

Management of pseudo Class III malocclusion in southern Chinese children

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Aim To illustrate a simple effective method for early treatment of pseudo Class III in the mixed dentition and to highlight the advantages of early treatment by showing a 4-year follow-up of the treatment effects.

Subjects Twenty-one consecutive southern Chinese patients with a mean age of 9.6 years were included in the early treated group with pseudo Class III malocclusion.

Methods Lateral cephalometric films taken at the beginning and at the end of treatment were analysed. The arithmetic mean and standard deviation (SD) were calculated for each cephalometric variable and paired *t*-tests were performed to assess the statistical significance of the treatment effects.

Results Anterior crossbites and mandibular displacements were eliminated after the treatment. The angulation of the upper incisors to the maxillary plane showed an increase by a mean of 9.5° ($P < 0.001$), while the angulation of the lower incisors to the mandibular plane showed a decrease by a mean of 4.9° ($P < 0.001$).

Conclusion In pseudo Class III malocclusion, proclination of upper incisors and/or retroclination of lower incisors with simple fixed appliances contribute to the correction of anterior crossbite and the elimination of mandibular displacement. Proclination of upper incisors, use of Leeway space and arch width increase provide space required for the eruption of the premolars and canines.

Pseudo Class III malocclusion has been characterised by an anterior crossbite in the presence of a forward mandibular displacement.^{1,2} The skeletal relationship is usually Class I or mildly Class III. The incidence of pseudo Class III malocclusion in a sample of 7096 Chinese children was estimated to be 2–3%, which is one and a half times that of skeletal Class III malocclusion in the same population.³ With such a high incidence of pseudo Class III malocclusion, it is difficult to justify the lack of attention given to the timing of treatment of pseudo Class III malocclusion which remains to be controversial.⁴ Some clinicians believed that in many patients, it was best to allow the eruption of the permanent teeth before initiating orthodontic treatment. That way, a relatively straight forward manner of treatment within a predictable period of time could be provided for the patients. However, delaying the treatment until the permanent dentition may cause loss of space required for the eruption of the canines.^{1,5,6} This lack of space could be caused by the retroclination of upper incisors frequently found in pseudo Class

III malocclusions. Therefore, a growing number of clinicians believe in the advantages of early intervention.^{7–11} The alternative treatment to this kind of malocclusion include the use of protraction headgear, chin cap and Fränkel III, which have been shown to be effective with statistically significant changes in the cranio-facial complex.^{12–18} Besides skeletal changes, the benefits attributed to the early treatment of pseudo Class III malocclusion focus on gaining space for the eruption of canines, improving self-esteem of the growing child^{7,8,10,19} and on eliminating traumatic occlusion to the incisors in crossbite.^{2,9,20}

In the current study, we aimed at familiarising the practising clinician with concepts of early diagnosis of pseudo Class III malocclusion and the benefits of early intervention. Specific emphasis was given to treatment planning to ensure maximum benefits in the shortest treatment time. The aims of the present article are to illustrate a simple effective method for the early treatment of pseudo Class III malocclusion in the mixed dentition and to highlight the advantages of early intervention by following up these cases for a period of 4 years.

Subjects

Twenty-one consecutive patients (12 males and 9 females with a mean age of 9.6 ± 1.5 years) in the mixed dentition stage before the exfoliation of the second primary molars were included in this study. The average treatment time was 7 months. The criteria for selecting the patients were: (1) Class III incisor relationship (at least two incisors with reverse overjet and overbite) in centric occlusion; (2) Patients were in the mixed dentition stage without exfoliation of the second primary molars; (3) All subjects exhibited mandibular displacement; (4) No subjects had undergone orthodontic therapy of any type prior to this treatment and (5) All subjects were southern Chinese.

Methods

The following parameters were measured before and after treatment to evaluate the effects of treatment:

Cephalometric analysis — dental changes

Lateral cephalometric films were taken at the beginning and at the end of the treatment. The mean time difference was 7 months with a range of 4 to 8 months. All radiographs used in the present study were taken in the same cephalostat and traced on acetate paper. The reference points were marked with a sharp pencil by one observer as shown in fig. 1. The evaluation was carried out with dentofacial planner 7.0 (Dentofacial Software Inc. Canada) using traditional cephalometric analysis methods.

