioning or wire bendings are usually necessary in the finishing stage to establish ideal marginal ridge relationships and contact points. The orientation of brackets is checked and they are vertically repositioned so that the marginal ridges are at the same height or within 0.5mm of each other. Bite opening curves can be used to achieve overcorrection in deep bite cases.<sup>14</sup>

#### 4.3. Transverse considerations

Archform and archwire coordination, establishing correct posterior torque and transverse over corrections in expansion cases are the major transverse considerations during the finishing stage.<sup>14</sup>

#### 4.4. Dynamic considerations

Good facial esthetics and an ideal static and functional occlusion are the main objectives of orthodontic therapy. In order to direct the mechanotherapy towards achieving final ideal, static and functional occlusion, the patient is monitored in centric relation throughout the treatment. If this is disregarded, treatment may finish with the mandible in centric occlusion, with many pre-maturities that may trigger TMD. Minor corrections of condylar and mandibular positions can be achieved in the finishing stages. If the patient exhibits an anterior slide with a corresponding anterior condyle position, headgear or Class II elastics are to be continued for an additional period of time to allow the condyles to seat in the fossae. Conversely, if the patient exhibits a significant posterior condylar position with no evidence of anterior slide, Class II elastics and headgears are discontinued and Class III elastics are given.<sup>14</sup>

#### 4.5. Cephalometric and esthetic considerations

Final cephalometric radiographs may be taken approximately 3-4 months before debonding rather than after treatment, so that necessary tooth positions can be corrected. The most important factors to be evaluated involve the soft tissue profile, anteroposterior positions and torque of the incisors, mandibular plane changes, degree of vertical development or restriction and the success in correcting anteroposterior skeletal and dental components. Superimposition of final and initial radiographs is done to accurately determine the changes that have been achieved.<sup>14</sup>

##### 4.5.1. Settling the case – The final phase of finishing

Rectangular stainless steel wires are needed for overbite control, anteroposterior corrections and space closure, but they are rigid and restrict settling of the teeth in the finishing stages. Upper and lower arch wires are removed one week before debonding and the teeth are ligated from second premolar to second premolar in a serpentine

fashion using ligature wire. This allows the occlusion to settle without creating any interdental spacing. During the following week, the patient is advised to chew as much gum as possible. This fine detailing method is ideal if only minimal discrepancies remain in the tooth positions or if the patient's cooperation during treatment has not been satisfactory. Vertical spaghetti elastics, serpentine elastics and box elastics with a Class II or Class III vector may be used for settling the occlusion.<sup>14,15</sup>

### 5. Finishing in Lingual Orthodontics

The finishing phase is the most challenging and difficult stage in Lingual Orthodontics. In certain cases, finishing of a case will take as much time or longer than the correction of the major problems of malocclusion, therefore, the time spent on finishing plays a major role in determining the overall treatment duration. Usually, the finishing quality of treatment is homogeneous for labial and lingual techniques. Similar to labial orthodontics, finishing in lingual technique also involves dynamic, cephalometric, esthetic and functional considerations.<sup>16,17</sup> The difficulties encountered in the finishing phase of lingual orthodontics are mainly due to:

1. Patients' characteristics
2. Anatomy of the lingual surfaces
3. Mechanics involved

Most of the patients receiving lingual orthodontics are adults with unique personal needs that are associated with general dental and periodontal issues. Adult orthodontic treatment is more challenging than conventional adolescent treatment, because it requires individual solutions for specific problems with an interdisciplinary approach to achieve optimum final results. In general, it is difficult to achieve a good final result in dentition with abraded and missing teeth, and with periodontal and restorative complications. It is even more complicated with the lingual technique as lingual anatomy in such cases is further impaired.<sup>16,18</sup>

The morphology of the lingual surfaces of anterior teeth varies considerably from the uniform labial surfaces. The irregular palatal surface is the key explanation for the inaccuracy of the lingual bracket placement, which is a major factor affecting the finishing stage.<sup>16,18</sup>

The lingual surfaces of the anterior teeth are more inclined than the corresponding labial surfaces and therefore the point of application of force is at a distance from the center of resistance. As a consequence, bending the arch in one direction will produce tooth movement in an unwanted direction. To avoid this, finishing bends must be made in more than one plane of space. The short lingual arch length and wide inter bracket distance make it difficult to achieve precise and efficient three-dimensional finishing

bends. Finishing procedure in lingual orthodontics can be broadly divided into 3 steps.<sup>16,18</sup>

