A skeletal Class III malocclusion with agenesis and canine-bicuspid transposition: a non-surgical approach

Carlos Bellot-Arcís, Verónica García-Sanz and Vanessa Paredes-Gallardo
Stomatology Department, University of Valencia, Valencia, Spain

Background: The present case report describes the orthodontic management of a patient who presented with a skeletal Class III malocclusion combined with other dental anomalies. The malocclusion was complicated by agenic maxillary lateral incisors and a lower right second premolar, in company with the transposition of the maxillary canines and premolars.

Methods: Dentoalveolar compensation of the anteroposterior jaw relationship was performed. The upper deciduous lateral incisors were extracted and the spaces closed, so that the first premolars replaced the missing lateral incisors while the canine transposition was maintained.

Results: Satisfactory results were obtained which provided an improvement in function and occlusal stability, as well as smile and profile aesthetics.

Conclusion: This case demonstrates the importance of an accurate diagnosis when many treatment options are available and clearly addressed.

Received for publication: July 2017
Accepted: November 2017

Carlos Bellot-Arcís: carlos.bellot@uv.es; Verónica García-Sanz: veronique_hd@hotmail.com; Vanessa Paredes-Gallardo: vanessa.paredes@uv.es

Introduction

The incidence of a skeletal Class III malocclusion varies between 1% and 19% depending on ethnicity and the population studied.1-3 The incidence in Caucasians is 1–5%.4,5 Treatment options for a skeletal Class III in non-growing patients may involve orthognathic surgery, orthodontic dentoalveolar compensation, or a combination of both. The decision regarding which type of treatment is suitable for a particular patient depends on the severity of the discrepancy, the inclination and position of the anterior teeth, and dental and facial aesthetics.6

Dentoalveolar compensation is often a valid option when the malocclusion is not severe. Compensation is usually achieved by the retroclination of the lower incisors and mesial advancement of the maxillary teeth, which causes upper incisor proclination.7 A camouflage option makes the underlying skeletal problem less evident, and the treatment usually leads to an improvement in occlusion, function, and aesthetics.8 This procedure often results in a slight retraction of the lower lip, as well as deepening of the mentolabial fold.9

Lateral incisor agenesis is often associated with a skeletal Class III relationship10 and is the second most commonly absent tooth after the lower second premolar.10

The treatment of patients with agenic lateral incisors is controversial,12 and presents a challenging problem. Treatment planning depends on numerous factors including, among others, the anteroposterior jaw relationship and arch discrepancy.13 One treatment option consists of opening or maintaining the anterior space and placing a suitable prosthetic restoration. However, tooth-supported restorations can compromise periodontal status, which can present
further aesthetic limitations.\textsuperscript{14} Closing the space by placing the canines adjacent to the central incisors is an alternative treatment, although in some cases it is necessary to perform canine enameloplasty in order to achieve optimal aesthetics. This option has been described as stable and acceptable to the patient.\textsuperscript{15}

Agenesis of the mandibular second premolar is commonly associated with other dental anomalies such as maxillary canine and first premolar transposition.\textsuperscript{10,16} Maxillary transposed teeth can be left uncorrected or moved to their correct position, the second option being advantageous when the canine is not fully erupted.\textsuperscript{17}

**Case report**

**Pretreatment evaluation**

A 17-year-old female presented wishing to improve her smile aesthetics, with a particular concern regarding her anterior crossbite. Her dental and medical histories were unremarkable.

Facial photographs showed an unaesthetic smile with insufficient exposure of the upper anterior teeth, asymmetry as the chin had shifted slightly to the left, mild mandibular protrusion, a straight profile and an increased lower facial third (Figure 1).

An intraoral examination and dental cast analysis determined that the anteroposterior dental relationship was a molar Class I and a canine Class III. There was an anterior reverse overjet of 3 mm. No maxillary transverse deficiency or posterior crossbite were evident. The upper deciduous lateral incisors and the lower right second deciduous molar were present but the corresponding permanent replacement teeth were agenic. There was a 1.5 mm diastema between the upper central incisors, and the lower dental midline had deviated 2 mm to the left. A bilateral transposition of the maxillary canines and first premolars was also noted (Figures 1 and 2).