Statistical analysis

All statistical analysis was performed with the program GraphPad InStat. The arithmetic mean and standard deviation (SD) were cal-

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REFEREED PAPER

Received 31.07.98; accepted 16.12.98

© British Dental Journal 1999; 186: 183–187

culated for each variable. Paired *t*-tests were performed to assess the statistical significance of any dental change due to early treatment. The levels of significance were: **P* < 0.05; †*P* < 0.01; ‡*P* < 0.001; *P* > 0.05 (NS).

Thirty cephalograms with ten variables were recorded twice independently on two separate occasions with a 2-week interval and the difference was small and not statistically significant. The method error in locating, superimposing and measuring the changes of different landmarks was calculated by the formula:²¹

$$ME = \sqrt{\frac{\sum d^2}{2n}}$$

Where *d* is the difference between two registrations of a pair and *n* is the number of double registrations. All variables were traced and superimposed with measurements recorded on two different occasions. The combined ME did not exceed 1.2° for angular variable investigated.

Appliance design and treatment sequence

Treatment provided included a simple 2 × 4 fixed appliance therapy which comprised two molar bands or buccal tubes (Ormco Corporation, Glendora, CA 91740) on the first molars and four brackets (.018" bracket slot, Ormco Corporation, Glendora, CA 91740) on the incisors (fig. 2c). The initial aligning wires were 0.016" nickel titanium (NITI, Ormco Corporation, Glendora, CA 91740). These wires were used for 1–2 months to align the incisors.

The aligning stage was followed by leveling of the anterior segment of the dental arch. Leveling was achieved by introducing advancing loops into 0.016" (0.4 mm) diameter stainless steel round wires (Ormco Corporation, Glendora, CA 91740). These loops were added mesial to the first molars to procline the upper incisors, and/or closing loops were added mesial to the lower molars to retrocline the lower incisors. In the upper arch, the distal portion of the loop lay against the mesial end of the molar tube whereas, in the lower arch, the loop was located at some distance mesial of the molar tube. The length of the vertical loop was dependent on the depth of the vestibule. As a guidance, 8 mm length for the maxilla and 6 mm length for the mandible were usually employed. The width of the upper loops was usually 5 mm and it placed the anterior segment of the wire 2–3 mm labial of the incisors. The wire was activated by engaging it with the incisor brackets and it resulted in incisor proclination in 2–3 months. An alternative method was to use a plain archwire with the addition of open coil springs to guide the upper labial segment forward.

By the end of these 3 months, the anterior crossbite was eliminated and the incisors were aligned (fig. 2c). This stage was followed by differential torque application using rectangular .016" × .022" TMA (Titanium molybdenum alloy, Ormco Corporation, Glendora, CA 91740) wire to place the roots of the incisors in the alveolar ridge. This wire has properties midway between stainless-steel and nickel titanium. The TMA rectangular wire was used on average for 2–3 months to apply palatal root torque

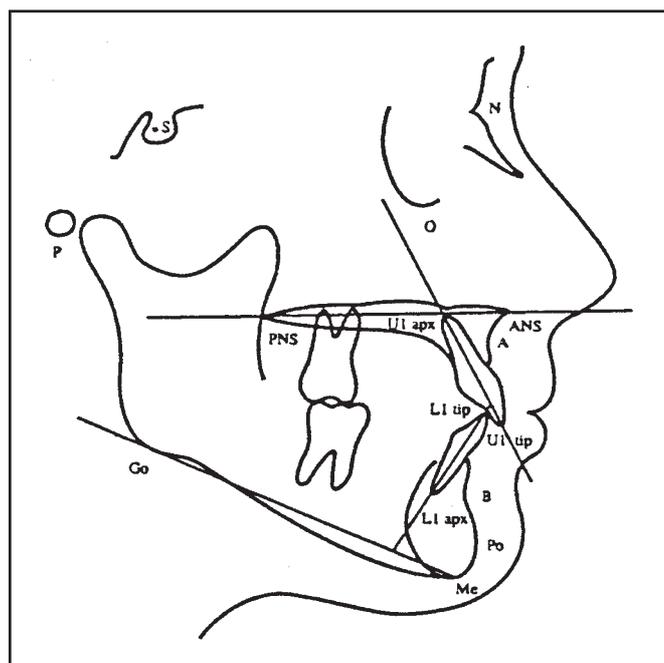


Fig. 1 Reference points and lines used in cephalometric analysis

on the upper incisors where needed. After torque application was completed, the wires were removed and the teeth were tied with ligature ties and allowed to settle for 1 week. If no relapse occurred, the appliances were debonded and no retainers were used. If signs of relapse occurred after the settling period, the same final TMA rectangular wire was retied and more detailed torque was applied.

