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Intrusion of Supraerupted Maxillary Molar Using a High Interim Restoration on the Defective Opposing Tooth: A Clinical Report

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Abstract

Wear, extraction, or fracture of all or part of a mandibular first molar can lead to the supraeruption of the opposing maxillary molar, resulting in occlusal interference and lack of restoration space. This report describes a method to gain sufficient vertical space for permanent restoration. A direct composite resin restoration was placed on the occlusal surface of a lower molar, intentionally making the interim restoration high and intruding the maxillary molar. After 6 weeks, the extruded tooth returned to the desired position, and functional occlusion was restored, enabling a ceramic restoration on the mandibular molar. No marked adverse sensory reaction was reported in this therapeutic process, and no deleterious signs were detected in the teeth, periodontium, or temporomandibular joints. The simple treatment type was effective, noninvasive, and time saving, while also preserving maximum tooth structures.

A defect on the occlusal surface of a lower molar caused by caries, wear, erosion, crown loss, or other causes can result in a short clinical crown. Without an immediate restoration, the extrusion of the opposing tooth and closure of the vertical space can occur. As a result, an occlusal interference might develop and risk further fractures. The challenge in these circumstances is gaining sufficient space for restoration. This is also considered as the primary objective in the therapy.[1]

Conventionally, several methods can manage this problem. The first option is the occlusal reduction of the extruded antagonist molar followed by the insertion of a fixed prosthesis. This may require endodontic treatment of the opposing tooth at the expense of pulp vitality. Another option is subapical osteotomy to obtain osteal impaction, but this involves an aggressive operation.[2] Finally, orthodontic intrusion can be undertaken by application of various devices, such as extraoral headgear, full-arch braces, modified palatal bars, removable resin plates with bands, tongue cribs, or corticotomy combined with magnets.[3-10] These all have similar shortcomings in that they are complex, unesthetic, time consuming, and inconvenient with a side effect of extrusion or tipping of the anchorage teeth. Molar intrusion is considered one of the most difficult tooth movements in orthodontics because of multiple roots. In recent years, mini-screw and mini-plate implants have created a skeletal anchorage, but this approach is expensive and remains invasive.[11-14]

In 1975, Dahl et al[15] described a metal-based, removable, anterior bite platform retained by clasps in the canine and premolar regions to create interocclusal space in a patient with tooth wear in the anterior maxillary segment. The Dahl concept refers to the axial tooth movement observed to occur when a localized appliance or restoration was placed in supraocclusion, as the occlusion reestablishes the full arch at an average of 1.05 mm over 4 to 6 months.[16] The Dahl concept is thought to occur through a process of controlled intrusion and extrusion of dentoalveolar segments. Hemmings et al[17] suggested that an element of mandibular repositioning involving the condyle may also occur concomitantly. The same principle may be extended to the controlled movement of posterior teeth to create space.[18]

In this report, we present an innovative and simple approach to reverse the loss of space by placing a high interim restoration onto the occlusal surface of the defect tooth, with a thickness to match the amount vertical space needed, expecting the extruded molar to return to its original position. An investigation of the clinical and radiological changes of tooth, periodontium, and temporomandibular joint (TMJ) during the course of therapy were conducted.

Clinical report

A 14-year-old boy was referred to the Department of Prosthodontics, School of Stomatology, Nanjing University,

Figure 1 Pretreatment intraoral photographs. (A) Maxillary occlusal view. (B) Frontal view. (C) Mandibular occlusal view. (D) Right buccal view. (E) Left buccal view.

China, for restoration of a left mandibular molar defect. He was a middle school student in good general health and reported no specific medical history, dental treatment history, or dysfunctional habits. He became aware of decay in the left first mandibular molar about 5 years prior, but no palpable discomfort had accompanied it since. On clinical examination, a dark, stained carious defect on the occlusal surface of the first molar in the third quadrant was observed, but on tactile examination was smooth and hard, indicating arrested caries. There was slight sensitivity to a cold stimulus, but the tooth was positive to an electric pulp vitality test. As a consequence, the left maxillary first molar had extruded or overerupted into the space to gain contact with the opposing residual crown on the mesial aspect, occupying the vertical space for restoration. The patient presented with a Class I canine and molar relationship, acceptable intercuspation, and a pleasant facial profile. The Debris Index was 1 degree while Calculus Index was 0 degree. There was slight gingival swelling and bleeding on probing but no attachment loss or tooth mobility, with a probing depth no more than 3 mm, and a tentative diagnosis of puberty-associated gingivitis (Fig 1). No signs and symptoms were discovered in the TMJ and periodontal tissue. Radiographic examination revealed a carious defect close to the pulp and normal periradicular area of the defective tooth with complete apical closure of the roots (Fig 2A).