A panoramic radiograph verified the agenesis of both upper permanent lateral incisors and the lower right second premolar. It was evident that the transposition of maxillary canines and premolars was complete by the involvement of both the crowns and the roots (Figure 3).

A lateral cephalometric analysis indicated a skeletal Class III relationship with a Wits appraisal of -8 mm and an ANB of -2.3º. The maxillary incisors were
retroclined and formed an angle of 102.9° with the
palatal plane. The lower incisors were also retroclined
(85.5°) in relation to the mandibular plane (Figure 4
and Table I).

**Treatment objectives**

The main treatment objectives were to: (1) enhance
the smile aesthetics by achieving an acceptable overjet
and improving exposure, position, and morphology of
the upper anterior teeth, and (2) obtain an acceptable
dental relationship for improved function and stability.

**Treatment alternatives**

Several treatment alternatives were considered and
discussed with the patient and her mother. To manage
the dental and skeletal anteroposterior relationships,
orthognathic surgery involving dentoalveolar compen-
sation and maxillary advancement were considered.
The surgical approach was dismissed because there
was a functional component, created by an edge-to-
edge incisal relationship in centric occlusion, and the
patient was reluctant to undergo surgery.

A second consideration was whether to maintain the
spaces created by the missing lateral incisors or elect
to close the spaces and avoid prosthetic involvement.
As there was posterior crowding, it was finally decided
to close the spaces in order to achieve better aesthetics
and adequate periodontal status.

As the maxillary canines were fully erupted and their
transposition complete, the option of correcting the
position of the premolars and canines was rejected.

Lower extractions were also considered to facilitate
the management of the anteroposterior dental
relationship. Extractions of the mandibular right
second deciduous molar and left second premolar
were therefore proposed. However, the patient refused
to have healthy teeth removed and so this option was
discarded. The patient agreed to use Class III elastics to
manage and correct the anteroposterior relationship.

After the initial treatment plan was designed based on
an accurate diagnosis and the patient’s requirements,
working models with a diagnostic set-up helped
visualise and verify the treatment outcomes.

**Treatment Progress**

Tip-Edge Plus® 0.022 × 0.028” bracket appliances
(TP Orthodontics Inc, IN, USA) were bonded to the
upper and lower permanent teeth. The brackets have a special feature that allows the teeth to tip distally due to their slot morphology. The maxillary canines and premolars received brackets usually placed on contralateral teeth in order to allow mesial tipping, which would contribute to Class III correction (Figure 5). Composite resin build-ups were bonded to the upper first premolars to produce disocclusion and so facilitate anterior crossbite correction.

The palatal cusps of the upper first premolars were reduced to avoid interferences. Subsequently, 0.014” superelastic nickel-titanium (SE NT) archwires were placed for levelling and aligning of the dental arches. Metallic ligatures were passed through the vertical slots of the upper second premolar brackets to hasten alignment.

Elastic thread was tied from upper right to upper left first premolar to begin anterior space closure (Figure 6). After alignment was achieved, upper and lower 0.016 × 0.025” SE NT archwires were placed. At this stage, the upper deciduous lateral incisors were extracted and elastic chain was used for space closure. The extractions had been delayed to avoid aesthetic disadvantage. Class III elastics were used by the patient 24 hours a day. Once the anterior crossbite had been corrected, uprighting springs were placed through the vertical slot of maxillary canines and first premolars in order to correct unwanted mesial tipping (Figure 7).

After eight months of intermaxillary elastic wear, a complete molar Class II relationship was achieved and the anterior crossbite was corrected. The posterior build-ups were therefore removed. To attain acceptable interdigitation, interproximal enamel reduction was performed on the lower right deciduous molar. Stainless steel 0.0215 × 0.028” archwires along with 0.016” SE NT archwires were placed, which passed through the auxiliary tunnels to upright the teeth and achieve optimal torque and tipping. Finishing bends were incorporated into the archwire to improve the position of individual teeth. Auxiliary hooks were crimped to the archwires mesial to the canines, and an elastic chain was placed to the hooks on the first molar tubes in order to prevent spaces from opening (Figure 8).

