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# Treatment of mandibular second molar impaction in a patient with metal hypersensitivity

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It is widely accepted that the prevalence of metal hypersensitivity is increasing. Furthermore, the incidence of unerupted mandibular second molars is 2.3%, of which 0.2% is judged to be a result of impaction. While it is becoming more common to treat impacted mandibular second molars in daily clinical practice, metal hypersensitive patients presenting with unerupted molars are less frequently encountered. There have been no previous reports of patients who required mandibular molar traction and who also suffered from metal hypersensitivity. Therefore, this is the first case report to describe the long-term stability of mandibular second molar dis-impaction, leading to high level of patient satisfaction.

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## Introduction

It is widely accepted that the prevalence of metal hypersensitivity is increasing.<sup>1-8</sup> Peltonen reported that 4.5% of the general population had a sensitivity to nickel and it has been further reported that the prevalence by gender is five to ten times higher in females than in males.<sup>1,2</sup> Additionally, the literature notes that orthodontic treatment does not affect the prevalence of nickel hypersensitivity, and that the incidence is associated with a history of body piercing prior to treatment.<sup>2,9-13</sup>

Past studies have shown that the incidence of unerupted mandibular second molars is 2.3%, of which 0.2% is judged to be due to tooth impaction.<sup>14-20</sup> While it is becoming more common to treat impacted mandibular second molars in daily clinical practice,<sup>17,18,20</sup> metal hypersensitive patients with unerupted molars are less frequently encountered.

There have been no previous reports of metal hypersensitive patients presenting with mandibular

molar impaction and therefore the prevalence of the combined conditions has not been clarified. The present case report describes a patient who suffered from metal hypersensitivity and who also required mandibular second molar orthodontic traction. Treatment stability was later assessed.

## Diagnosis and treatment objectives

A 19-year-old female suffering from metal hypersensitivity presented at the hospital orthodontic clinic. The chief complaints were a horizontally impacted mandibular second molar, crowding and a cross-bite of the incisors. In addition, the maxillary right second premolar was palatally displaced.

On examination, the patient presented with a straight profile, an acute nasolabial angle and crowding in the incisor region (Figure 1A). The intraoral findings revealed a Class III relationship of the canine and the molars on the left side, but a Class III relationship of the canine and a Class II relationship of the