**Step 1:** Initial resilient rectangular archwire is reused for a period of 3 to 4 months, after steel ligating across the extraction spaces. This will regain control by full bracket engagement of the wire. This allows achieving ideal torque of the anteriors, arch coordination and correction of minor rotations.<sup>16</sup>

**Step 2:** This step is associated with settling the occlusion by achieving correct interdigitation and midline coordination. A round stainless steel wire or 0.0175" x 0.0175" TMA wire is used in the mandible, and a 0.014" round sectional wire from canine to canine or lateral incisor to lateral incisor is used in the maxilla. The posterior segments are ligated with figure 8 steel ligature wire and vertical elastics are tied to lingual brackets or clear labial buttons. Final detailing bends are usually given 4-6 weeks after the teeth have settled. Anterior vertical elastics from labial to labial clear buttons are preferred in Class I and II cases. In open bite cases, elastics extend from lingual to lingual brackets and from upper lingual brackets to lower labial clear buttons in Class III cases to enhance overjet correction. Anterior cross-elastics are used to correct midline discrepancies when the discrepancy. The elastics are worn usually from upper lingual brackets to lower labial clear buttons. Posterior vertical elastics, short Class II or Class III elastics are worn from lingual to lingual brackets or from clear buttons bonded on the labial surface.<sup>16</sup>

**Step 3:** Final detailing and finishing bends are incorporated in this step. Finishing bends are preferred over bracket repositioning because accurate repositioning for minor corrections is difficult to achieve. Inset bends, onset bends, V bends and rotation bends are usually placed to achieve fine detailing.<sup>16</sup>

### 5.1. Post finishing finalizing procedures

After debonding, an articulating paper is used to check the occlusal contacts and any balancing and functional interferences are removed. Esthetic recontouring of incisal edges may be performed to enhance esthetics and function. Bleaching of the teeth is also considered as a part of the finishing procedure and should be done before selecting the method of retention.<sup>16,18</sup>

## 6. Tooth positioner in case finishing

The tooth positioner, which was introduced by Kesling<sup>19</sup> in 1945, is a one-piece, resilient appliance which may be used for finishing orthodontic cases. This appliance occupies freeway space, covers the clinical crowns of all the teeth and about 3 mm of the buccal and lingual gingival mucosa. They are less frequently used in modern orthodontics due to the improved finishing inherent in pre adjusted systems. Impressions and a wax bite registration

are taken with the brackets in place, but with the arch wires and auxiliaries removed. The casts are sent to a laboratory for fabrication of a custom tooth positioner according to the orthodontists' prescription. The brackets are sculpt away from the cast, a wax setup is created and the positioner is fabricated. Desired artistic positioning bends are added to the archwires after the impressions are made. The patient is then scheduled to return in two to three weeks so that the final positioning bends can take effect. After debonding, the tooth positioner is delivered and it is to be worn 24 hours a day, except while eating and brushing, for about 6-8 weeks.<sup>19,20</sup> Cometti et al<sup>21</sup> reported that a minipositioner improved the overall finish of the treatment, outperforming bonded lingual retainers.

## 7. Special finishing procedures to avoid relapse

Changes resulting from continued growth in a Class II, Class III, deep bite or open bite pattern contribute to a return of the original malocclusion. Controlling this type of relapse requires a continuation of active treatment after the fixed appliances have been removed, rather than specific finishing procedures to prevent relapse. Active retention in the form of an extraoral force in conjunction with orthodontic retainers or a functional appliance is usually needed in patients with skeletal problems who have undergone orthodontic treatment. Overtreatment and adjunctive periodontal surgery to reduce rebound from elastic fibers in gingiva may be required in some cases to avoid relapse.<sup>22</sup>

## 8. Assessment of finished cases

The most commonly used grading system for the assessment of finished cases is the ABO Objective Grading System.<sup>23</sup> It was developed by John Casco, James Vaden, Vincent Kokich, Joseph Damone, Don James, Thomas Cangialosi, Michael Riolo, Stephen Owens and Eldon Bills through a series of four field tests over a period of 5 years (1994-1999). This Grading System for scoring dental casts and panoramic radiographs contains eight criteria: alignment, marginal ridges, buccolingual inclination, occlusal relationships, occlusal contacts, overjet, interproximal contacts, and root angulation.<sup>23</sup>

### 8.1. Alignment

In the anterior regions, proper alignment is characterized by coordination of alignment of the incisal edges and lingual incisal surfaces of upper incisors and canines and the incisal edges and labial incisal surfaces of lower incisors and canines. In the mandibular posterior region, the mesiobuccal and distobuccal cusps of the molars and premolars should be in the same mesiodistal alignment and in the maxillary arch, the central grooves should all be in the same plane.