Finally, 0.016” SE NT archwires were inserted along with short triangular intermaxillary 1/8” elastics (Super thread, Rocky Mountain Orthodontics, CO, USA) to provide posterior interdigitation.

### Table I. Pretreatment and post-treatment cephalometric measurements.

| Cephalometric analysis                  | Initial | Norm | Final |
|----------------------------------------|---------|------|-------|
| SNA angle (°)                           | 78.2    | 82   | 78.8  |
| SNB angle (°)                           | 80.5    | 80   | 79.1  |
| ANB angle (°)                           | -2.3    | 2    | -0.3  |
| Wits appraisal (mm)                     | -8      | 0    | -4.3  |
| U1-palatal plane (°)                    | 102.9   | 110  | 105   |
| IMPA [L1-MP] (°)                        | 85.5    | 95   | 84.4  |
| Interincisal angle (°)                  | 140.1   | 130  | 138.3 |
| Overjet (mm)                            | -3.4    | 2.5  | 1.5   |
| Overbite (mm)                           | 1.6     | 2.5  | 1     |
| Facial axis [NABA-PTGN] (°)             | 94.1    | 90   | 90.9  |
| FMA [MP-FH] (°)                         | 27.6    | 26   | 29    |
| Mandibular length (GO-GN) (mm)          | 79      | 78   | 81.2  |

Figure 5. Illustration of a Tip-Edge Plus® bracket belonging to the upper right quadrant bonded on an upper left tooth to allow mesial tipping.
Figure 6. Treatment progress intraoral photographs. First treatment stage.

Figure 7. Treatment progress intraoral photographs showing uprighting springs.

Figure 8. Treatment progress intraoral photographs. Last treatment stage.
After 24 months of treatment, all appliances were removed and canine-to-canine fixed lingual retainers were placed on both upper and lower arches, and thermoplastic removable retainers were provided to be worn at night.

**Treatment results**

All treatment objectives were achieved. The facial photographs show a more attractive smile and an improvement in the patient’s profile, which was slightly less straight after treatment (Figure 9).

Intraoral photographs and a dental cast examination showed a complete molar Class II and canine Class I. Overjet and overbite were considered to be adequate. Molar and premolar interdigitation was acceptable, although less precise on the right side due to the presence of the deciduous molar. The frontal view shows full closure of the interincisal diastema. The lower midline was corrected, and the upper first premolars adjacent to the central incisors created acceptable and harmonic dental aesthetics (Figures 9, 10). The restoration and reshaping of the upper bicuspids to resemble lateral incisors as
well as gingivectomies were suggested to the patient. However, she was happy with the aesthetic results and declined further treatment.

From the panoramic radiograph, good root parallelism was achieved and only minimal resorption was detected in the upper left first premolar root (Figure 11). The cephalometric tracing and superimpositions showed a decrease of 2° in the ANB angle and 3.7 mm in the Wits appraisal, which indicated an improvement in the anteroposterior relationship. The upper incisors were slightly proclined, showing an increase of 2° in the upper incisor long axis to the palatal plane. The facial axis decreased by 3° (Figures 12, 13 and Table I).

Discussion

Dentoalveolar compensation of the skeletal Class III was the treatment of choice in the present case. A contributing reason for this option was the diagnosis of a functional anterior displacement of the mandible. According to previous reports, if an end-to-end anteroposterior relationship can be reached when approaching centric relation, and when a forward position of the mandible with normal mandibular length is found, then the malocclusion can be classified as pseudo-Class III, and may be treated by dentoalveolar compensation. These characteristics were present in the current case as an edge-to-edge relation could be achieved and the mandibular length was 79 mm (Gonion-Gnathion).