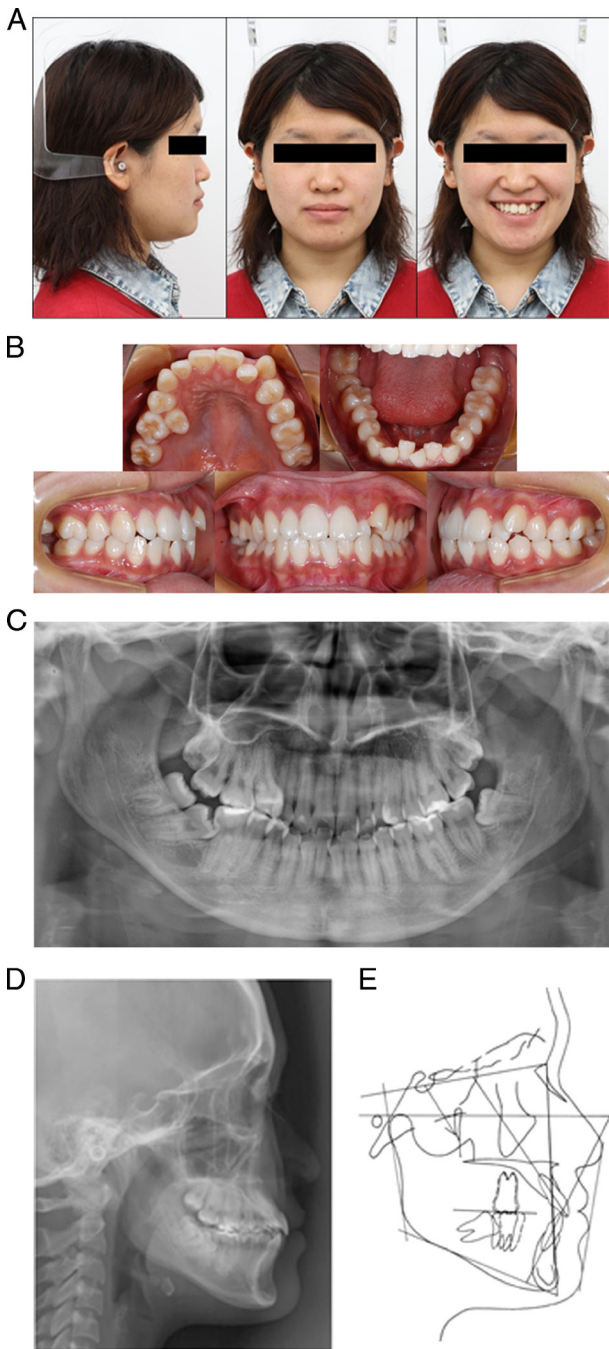


Figure 1. Pretreatment photographs and radiographs: (A) facial photographs, (B) intraoral photographs, (C) panoramic radiograph, (D) lateral cephalometric radiograph and (E) lateral cephalometric tracing.

molars on the right side (Figure 1B). A pretreatment panoramic radiograph revealed a horizontally impacted mandibular left third molar and unerupted maxillary third molars. The mandibular right second molar was horizontally impacted and adjacent to the distal root of the first molar (Figure 1C). On three-dimensional computed tomography (3DCT), distal

root resorption of the mandibular right first molar was evident (Figure 2). However, there were no signs of osseous ankylosis and no subjective symptoms related to the affected molars.

A lateral cephalometric radiograph was taken in centric occlusion and in a lip-closed position (Figures 1D, E). The radiographic analysis indicated a Class III skeletal relationship (ANB angle of 0°), a low facial height angle (FMA 22.5°), plus a labial inclination of the maxillary incisors (U1-SN, 114.0°) to compensate for the skeletal pattern. The mean values of the incisors were U1-APog of 8 mm, L1-APog of 5 mm, and without a protruded lip line (Esthetic line: upper -3.5 mm, lower -1.0 mm) compared to Japanese normative means (Table I).

At the same time as the orthodontic examination, the patient underwent detailed specialist examination for metal hypersensitivity and was found to be severely sensitive to nickel as assessed by a medical patch test.

As a result, the patient was diagnosed with asymmetric molar relationships, a horizontal impaction of the mandibular right second molar, crowding of the anterior teeth in an underlying skeletal Class III relationship. The case was further complicated by the nickel hypersensitivity.

The treatment objectives were to correct the mandibular right second molar impaction and to establish a stable occlusion while also managing the crowding of the



Figure 2. Three-dimensional computed tomography (3DCT) images.

Table 1. Cephalometric analyses

	Pretreatment	Posttreatment	After retention	Normative mean
SNA (°)	82.0	82.0	82.0	82.1
SNB (°)	82.0	82.0	82.0	78.5
ANB (°)	0.0	0.0	0.0	3.6
Facial angle (°)	92.5	93.0	93.0	84.6
Y-axis (°)	58.0	58.0	58.0	65.2
FMA (°)	22.5	22.0	22.0	28.6
SN-MP (°)	32.5	32.0	32.0	34.7
Gonial angle (°)	121.0	121.0	121.0	121.2
Occ. Plane to SN (°)	12.0	13.5	13.5	16.8
U1 to SN (°)	114.0	111.0	111.0	103.8
IMPA (L1 to MP) (°)	94.0	90.0	90.0	96.2
Interincisal angle (°)	119.5	127.0	127.0	125.6
U1 to A-Pog (mm)	8.0	6.0	6.0	7.1
L1 to A-Pog (mm)	5.0	3.0	3.0	3.6
E-line:Upper (mm)	-3.5	-4.0	-2.0	0.2
E-line:Lower (mm)	-1.0	-4.0	-1.0	2.1
Overjet (mm)	R + 4.0, L + 2.0	3.0	3.0	3.1
Overbite (mm)	R + 3.0, L + 1.5	2.0	2.0	3.3

incisors to produce an aesthetic alignment of the teeth. The treatment plan was to extract premolars in the maxilla and mandible and actively improve the right side molar relationship. The extractions chosen were the second premolars on the right and the first premolars on the left side of the maxillary and mandibular arches. It was also decided, and radiographically confirmed, to extract all third molars.