If all teeth are in alignment or within 0.50 mm of proper alignment, no points are subtracted from the candidate's score. For a deviation of 0.5-1 mm, 1 point should be subtracted for the malaligned tooth. For a discrepancy greater than 1mm, 2 points should be deducted. The total number of deductions are subtracted from 64 to give the alignment score.<sup>23</sup>

### 8.2. Marginal Ridges

Marginal ridges of adjacent posterior teeth should be at the same level or within 0.5mm of the same level. For a discrepancy of 0.5-1mm, 1 point should be subtracted and for a discrepancy greater than 1mm, 2 points should be subtracted for any contact point. The total number of deductions should be subtracted from 32 to give the marginal ridge score.<sup>23</sup>

### 8.3. Buccolingual inclination

The buccolingual inclination of the posterior teeth should be assessed using a flat surface extending between the occlusal surfaces of the right and left posterior teeth. The straight edge should contact the buccal and lingual cusps of mandibular and maxillary molars respectively. The non functional cusps should be within 1mm of the surface of the straight edge. If these cusps are more than 1 mm, but less than 2 mm from the straight edge surface, 1 point should be subtracted for that tooth and if the discrepancy is greater than 2 mm, 2 points should be subtracted. The total number of deductions are subtracted from 40 to give the buccolingual inclination score.<sup>23</sup>

### 8.4. Occlusal contacts

The maxillary and mandibular functional cusps should contact the occlusal surfaces of opposing teeth. If a cusp is out of contact with the opposing arch and the distance is 1 mm or less, 1 point is deducted for that tooth and if the distance is greater than 1 mm, then 2 points are deducted. The total number of deductions are subtracted from 64 points to give the occlusal contacts score.<sup>23</sup>

### 8.5. Occlusal relationship

This section determines whether the occlusion is finished in an Angle's Class I relationship. The maxillary cusps should align with or within 1mm of embrasure or interproximal contact or buccal grooves of the lower teeth. For a deviation of 1-2mm, 1 point is subtracted and for a deviation of more than 2mm, 2 points are to be subtracted. The total number of deductions are subtracted from 24 to give the occlusal relationships score.<sup>23</sup> Angst et al<sup>24</sup> reported significant long term changes after debonding and suggested a higher finishing quality at debonding to achieve improved settling of the occlusion.

### 8.6. Overjet

Overjet is evaluated by articulating the models and by viewing the labiolingual relationship of the maxilla in relation to mandible. The mandibular incisors and canines should contact the lingual surfaces of maxillary incisors and canines. If the mandibular anteriors are not contacting the lingual surfaces of maxillary anteriors, and the distance is 1mm or less, then 1 point is deducted. If the discrepancy is greater than 2mm, 2 points are deducted. The total number of deductions are subtracted from 32 to give the overjet score.<sup>23</sup>

### 8.7. Interproximal contacts

Maxillary and mandibular casts are viewed from occlusal aspect and the mesial and distal aspects of the teeth should be checked for tight contacts. 1 point is subtracted if up to 1mm of interproximal space is present in between the teeth and 2 points are deducted if more than 2mm of space exists. The total number of deductions are subtracted from 60 to give interproximal contacts score.<sup>23</sup>

### 8.8. Radiographic analysis

The angulation of roots of maxillary and mandibular teeth are evaluated for parallelism on a panoramic radiograph. If a root is angulated and if the discrepancy is 1-2mm, 1 point is deducted. For a discrepancy greater than 2mm, 2 points are deducted. The total number of deductions are subtracted from 64 to give root angulation score.<sup>23</sup>

### 8.9. Passing score

A case that loses more than 30 points fails and a case that loses less than 20 points will pass.<sup>23</sup>

## 9. Conclusion

Finishing and detailing phase, which is the final stage of active orthodontic treatment, enables to perfect the occlusion by following various criteria established by different authors. It also improves the esthetic result, while achieving the treatment objectives planned during the initial stages. Excellent orthodontic finishing is critical and requires a variety of procedures, such as good diagnosis, a suitable treatment plan and the implementation of that treatment plan. Considering the numerous variables in all three planes of space, that have an effect on the finished orthodontic treatment result, the orthodontist must keep them in mind and take care to eliminate mistakes from the beginning of the treatment to minimize errors so that minimum amount of work is to be done during the actual stage of finishing and detailing.

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None.

## 11. Conflict of Interest

None.

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