Following Class III camouflage treatment, the upper incisors invariably present excessive proclination, which can result in an unattractive smile and diminished incisor exposure. In the present case, the upper incisors reached an acceptable inclination due to the extraction of upper teeth followed by space closure. In this way, tooth display at rest and in smiling were appropriate and the smile arch was harmonic.

The patient presented with agenesis of the upper lateral incisors. Space closure was performed leading to satisfactory aesthetic and periodontal results. Nordquist and McNeill compared patients with lateral incisor agenesis who had been treated by space closure with those who received prosthetic replacements. It was found that the space closure group showed better periodontal health, but no differences in occlusal function were found. Robertson and Mohlin concluded that, aesthetically, lateral incisor space closure was more acceptable to patients than a prosthetic solution.

By closing the patient’s lateral incisor spaces, a final anteroposterior relationship of a complete molar Class II was obtained, with good interdigitation in the left buccal segment. Although interdigitation was acceptable, optimal results could not be attained in the right segment due to the presence of the lower right second deciduous molar. As the patient had agenesis of the permanent second premolar, it was decided not...
to extract the deciduous molar in order to maintain arch symmetry. These teeth have been proved to have a good prognosis of long-term survival.21 Some interproximal enamel reduction was performed on this tooth to enhance the occlusion.

The case presented an additional dental anomaly in the transposition of the maxillary first premolars and canines. The transposition was maintained and, as a result, an acceptable occlusion was obtained as the canines were placed in their correct position in the arch, which technically achieved a canine Class I relationship. The first premolars therefore replaced the missing lateral incisors, which resulted in a compromised but acceptable aesthetic result. Replacing maxillary anterior teeth with bicuspids is a treatment alternative that can be considered when there is a combination of lateral agenesis and premolar transposition, or if an anterior tooth is missing and premolar autotransplantation is performed. Both procedures have been reported to result in satisfactory outcomes.17,22

In the present case report, the transposed teeth were fully erupted. This situation contributed to the decision to maintain the transposition. According to Ciarlantini and Melsen, satisfactory results can be obtained through this option, provided that the teeth involved are fully erupted.17

Orthognathic surgery was proposed to the patient as the ideal solution but she was reluctant to undergo an invasive procedure. The patient also declined having mandibular teeth extracted. It was made clear that the wearing of elastics was important in order to achieve acceptable results and she proved compliant in this respect.

Uprighting both maxillary canines was challenging since their roots were tipped distally, which was unfavourable considering the direction of the planned mesial movement. Good root parallelism was finally achieved by using full-size archwires and uprighting springs.

According to the cephalometric measurements, treatment brought about a significant improvement in the skeletal anteroposterior relationship as the Wits appraisal reduced to -4.3 mm. A substantial change was also observed in the facial axis, which showed a decrease of $3^\circ$. Both anteroposterior and vertical cephalometric changes were attributed to the correction of the functional anterior displacement of the mandible.

**Summary and conclusions**

In the presented case, a precise diagnosis was crucial to successful treatment planning. After discarding the option of surgery, Class III camouflage was undertaken with additional key decisions due to the anomalies of transposition and agenesis.

An attractive smile was achieved by improving maxillary incisor display and obtaining a positive overjet.

The anteroposterior dental relationship provided acceptable functionality and occlusal stability.

The correction of the functional anterior displacement of the mandible contributed to the enhancement of the anteroposterior skeletal relationship and the patient’s profile aesthetics.

