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# True intrusion of maxillary first molars with zygomatic and palatal miniscrew anchorage: a case report

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The intrusion of the maxillary first molar is indicated when occlusal clearance is needed for prosthetic rehabilitation. Maxillary molar intrusion may be undertaken using skeletal anchorage systems to avoid complicated mechanics delivered by conventional intra-oral fixed appliances. In the present case report, the efficient use of orthodontic miniscrew anchorage by applying simple mechanics for true maxillary first molar intrusion is described. This was followed by the rehabilitation of the mandibular first molar spaces with implant prostheses. A 16-year-old female patient had masticatory difficulty due to the bilateral overeruption of the maxillary first molars and carious mandibular first molars. True intrusion of each maxillary first molar was achieved using zygomatic and palatal paramedian miniscrews placed in line with the central axis of the teeth. Simultaneously, alignment of the upper arch was achieved via fixed appliance therapy. Using two orthodontic miniscrews to intrude each maxillary molar, orthodontic treatment was simplified by eliminating the need for miniplate placement by extensive surgery and the creation of intra-oral multiunit anchorage. Masticatory efficiency was improved by increasing the occlusal table with prosthetic rehabilitation of the mandibular first molar spaces with dental implant prostheses.

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## Introduction

Caries involvement of the permanent mandibular first molars in childhood can result in a number of problems should the teeth require extraction. The adjacent teeth tend to tilt and the opposing teeth may overerupt if the lost teeth are not restored immediately. Conventional orthodontic methods<sup>1,2,3</sup> for the intrusion of overerupted maxillary molars require a complex appliance to reinforce anchorage, and often the results are unpredictable. Adverse effects occur related to the extrusion and tipping of the anchor teeth. Some clinicians prefer reducing and reshaping the crown of the overerupted maxillary molar (followed by root canal treatment in many cases) to create space for the prosthetic rehabilitation of the mandibular molars.

Because of the increased versatility of skeletal anchorage systems, the use of miniplates, miniscrews and prosthetic implants to provide absolute anchorage for maxillary molar intrusion has been reported.<sup>4,5,6</sup>

Miniscrews are widely used because they are relatively simple to insert, and force can be applied immediately following placement. However, from the biomechanical perspective, it is important to ensure that the line of applied intrusive force is perpendicular to the occlusal plane in a gingival direction and passes through the centre of resistance (Cres) of the molar so that true intrusion occurs without undesired tipping or rotation.<sup>7</sup>

A past publication has suggested two miniscrews on the buccal and palatal inter-radicular area, respectively,

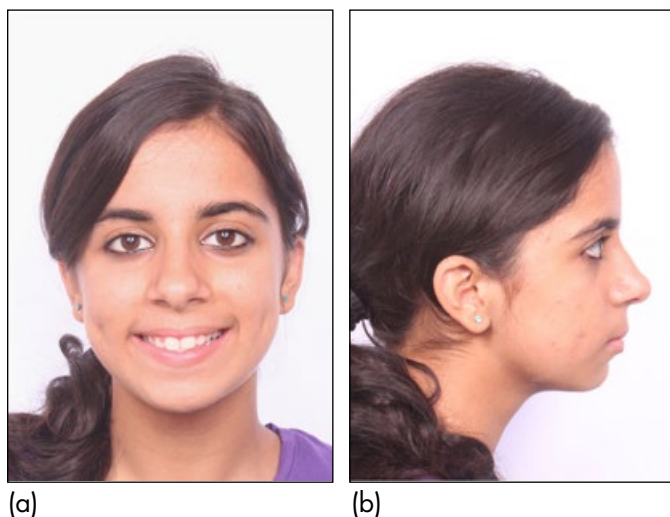


Figure 1 (a, b). Pretreatment extra-oral photographs.