Results

Treatment effects

Incisors inclination On average, upper incisor inclination to the maxillary plane at the beginning of treatment was 111.4° (Table 1), which indicated upright upper incisors compared with the Chinese norm of 118±6° for upper incisors inclination to the maxillary plane.²² Orthodontic treatment for a short period (7 months) resulted in proclination of the upper incisors by an average of 9.5° (*P* < 0.001) (Table 1). At the beginning of the treatment, the average value of lower incisor inclination to the mandibular plane was 91.9° and the Chinese norm is 97±7° (Table 1).

Nineteen out of 21 cases received treatment in the upper arch only and no treatment in the lower arch. However, the angulation of lower incisors on average decreased by 4.9° (*P* < 0.001) (Table 1). The average post-treatment value for lower incisor inclination was 87.0° (Table 1), which indicated slightly retroclined lower incisors both before and after the treatment. Two cases received orthodontic treatment to retrocline the lower

Table 1 Treatment effects for nineteen cases with 2x4 appliance in the upper arch

| | Chinese norm | PreTx | | PostTx | | Diff. | |
|---------|--------------|-------|-----|--------|-----|-------|-----|
| | | Mean | SD | Mean | SD | Mean | SD |
| SNA | 82.0 ± 3.5 | 81.3 | 3.0 | 81.5 | 2.5 | 0.2 | 1.7 |
| SNB | 79.0 ± 3.0 | 80.0 | 3.0 | 80.1 | 3.0 | 0.1 | 1.9 |
| ANB | 3.0 ± 2.0 | 1.3 | 2.1 | 1.4 | 2.0 | 0.1 | 0.9 |
| U1/MxPL | 118.0 ± 6.0 | 111.4 | 6.4 | 121.0 | 6.6 | 9.5† | 4.0 |
| L1/MnPL | 97.0 ± 7.0 | 91.9 | 4.2 | 87.0 | 2.7 | -4.9‡ | 3.5 |