The removal of the impacted mandibular right second molar followed by moving the mandibular right third molar into its position, was considered. However, there was a risk of damage to the mandibular right third molar during the extraction of the impacted second molar. A previous study reported that extracting the impacted second molar, with the intention of replacing it with the third molar, was the least successful treatment option.<sup>17</sup> Therefore, all third molars were extracted.

### Treatment progress

For aesthetic and sensitivity reasons, 0.018-inch zirconia brackets (COBY; BIODENT CORPORATION, Tokyo, Japan) and 0.018-inch titanium tubes (titanium

Orthos; Ormco Corporation, Orange, CA, USA) were attached to the teeth. In addition, arch wires made of titanium-niobium (Ti-Nb) alloy (GUM METAL; JM ORTHO, Tokyo, Japan) and titanium-molybdenum (Ti-Mo) alloy (TMA; Ormco Corporation, Orange, CA, USA) were inserted.

The treatment procedure on the left side followed the same pattern as a mainstream Class III crowding case with premolar extractions. The following description focuses on the right side treatment.

The maxillary right third molar and second premolar were extracted prior to active treatment. Levelling was started using 0.014-inch Ti-Nb alloy arch wires but the mandibular arch posed significant difficulties. Because the mandibular right second molar was horizontally and deeply impacted close to the adjacent tooth, it was impossible to place a bracket and avoid possible root resorption. Therefore, mesial movement of the first molar was required until a space developed between the first and second molars. A 0.016-inch Ti-Nb wire and an elastic chain were placed at the same time as the extraction of the mandibular right second premolar (Figure 3A). Four months after the commencement of first molar protraction, space was gained.