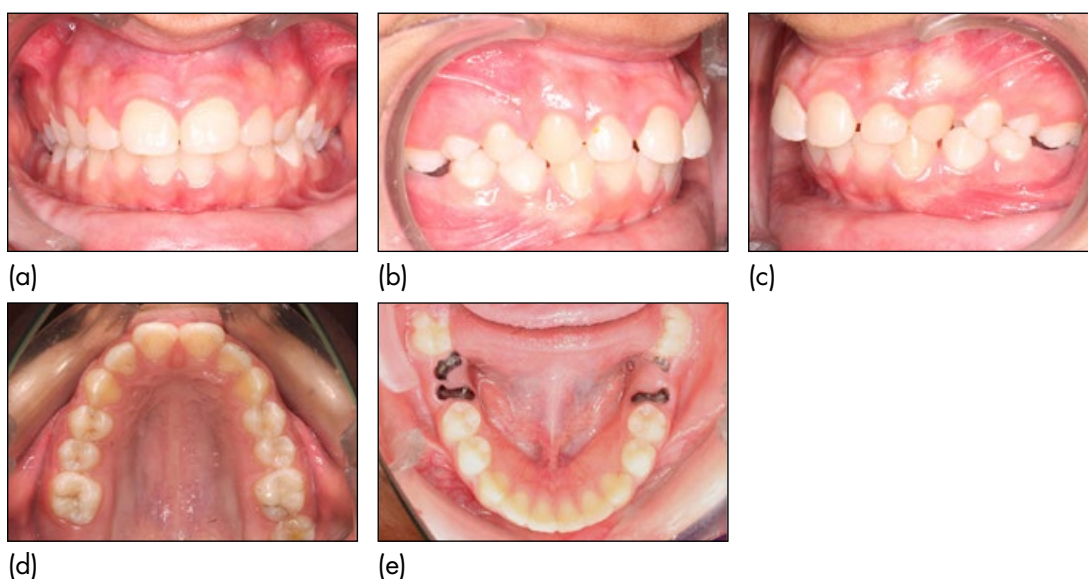


Figure 2 (a, b, c, d, e). Pretreatment intra-oral photographs.

to provide intrusive force from both sides.<sup>8</sup> However, in cases with limited or no inter-radicular space, the positioning of mini-implants at these sites is not always feasible. In addition, complicated and compensating biomechanics may be needed, to avoid tooth tip, or the placement of additional implants on either side of the alveolar process to improve force delivery. Palatal root control appears to be the key to maxillary molar intrusion, which can be better applied through direct rather than indirect anchorage. The simultaneous use of buccal and lingual force is considered the most effective protocol to achieve true molar intrusion.<sup>7,9</sup>

In the present article, a case report is presented of a 16-year-old female patient with overerupted bilateral

maxillary first molars treated with buccal and palatal miniscrews placed in line, and parallel to, the central axis of the maxillary first molar.

### Case report

#### *Pretreatment evaluation*

A 16-year-old female patient presented with a chief complaint of an inability to adequately chew solid food and spaces between the upper front teeth. An extra-oral examination showed a convex profile, competent lips but mild protrusion of the upper lip (Figure 1A–B). On intra-oral examination, grossly carious root stumps of the mandibular first molars

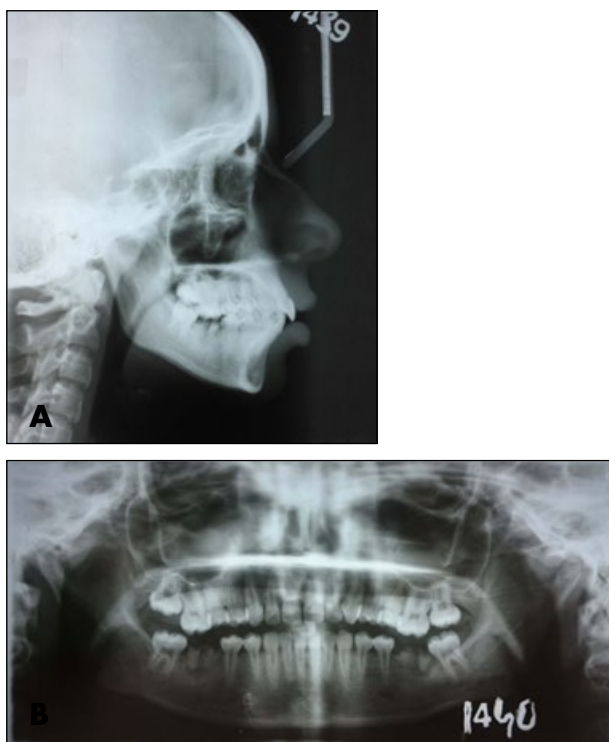


Figure 3 (a, b). Pretreatment lateral cephalogram and orthopantomogram.

and bilaterally overerupted maxillary first molars were apparent. Minor rotations and spacing of the upper and lower dentitions were also evident (Figure 2A–E).

The lateral cephalogram revealed a Class I skeletal relationship<sup>10</sup> (ANB = 5°) with a vertical growth pattern (SN-GoGn = 37°) (Figure 3A). The OPG revealed periapical lesions associated with the 36 and 46, overerupted 16 and 26 (6 to NF = 27.5 mm) and unerupted 17 and 27. Root crowding in the upper posterior segments with inadequate inter-radicular space was apparent (Figure 3B).