**P* < 0.05; †*P* < 0.01; ‡*P* < 0.001

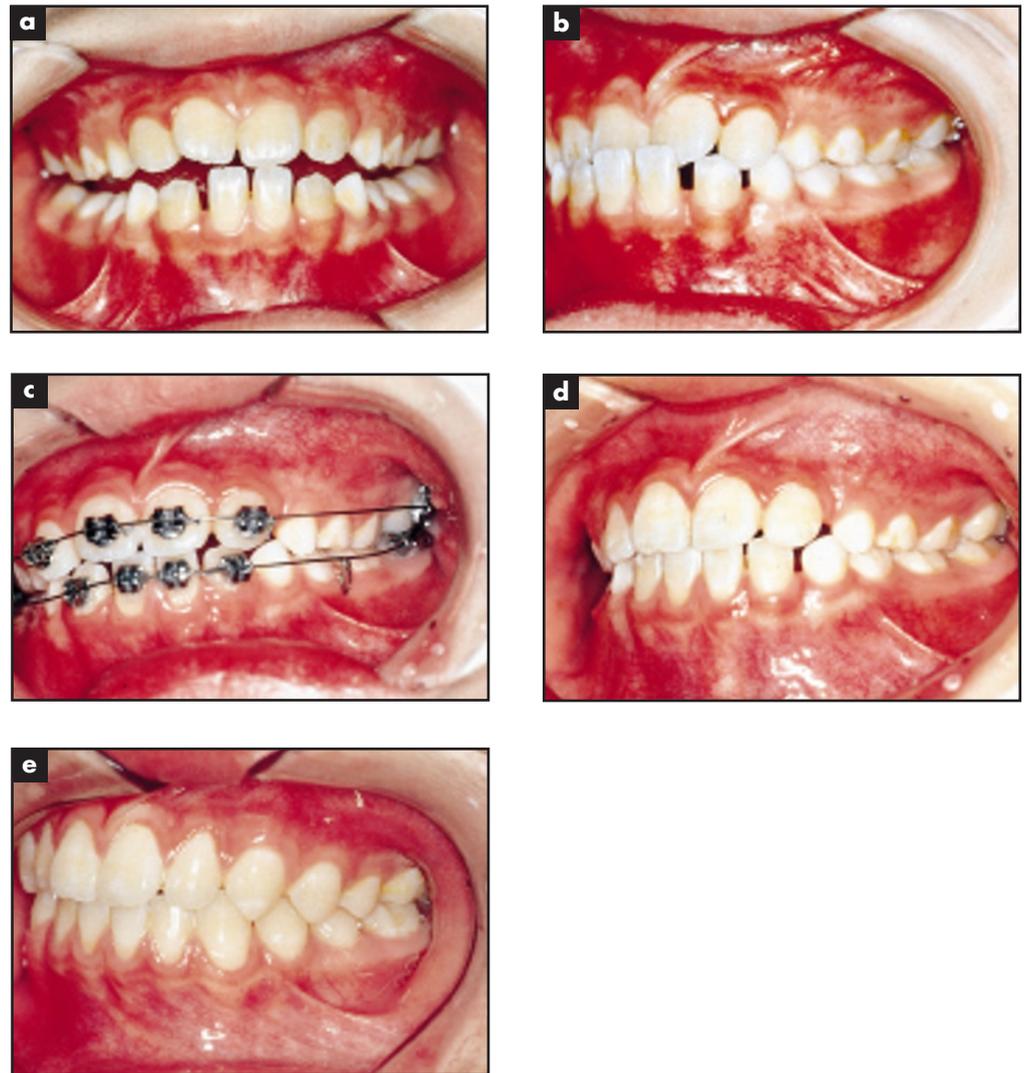


Fig. 2 (Case report 1).
Pretreatment: a) Frontal views at centric relation, b) Left side buccal and labial view; During treatment: c) Left side buccal and labial view; Post-treatment: d) Left side buccal and labial view; Four years follow-up: e) Left side buccal and labial view

incisors using closing loops on a fixed appliance. The values of the inclination of the lower incisors at the beginning of treatment for these two cases were 100.2° and 97.3°, and after simple fixed appliance treatment, the values of lower incisor inclination to the mandibular plane were 90.1° and 93.6°, respectively.

Discussion

Analysis of pretreatment radiographs revealed upright or retroclined upper incisors with an average value of 111.4° (Table 1). Upper incisor retroclination must have contributed to the crowding in the upper arch manifested in the lack of space for canine eruption.

Analysis of pretreatment records discussed above led us to the diagnosis that the retroclined upper incisors caused dental interference during the path of closure of the mandible. This dental interference led to mandibular displacement in a forward and upward direction to achieve function (fig. 2a). Also the retroclination of the upper incisors contributed to the space loss in the upper arch. Therefore, the early treatment objectives were to procline the upper incisors, eliminate mandibular displacement and to create space required for the eruption of canines and premolars.

Compared to alternative approaches to the early treatment of pseudo Class III malocclusion (such as chin cap, reverse headgear and Frankel III) this fixed appliance offers an effective way to control tooth movements in an anteroposterior direction ie proclination or retroclination. It also controls the position of the

roots, ie torque control in buccolingual directions when rectangular wires are used.

Only two out of twenty-one patients received both upper and lower arch treatment. In these two cases, the mandibular displacement was caused by dental interference due to mildly retroclined upper incisors (115°, 111°) and mildly proclined lower incisors (100.2°, 97.3°). Therefore, the objectives were to eliminate displacement by proclination of the upper incisors using advancing loops and retroclination of the lower incisors using closing loops. The remaining nineteen patients only received treatment in the upper arch. On average, 2.5° of proclination of incisors creates 1 mm of space on each side.²³ In all 19 remaining patients, upper incisors were proclined by an average of 9.5°. The presence of the advancing loops mesial to the first molars prevented the mesial drift of first molars and allowed the use of the Leeway space for canines and premolars eruption. Analysis of arch width showed an increase after the treatment. Therefore, the total space gained by a short period of treatment was a combination of proclination of the upper incisors, use of the Leeway space and an increase in the arch width.