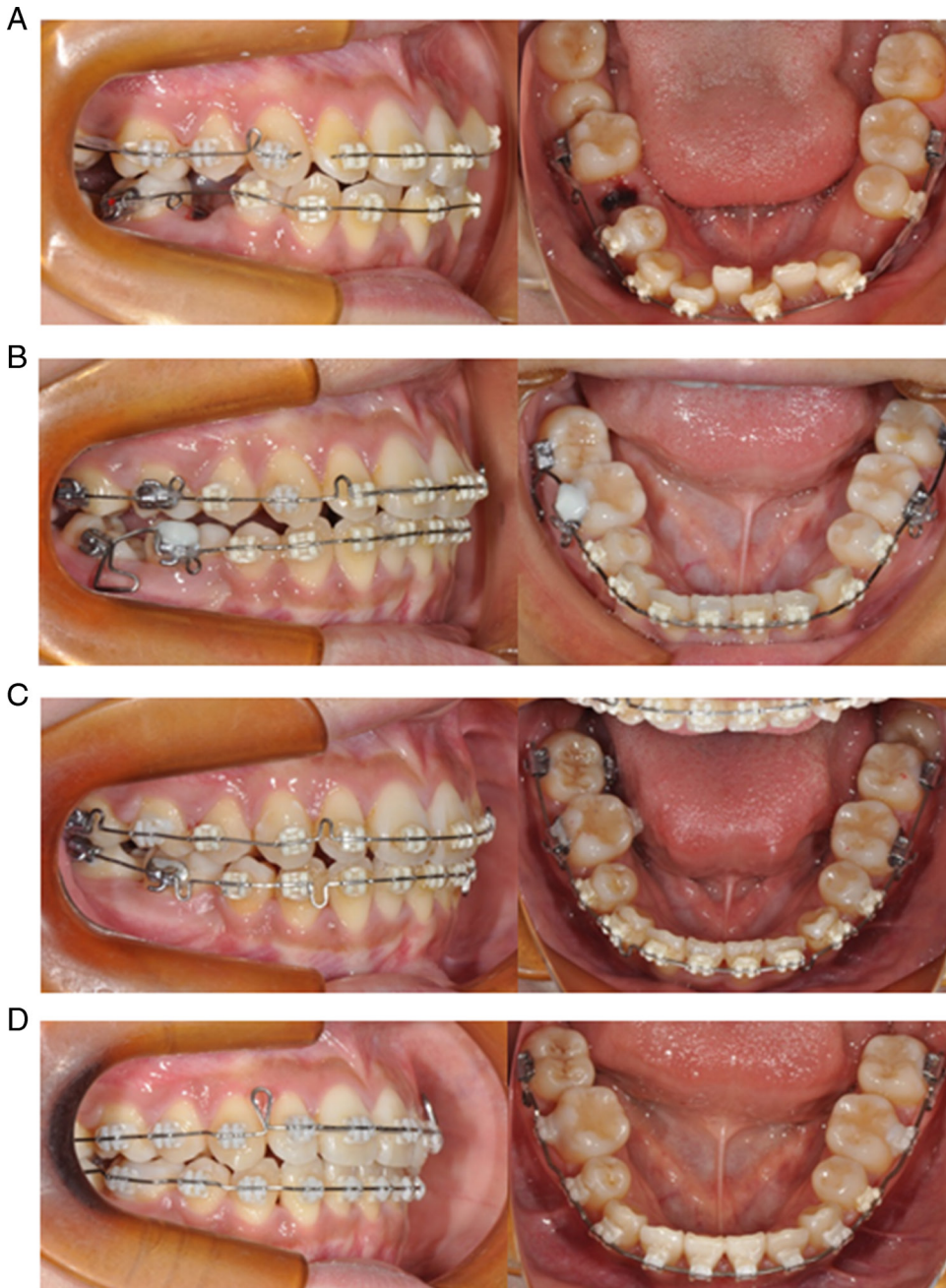


Figure 3. Progress photographs: (A) mesial movement of the mandibular right first molar, (B) mesial marginal ridge of the mandibular right second molar is confirmed, (C) initial stage of molar occlusion using the occlusal surface of the mandibular right second molar, (D) inclination of the second molar is improved.

Initially, a clear button was bonded to the distal surface of the impacted second molar, and a segmental wire was attached to the first and second molars. An omega loop and an L-loop were incorporated into the segmental wire made of 0.016-inch Ti-Nb. The segmental wires were fixed directly to the buccal side of the first molar by resin to facilitate the activation of the loops. This procedure was started before third

molar extraction so that traction was continued without interruption.

Six months after the start of traction, the mesial marginal ridge of the mandibular right second molar became visible. Torque control was started by using an 0.016 × 0.022-inch Ti-Mo wire (Figure 3B). As treatment progressed, the distal ridge of the mandibular right second molar contacted the

maxillary teeth which subsequently generated a mandibular shift due to the occlusal interference. The patient was instructed to use vertical elastics (Ormco Corporation, Orange, CA, USA) attached to the right first molars (3/16-in 6-oz, 4.76 mm, 170 g) and, after three months, the second molar occlusion had settled and the elastics were discontinued (Figure 3C).

Following 15 months of active treatment, the molar occlusion had been fully established and final space closure and torque control were initiated using a 0.017 × 0.025-inch Ti-Mo arch wire and closing loop mechanics.

At 31 months, a 0.018 × 0.025-inch Ti-Nb arch wire was placed for final alignment (Figure 3D). Since there were no convertible tubes or double tubes for metal allergy patients, using a zirconia bracket that matched the first molar tooth shape was beneficial. By bonding the bracket on the first molar, it was possible to place first and second order bends in the arch wire for better control of the second molar. However, the zirconia bracket increased the thickness of the bracket base and so it was necessary to consider the amount of offset required for the first molar. Simultaneously, anterior vertical elastics (3/16-in 6-oz, 4.76 mm, 170 g) were applied for two months to obtain an ideal overbite which had opened during the earlier stages of treatment.

At 38 months, the appliances were debonded and retainers inserted (Figure 4B). The circumferential retainers made from Ti-Mo wires were worn in both arches for two-years of retention. Additionally, a bonded retainer of Ti-Nb wire was worn between the mandibular premolars. Since the Ti-Mo wires of the circumferential retainers loosen or deform more easily than stainless steel wires, adjustments were made every two weeks for the first three months of the retention period.

The occlusal relationship three years after treatment was stable and showed no relapse (Figure 5A-C). Presently, the mandibular bonded retainer is being continued at the request of the patient.