### ***Treatment objectives***

The treatment objectives were:

1. To improve the occlusal table to enable enhanced masticatory efficiency.
2. Bone preservation following the extraction of carious root stumps of 36 and 46 to facilitate prosthetic rehabilitation.
3. To intrude the overerupted 16 and 26 to create enough space for prosthetic rehabilitation of the 36 and 46 spaces.
4. Correction of the minor rotations.
5. Consolidation of the spaces in the maxillary arch.

### ***Treatment plan***

The treatment plan involved extraction of the carious 36 and 46 root stumps and simultaneous preservation surgery with a graft to prevent bone loss in the bucco-lingual and vertical planes during healing.<sup>11</sup> This was followed by intrusion of the overerupted 16 and 26 using skeletal anchorage with simultaneous fixed appliance treatment for alignment and consolidation of the spaces. Dental implant placement in the 36 and 46 sites was performed under local anaesthesia. Buccal miniscrews (2 mm × 12 mm) were inserted into the zygomatic buttress region and palatal miniscrews (2 mm × 6 mm) into the paramedian region of the palate in line with the centre of the maxillary first molar crowns bilaterally.

The patient decided to undergo single arch fixed appliance orthodontic treatment only.

### ***Treatment progress***

Following the extraction of the 36 and 46 root stumps, demineralised freeze-dried bone allografts (50 micron granules) were placed in the extraction sockets. A removable partial denture was worn at night to maintain the space for the future dental implants.

A pre-adjusted edgewise appliance 0.022" MBT prescription was placed. The maxillary arch was bonded and aligned from the left upper second premolar to the right upper second premolar through to 0.019" × 0.025" stainless steel archwires. The 16 and 26 were banded with molar tubes on the buccal and lingual buttons on the palatal side.

The miniscrews were inserted into the zygomatic buttresses by a maxillofacial surgeon via a stab incision in the buccal vestibule above the maxillary first molar root. Once proper visibility and access to the zygomatic buttress was gained, a pilot hole was drilled with a 1.5 mm drill bit in the bone directly above the maxillary first molar in line with its mesiobuccal groove so that the line of force would pass closely through the tooth's central axis. A miniscrew (dimension 2 mm × 12 mm) was inserted and orientated with its head directed intra-orally. A NiTi closed coil spring (0.30 mm × 6 mm) was tied to the implant head with ligature wire, which was passively ligated to the first molar. As a part of a standard treatment protocol after minor surgical procedure, amoxicillin 500 mg thrice daily for three days and 2% chlorhexidine mouth rinse

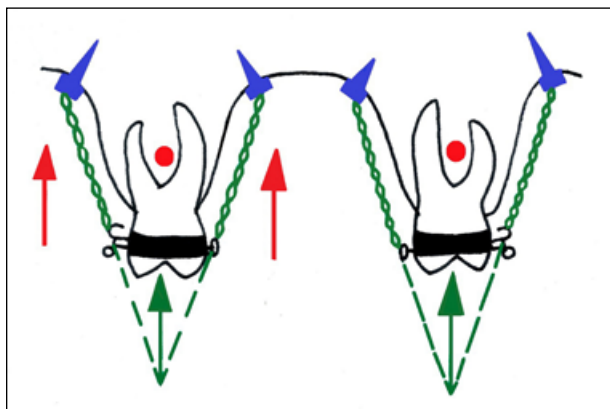


Figure 4. Force system produced by buccal and palatal miniscrews along the central axis of maxillary first molar for intrusion.

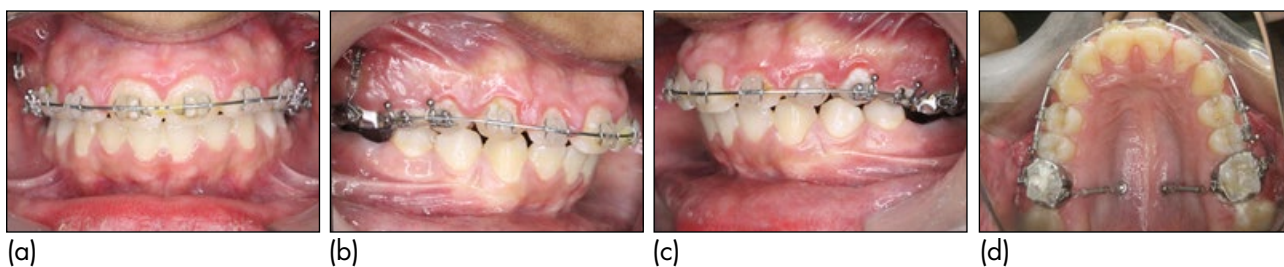


Figure 5 (a, b, c, d). Buccal and palatal miniscrews loaded with NiTi closed coil springs.