Another advantage of early treatment is the elimination of traumatic occlusion caused by the anterior crossbite. Polson *et al.*²⁴ reported that traumatic occlusions and their sequelae produce considerable morphologic alterations in the periodontal ligament and alveolar bone in squirrel monkeys. These changes were reversible when traumatising forces were discontinued or the tooth moved away from the influence of the force.

Case report

Case report 1 (fig. 2)

A Chinese boy, aged 9 years and 9 months presented with the chief complaint of ‘My top teeth bite behind my bottom teeth.’ (fig. 2a, 2b). Pretreatment cephalometric analysis showed mildly retroclined upper incisors (around 115°) and mildly proclined lower incisors (around 100°). Chinese normal value for upper incisors inclination is 118±6° and for lower incisors inclination is 97±7°.22

Treatment objectives: Early treatment objectives were to eliminate mandibular displacement.

Treatment changes: Treatment was initiated in the upper and lower arches with a simple fixed appliance. Two buccal tubes and four brackets (0.018" slot) were bonded to the upper and lower first molars and incisors, respectively. Initial leveling and aligning wire was 0.016" NiTi for 2 months. Stainless steel 0.016" wire with advancing loops in the upper archwire and closing loops in the lower archwire were used to procline the upper incisors and retrocline the lower incisors for 3 months (fig. 2c). TMA 0.016" □ □.022" wire was used to adjust detailed torque for 3 months.

After 8 months of treatment, the anterior crossbite was corrected and the mandibular displacement was eliminated (fig. 2d) and this led to an improvement of the facial profile. The upper incisors were proclined by 6° and lower incisors were retroclined by 10°. Post-treatment radiographs showed the angulation of the upper incisors to the maxillary plane was 12° and that of the

lower incisors to the mandibular plane was 90°. No retainers were used after treatment.

A 4-year follow-up showed settling of the occlusion, no relapse of the anterior crossbite and eruption of the permanent teeth into Class I relationship at the proper mandibular position (fig. 2e).

Case report 2 (fig. 3)

A Chinese boy aged 9 years presented with the chief complaint of ‘My top teeth bite behind my bottom teeth.’ (fig. 3a). Pretreatment cephalometric analysis showed upright upper incisors (around 113°). The chinese normal value is 118±6°.22 Space analysis showed 3.4 mm of crowding in the upper arch. Intra-oral photographs of the upper arch showed a lack of space for the eruption of upper canines (fig. 3b).

Treatment objectives: Early treatment objectives were: to eliminate traumatic occlusion to the lower incisors; to correct anterior displacement; and to create space for upper canines.

Treatment changes: Treatment was initiated in the upper arch only with a simple fixed appliance. Two molar bands were cemented to the upper first molars and four brackets (0.018" slot) were bonded to the upper incisors. Initial leveling and aligning wire was .016" NiTi for 2 months. Stainless steel 0.016" wire with advancing loops was used to procline the upper incisors for 3 months (fig. 3c). TMA 0.016" □ □.022" archwire was used to adjust detailed torque for 2 months. After 7 months' treatment, the anterior crossbite was corrected and the mandibular displacement was eliminated. The upper incisors were proclined by 7°. Post-treatment radiographs showed the angulation of upper incisors to maxillary plane was 122°. Post-