### Treatment results

The post-treatment facial assessment showed slightly retracted lips but an acceptable profile due to an improved nasolabial angle (Figure 4A). A lateral cephalometric analysis, indicated that the SNA,

SNB, and ANB angles did not change (Table I). The anterior teeth were slightly retracted as shown by U1-SN (114.0°-111.0°), IMPA (94.0°-90.0°), U1-APog (8.0°-6.0°), and L1-APog (5.0°-3.0°). The soft tissues showed changes of the nose tip and chin which resulted in decreased E-line values. A post-treatment panoramic radiograph showed improvement in molar position without abnormal findings related to the traction mechanics (Figure 4C). Molar anchorage control was confirmed by the superimposition tracings of the pre- and post- treatment lateral cephalometric radiographs (Figure 6).

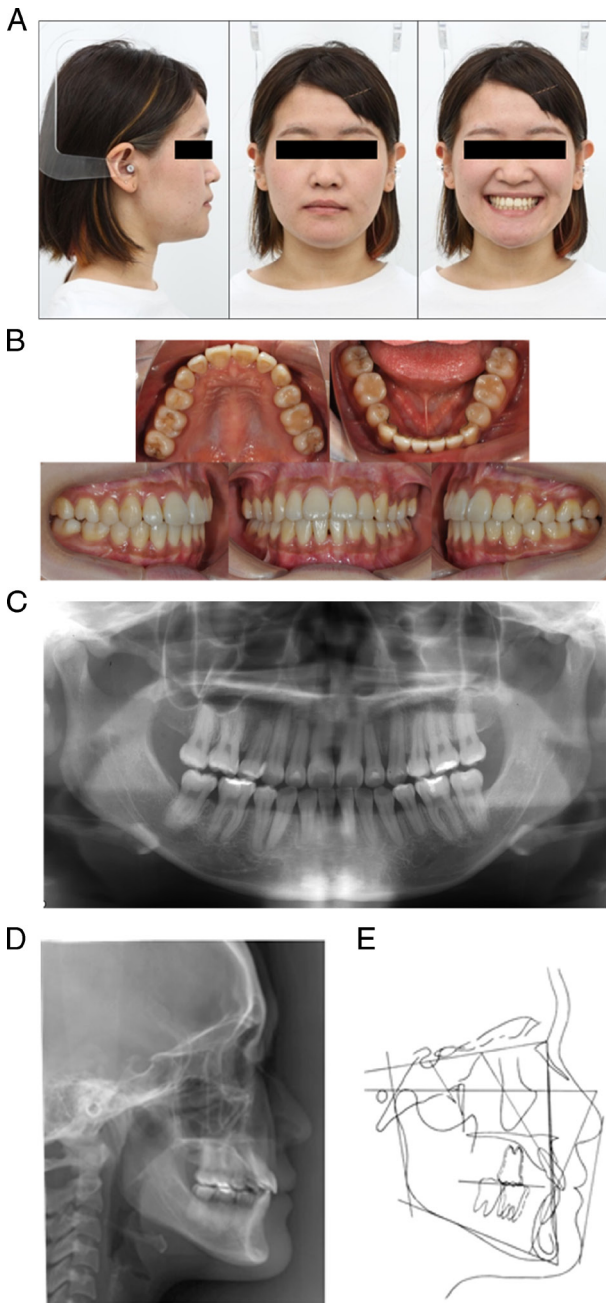
There was minimal change of the cephalometric findings three years after treatment (Table I, Figures 5D, E). The patient was very satisfied with the treatment results. The treatment was conducted and completed without symptoms of metal hypersensitivity.

### Discussion

Metal hypersensitivity is caused by metal ion elution. The onset is complicated and it is considered that body piercing is a major factor contributing to the condition.<sup>8-13</sup> A previous report revealed that piercing practices increased the risk of nickel hypersensitivity compared with non-piercings and it was further found that multiple piercings significantly affected the risk of developing nickel hypersensitivity.<sup>12,21</sup> The age at which piercing occurred is reflected in the duration of nickel exposure and once an allergic hypersensitivity is present, all dermal and oral mucosae become involved.