Figure 6 (a, b, c). Post-treatment intra-oral photographs.

were prescribed. Further, the patient was instructed to maintain good oral hygiene. As a submerged miniscrew, it was left for two weeks for adequate soft tissue healing before loading in order to eliminate the chance of inflammation in the region. After two weeks, additional miniscrews (dimension 2 mm × 6 mm) were placed in the right and left paramedian region of the palate in line with the central axis of the maxillary first molar and the buccal and palatal miniscrews were loaded (Figures 4 and 5A–D).

A total of 200 g of intrusive force was applied to each maxillary first molar by the activation of the NiTi closed coil spring tied to the buccal and palatal miniscrews. This applied 100 g of force per side. The NiTi closed coil springs were reactivated every

six weeks. Simultaneously, a sequence of aligning archwires was attached to the upper arch from 15 to 25 to correct the rotations and consolidate the minor spacing. The intrusion of the 16 and 26 was achieved in six months, after which the second molars were bonded. A continuous aligning wire was placed in the upper arch to generate an arch form and enable the final detailing of tooth position.

After seven months and following the success of molar intrusion, surgical placement of the mandibular dental implants was performed and the buccal and palatal miniscrews were removed. The removal of the buccal miniscrews required a minor surgical procedure by the maxillofacial surgeon. The upper arch was debonded after the treatment objectives were fulfilled.

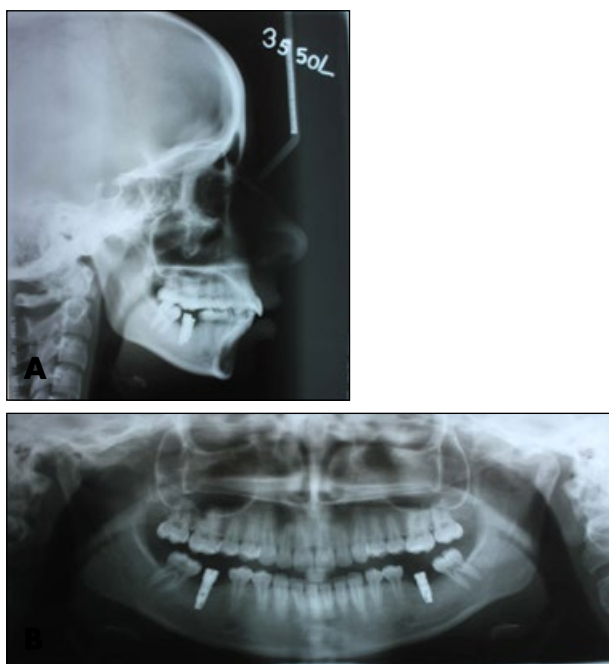


Figure 7 (a, b). Post-treatment lateral cephalogram and orthopantomogram.



Figure 8 (a, b). Post-retention extra-oral photographs.

Figures 6A–C show the intra-oral photographs after debonding. The lateral cephalogram and OPG post-treatment are shown in Figures 7A–B.

The upper arch was retained by a removable Hawley appliance. The dental implants were loaded after six months. Figures 9A–E depict the post-retention photographs after 20 months of treatment.

### Treatment results

At the completion of treatment, the following results were achieved:

1. Intrusion of each maxillary first molar (16 and 26) by 3.5 mm (Figure 11, Table I).
2. Spaces in the maxillary arch were consolidated and ideal alignment of the teeth in the maxillary arch was achieved.
3. A prosthetic implant with a PFM (Porcelain Fused to Metal) crown placed on the 36 and 46.
4. An increased occlusal table in the first molar region was provided, which resulted in improved masticatory efficiency.

The facial photographs show that overall facial balance was maintained. Cephalometric analysis indicated no marked skeletal changes. Adequate overjet and overbite were maintained. The maxillary and mandibular dental midlines were coincident and a solid occlusion was achieved. After 20 months of retention, the occlusion was stable and the facial profile maintained (Table I, Figures 8A–B, 9A–E and 10A–B).

Table I. Cephalometric measurements.