**Corresponding author**

Verónica García-Sanz  
Orthodontic Department  
5st floor  
Dentistry Clinic  
University of Valencia  
C/ Gascó Oliag,1. 46010  
Valencia  
Spain  
Email: veronique_hd@hotmail.com

**References**

1. Chan GK. Class III malocclusion in Chinese (Cantonese): etiology and treatment. Am J Orthod 1974;65:152-7.
2. Silva RG, Kang DS. Prevalence of malocclusion among Latino adolescents. Am J Orthod Dentofacial Orthop 2001;119:313-5.
3. Baik HS, Han HK, Kim DJ, Proffit WR. Cephalometric characteristics of Korean Class III surgical patients and their relationship to plans for surgical treatment. Int J Adult Orthodon Orthognath Surg 2000;15:119-28.
4. Thilander B, Myrberg N. The prevalence of malocclusion in Swedish schoolchildren. Scand J Dent Res 1973;81:12-21.
5. Haynes S. The prevalence of malocclusion in English children aged 11-12 years. Rep Congr Eur Orthod Soc 1970:89-98.
6. Stellzig-Eisenhauer A, Lux CJ, Schuster G. Treatment decision in adult patients with Class III malocclusion: orthodontic therapy or orthognathic surgery? Am J Orthod Dentofacial Orthop 2002;122:27-37.
7. Lin J, Gu Y. Preliminary investigation of nonsurgical treatment of severe skeletal Class III malocclusion in the permanent dentition. Angle Orthod 2003;73:401-10.
8. Proffit WR, Fields HW, Sarver DM. Contemporary orthodontics. 4th edn. St. Louis, Mo.: Mosby Elsevier, 2007; xii, 751.
9. Georgalis K, Woods MG. A study of Class III treatment: orthodontic camouflage vs orthognathic surgery. Aust Orthod J 2015;31:138-48.
10. Polder BJ, Van’t Hof MA, Van der Linden FP, Kuijpers-Jagtman AM.
BELLOT-ARCÍS, GARCÍA-SANZ AND PAREDES-GALLARDO

A meta-analysis of the prevalence of dental agenesis of permanent teeth. Community Dent Oral Epidemiol 2004;32:217-26.

11. Bassiouny DS, Afify AR, Baeshen HA, Birkhed D, Zawawi KH. Prevalence of maxillary lateral incisor agenesis and associated skeletal characteristics in an orthodontic patient population. Acta Odontol Scand 2016;74:456-9.

12. Johal A, Katsaros C, Kuijpers-Jagtman AM; Angle Society of Europe membership. State of the science on controversial topics: missing maxillary lateral incisors—a report of the Angle Society of Europe 2012 meeting. Prog Orthod 2013;14:20.

13. Thilander B. Orthodontic space closure versus implant placement in subjects with missing teeth. J Oral Rehabil 2008;35 Suppl 1:64-71.

14. Silveira GS, de Almeida NV, Pereira DM, Mattos CT, Mucha JN. Prosthetic replacement vs space closure for maxillary lateral incisor agenesis: A systematic review. Am J Orthod Dentofacial Orthop 2016;150:228-37.

15. Robertsson S, Mohlin B. The congenitally missing upper lateral incisor. A retrospective study of orthodontic space closure versus restorative treatment. Eur J Orthod 2000;22:697-710.

16. Peck S, Peck L. Classification of maxillary tooth transpositions. Am J Orthod Dentofacial Orthop 1995;107:505-17.

17. Ciarlantini R, Melsen B. Maxillary tooth transposition: correct or accept? Am J Orthod Dentofacial Orthop 2007;132:385-94.

18. Rabie AB, Gu Y. Diagnostic criteria for pseudo-Class III malocclusion. Am J Orthod Dentofacial Orthop 2000;117:1-9.

19. Reyes A, Serret L, Peguero M, Tanaka O. Diagnosis and treatment of pseudo-Class III malocclusion. Case Rep Dent 2014;2014:652936.

20. Nordquist GG, McNeill RW. Orthodontic vs. restorative treatment of the congenitally absent lateral incisor—long term periodontal and occlusal evaluation. J Periodontol 1975;46:139-43.

21. Bjerklin K, Bennett J. The long-term survival of lower second primary molars in subjects with agenesis of the premolars. Eur J Orthod 2000;22:245-55.

22. Tanaka T, Deguchi T, Kageyama T, Kanomi R, Inoue M, Foong KW. Autotransplantation of 28 premolar donor teeth in 24 orthodontic patients. Angle Orthod 2008;78:12-9.