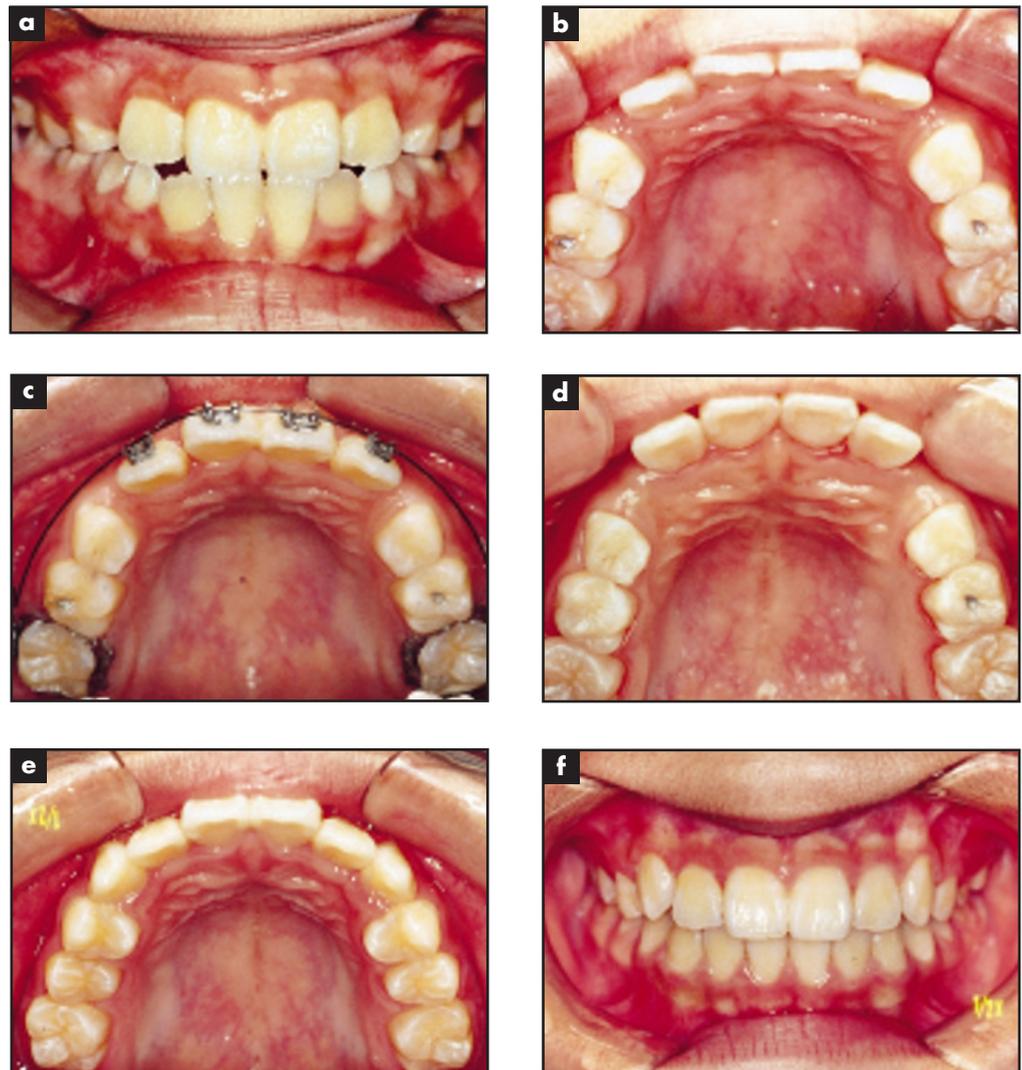


Fig. 3 (Case report 2). Pretreatment: a) Frontal view b) Upper occlusal view; During treatment: c) Upper 0.016 S.S round archwire with advancing loops; Post-treatment: d) Upper occlusal view; Two years follow-up: e) Upper occlusal view f) Frontal view

treatment space analysis showed 1.3 mm of excess space in the upper arch compared with 3.4 mm of crowding shown by pretreatment records (fig. 3d). Space gain was caused by the proclination of upper incisors by 7°.

A 2-year follow-up showed the settling of the occlusion, no relapse of the anterior crossbite and eruption of the permanent teeth into Class I relationship at the proper mandibular position (figs 3e, 3f).

Conclusion

Early orthodontic intervention for pseudo Class III malocclusion should be initiated to: prevent existing problems from getting worse; and minimise or eliminate the need for comprehensive orthodontic treatment at a latter stage.

The follow-up period (2–4 years) showed that the canines and premolars erupted in Class I occlusion. Some minor rotations and midline discrepancies were observed in some of the cases. However, without a doubt, the early interceptive treatment of these cases had either minimised the need for comprehensive treatment or in some other cases, eliminated the need for any further treatment.

The early treatment for a few months resulted in:

- Elimination of mandibular displacement thus allowing the permanent dentition to be guided into Class I at the proper mandibular position
- Creation of space for the eruption of canines and premolars
- Elimination of traumatic occlusion.

The authors sincere thanks are expressed to Mr Shadow Yeung, Faculty of Dentistry, The University of Hong Kong for his kind help with analysis of the data and Miss Frances Chow for her assistance with the manuscript.

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