S.no	Parameter	Pretreatment	Post-treatment	Post-retention
1.	SNA	80°	80.5°	80°
2.	SNB	75°	76°	75°
3.	ANB	5°	4.5°	5°
4.	1 to NF	29.5 mm	29 mm	29.5 mm
5.	6 to NF	<b>27.5 mm</b>	<b>24 mm</b>	<b>24.5 mm</b>
6.	Occlusal plane to SN	14°	16°	17°
7.	SN – GoGn	37°	35°	35°
8.	1 to NA	18°/4.5 mm	21°/5 mm	21°/5 mm
9.	U1 – SN (°)	98°	102°	101°
10.	Nasolabial angle	108°	108°	104°

Bolded measurements indicate significant molar intrusion.

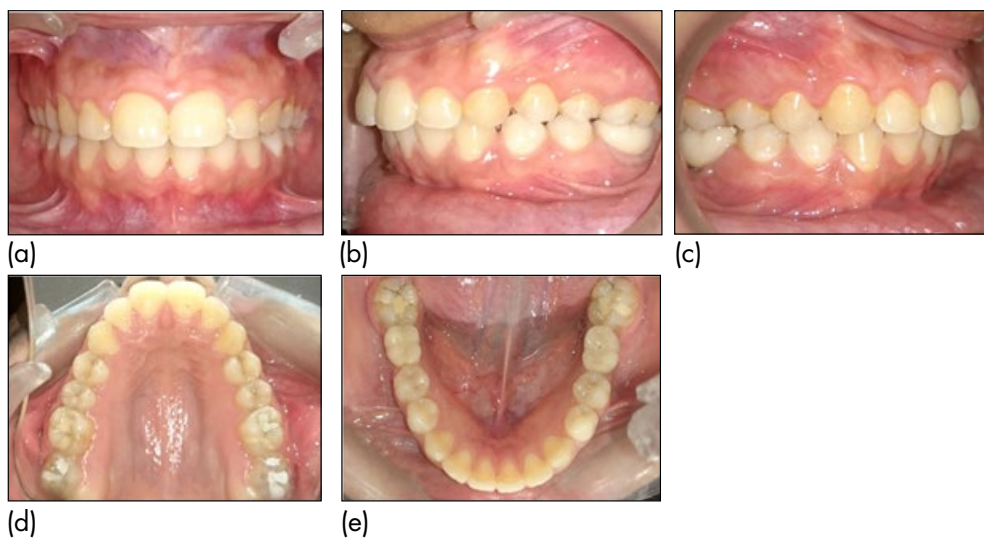


Figure 9 (a, b, c, d, e). Post-retention intra-oral photographs.

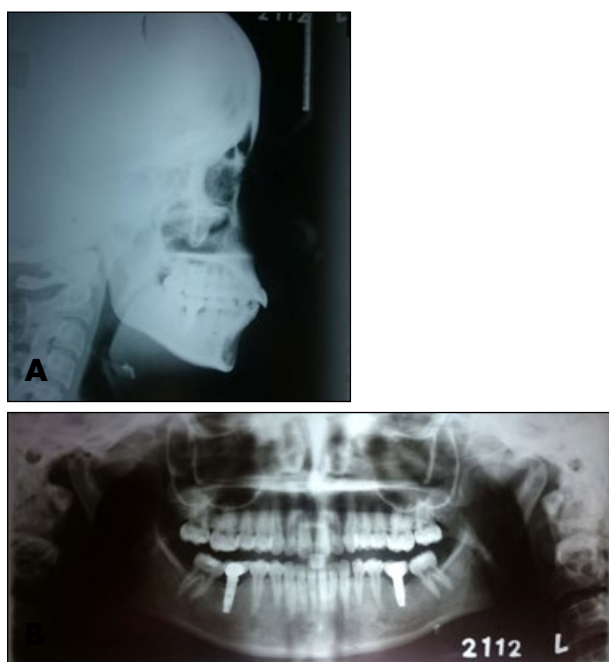


Figure 10 (a, b). Post-retention lateral cephalogram and orthopantomogram.

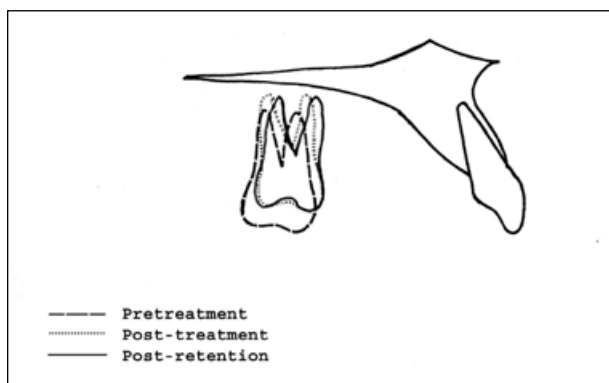


Figure 11. Superimposition showing maxillary molar intrusion.