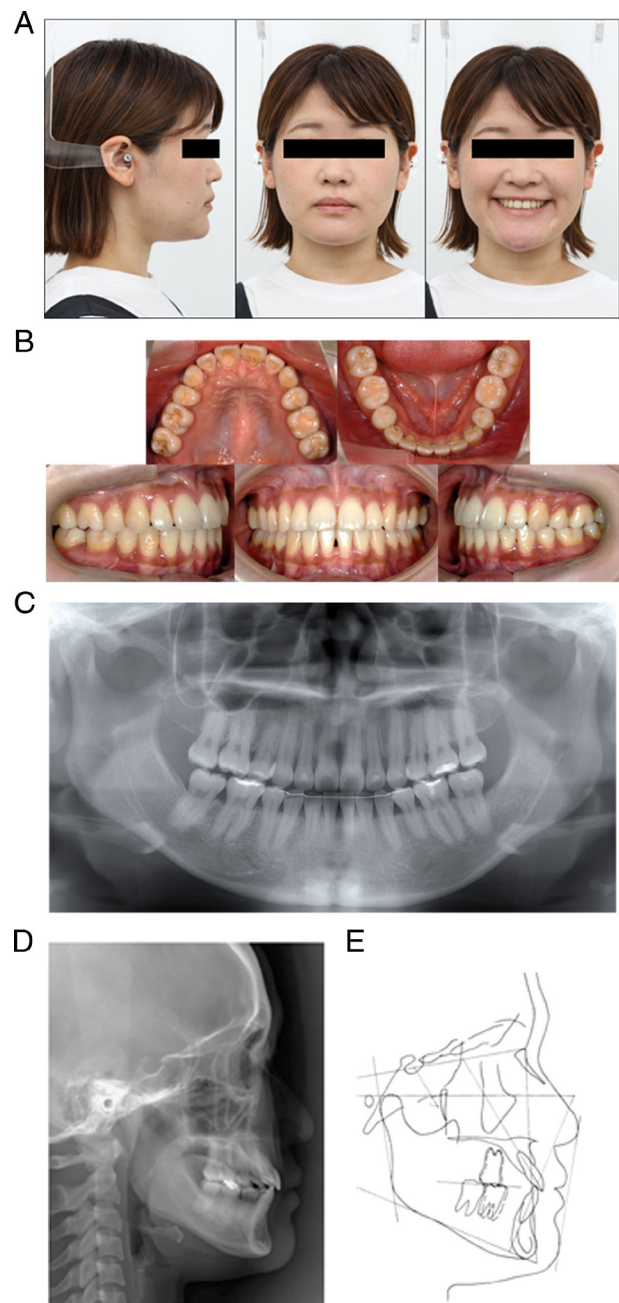
A systematic review and meta-analysis determined that orthodontic treatment did not affect the prevalence of nickel hypersensitivity.<sup>2</sup> The incidence of nickel hypersensitivity is considered to be depended on a history of piercing before treatment<sup>2,9-13</sup> and the present patient initially presented with pierced earlobes. Furthermore, previous reports suggested that the number of patients who have a hypersensitivity reaction to titanium, which is said to be the most biocompatible, has been increasing.<sup>13,22,23</sup> Despite extensive research, many aspects of the aetiology and pathology of metal hypersensitivity have not been completely clarified.<sup>13,24-27</sup>

In the present case, Class II correction on the right, which included mandibular second molar traction, was forecast to be a challenge. The impacted molar movement caused an expected occlusal interference. The treatment time for molar uprighting depends on accessibility and