### Discussion

Prior to the advent of skeletal anchorage systems, a method of reducing the crown length of an overerupted tooth was significant tooth reduction, which had endodontic implications. With contemporary treatment mechanics, intruding extruded teeth to the original occlusal plane is possible and preferable. Successful maxillary molar intrusion with surgical miniplates has been advocated by several authors.<sup>6,12</sup> However, patient discomfort is significant because of the surgical exposure, pain, postoperative inflammation and possible complications.

The appropriate insertion of miniscrews alleviates most of the problems associated with the placement of surgical miniplates and offers the advantage of providing close to absolute anchorage. Their simple design and ease of placement make them relatively comfortable for the patient.

A miniscrew implant in the mid-palatal area<sup>13</sup> has been used for the intrusion of maxillary molars, but usually in combination with a rigid transpalatal arch to prevent the horizontal component of the force tipping the teeth. One screw placed on the buccal and palatal aspects of the maxilla for each tooth assists in effectively producing true intrusion. However, a critical factor is the point of application of the intrusive force. To direct a force through the centre of resistance, simultaneous buccal and palatal forces need to be applied. In a previous case report, the buccal and palatal forces were generated by a TMA helical spring coupled with a miniscrew implant.<sup>8</sup> Controlling or minimising the side effects

associated with mini-implant placement in the inter-radicular area and counter moments generated with this force application system are the main concerns when using inter-radicular miniscrews. In patients with an inadequate inter-radicular area, it is wise to choose an alternative site for miniscrew placement that would not complicate treatment mechanics requiring intrusive force delivery. Centre of resistance of the upper first molar is expected to be at the centre of the crown of the tooth, close to the palatal root.<sup>9</sup> Therefore, the line of resultant force should pass along the central axis and achieve true molar intrusion.

In the presented patient, the placement of the miniscrews was in the zygomatic buttress and the paramedian region of palate for each molar. This was done in the expectation of delivering the resultant force along the central axis of the molar. A single buccal or palatal miniscrew would not have resulted in the desired direction of force and so it was decided the force from the buccal as well as the palatal side would be more beneficial. Due to insufficient inter-radicular space in the maxillary posterior region (Figure 3B), it was planned to place buccal and palatal miniscrews directly above the maxillary first molar in line with its central axis. Finally, the vestibular depth was less in the patient to allow for direct attachment of the active component (NiTi closed coil spring) to the buccal miniscrew head, and so it was decided to keep the miniscrew head submerged within the buccal mucosa with the NiTi closed coil spring attached to the screw head with a ligature wire. The NiTi closed coil spring extended below the vestibular depth into the oral cavity through the mucosa to apply intrusive force on the maxillary first molar from the buccal aspect. A stab incision for placement of the buccal miniscrew resulted in minimal exposure of the surgical site with significantly reduced inflammation and postoperative complications compared with the extensive surgical exposure required for the placement of a surgical miniplate with two or more surgical screws.

The position of the buccal and palatal miniscrews was determined by extending a line from the centre of the first molar mesiodistally on to the buccal mucosa and the palate to ensure the application of a direct intrusive force bilaterally.

A miniscrew can withstand a force level up to 500 g. Umemori et al.<sup>14</sup> recommended an initial force of 500 g for molar intrusion. Kalra et al.<sup>15</sup> suggested 90 g per tooth in growing children. Melsen and Fiorelli<sup>16</sup>

suggested 50 g bilaterally in adult patients to intrude maxillary molars. In the present case report, a force of 200 g per tooth was used; i.e., 100 g of force per miniscrew, which was sufficient to attain the desired intrusion.

An intrusion of 3.5 mm of both maxillary first molars was achieved with the rate of 0.5–1 mm per month without significant tipping or rotation. No obvious root resorption or loss of tooth vitality was observed.

## Conclusion

The present case report describes the successful management of overerupted maxillary first molars associated with carious mandibular first molars by a single arch orthodontic treatment programme. The outcome was facilitated by miniscrew-supported molar intrusion and accompanying rehabilitation of 36 and 46 with implant retained dental prostheses. This produced an acceptable occlusion and highly improved function.

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