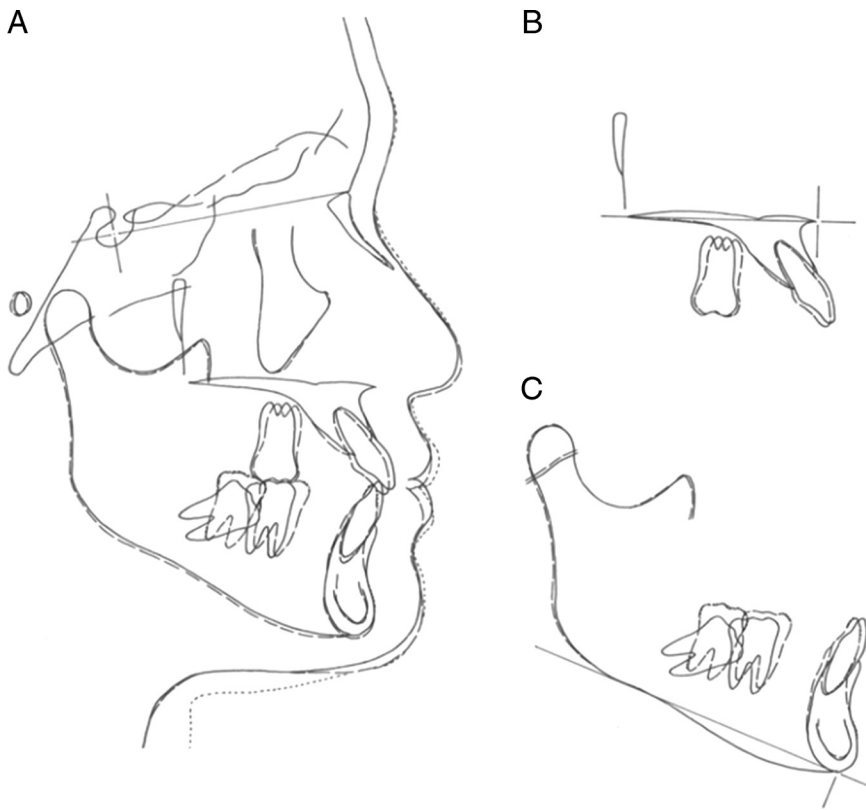
**Figure 4.** Posttreatment photographs and radiographs: (A) facial photographs, (B) intraoral photographs, (C) panoramic radiograph, (D) lateral cephalometric radiograph and (E) lateral cephalometric tracing.

the level of impaction.<sup>28</sup> Previous case studies have reported the preservation and alignment of impacted mandibular second molars, using methods such as a tip-back cantilever,<sup>29</sup> temporary anchorage devices (TADs),<sup>30,31</sup> a neosliding appliance,<sup>32</sup> plus others.<sup>33,34</sup> In the present case and because of the patient's metal hypersensitivity, the uprighting correction progressed using loop mechanics placed in Ti-Nb and Ti-Mo arch wires. By bonding the segmental wires directly



**Figure 5.** After retention photographs and radiographs: (A) facial photographs, (B) intraoral photographs, (C) panoramic radiograph, (D) lateral cephalometric radiograph and (E) lateral cephalometric tracing.

onto the molars, oral hygiene was more easily maintained compared to bulkier appliances with open-coil springs and other complex mechanics. Moreover, by reducing the distance between the button and resin bonding, an appropriate force for traction was achieved despite the thinness of the wires. The segmental wires incorporating loop mechanics were also efficient in actively adjusting the position of the molar root apex. Even if the clear button debonded as a result of occlusal



**Figure 6.** Superimposed tracings of lateral cephalometric radiographs at pretreatment (solid line), posttreatment (dashed line), and after retention (dotted line); right molars are traced. (A) on the sella-nasion plane at the sella, (B) on the palatal plane at ANS and (C) on the mandibular plane at Menton.

interference or via a heavy orthodontic force, recovery was not difficult using the segmental wire.

The characteristics of Ti-Nb and Ti-Mo wires have been summarised by previous reports.<sup>35–39</sup> In general, Ti-Nb wire has high flexibility, super-elasticity, and a low coefficient of friction which makes it suitable for use when a flexible wire is required. However, Ti-Mo wire is acceptable during the later stages of treatment when torque control is required. In the presented case, segmental wires made of beta-titanium demonstrated sufficient force delivery rather than apply more complex mechanics. Additionally, the treatment results showed long-term stability which satisfied the patient.

### Summary and conclusions

The presented patient had a history of metal hypersensitivity coupled with a severe malocclusion which was managed by considered orthodontic treatment. Currently, metal hypersensitivity patients with a mandibular second molar impaction are uncommon but the prevalence may be increasing. This is the first case report describing the treatment of mandibular

molar impaction in a patient with metal hypersensitivity. Through the presented case, it has been shown that treatment planning and the results were independent of the history of metal hypersensitivity. The metal hypersensitivity complicated treatment which was managed by the use of hypo-allergenic arch wires to establish a stable occlusion. The long-term treatment stability generated a high level of patient satisfaction. Even if there are medical limitations, satisfactory orthodontic treatment without a compromised outcome, can be achieved.

### Conflict of Interest

The authors declare that there is no conflict of interest.

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