After consulting with the patient and his parents, a plan was made to place composite resin onto the occlusal surface, restore the shape to its original dimension, and intentionally make the restoration high. Adequate vertical space could be obtained from the extrusion reversing in a few weeks. Finally, we would replace the resin filling with a permanent restoration. Before treatment began, an informed consent form was signed.

Preliminary impressions were cast and mounted onto a semi-adjustable articulator using a facebow record. Then a diagnostic wax-up of the planned restoration was made on the study model. The wax pattern of the defective molar was shaped to the predicted shape of the permanent restoration regardless of the deficient occlusal space (Fig 3A) and used to make a matrix from a silicone rubber impression (GC Corp., Tokyo, Japan). Tooth preparation was considered nonessential, as the defective surface was hard and smooth to probing. After acid etching (Uni-etch Semi Gel; Bisco, Schaumburg, IL) on the enamel and adhesion coating (One-Step Filled Universal Dental Adhesive; Bisco), the occlusal surface was restored with blue core resin (Luxa Cora Z, Dual Core Build-Up Composite, DMG, Hamburg, Germany) using a matrix. Once the dual-cured resin hardened in a few minutes, the matrix was removed, and further polymerization with curing light continued. Occlusal adjustment ensured a three-point contact was adjusted (Fig 3B). After the restoration, the teeth, apart from the two first molars

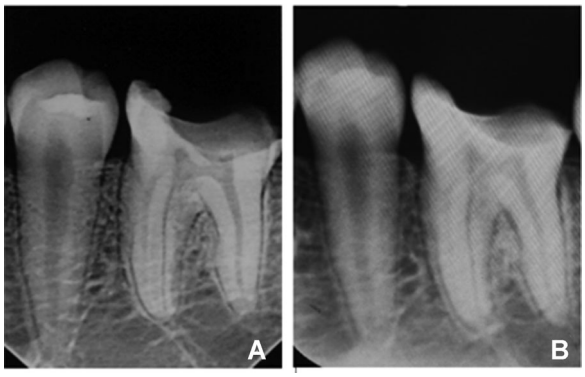

Figure 2 Periapical radiographs. (A) Pretreatment film. (B) Posttreatment film.

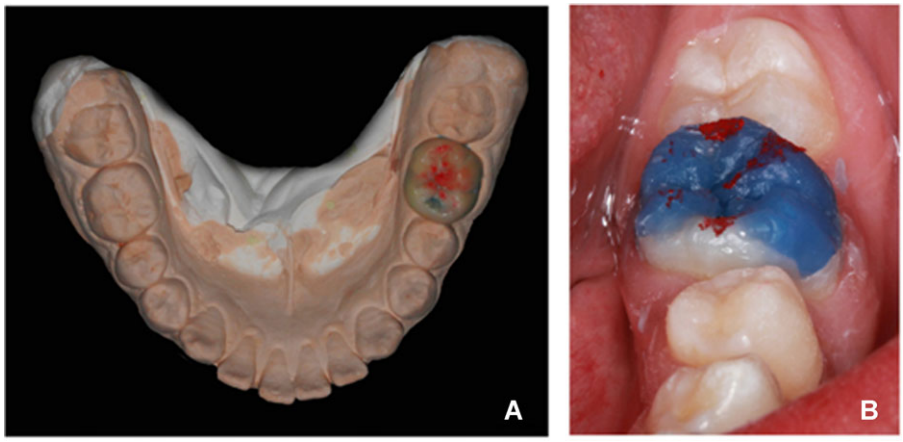

Figure 3 (A) Wax pattern of the mandibular lower molar. (B) Interim resin prosthesis cemented on #36.

Figure 4 Intraoral occlusion photographs after the high resin restoration was cemented. (A) Frontal view. (B) Upswept view. (C) Right buccal view. (D) Left buccal view.

in the left side, had no occlusal contact, and an open bite was created (Fig 4).

The patient managed to adapt to the occlusal change without any symptoms within the first few hours. During this period, he had to occlude and eat with only a couple of teeth. During intrusion, particular attention was paid to oral hygiene maintenance. He was recalled at a 2-week interval. No complaint was reported during this stage.

A month later, occlusal contact with the opposing teeth was reestablished in all teeth (Fig 5). The oral hygiene status was unchanged, and probing depths around the left first molars remained less than 3 mm. The electric pulp vitality test of the defective molar remained normal. No symptoms were observed around the TMJ examination.

Once the initial intrusion was successful, and the space had been regained, definitive restoration was possible. Tooth preparation for a ceramic onlay was performed on the mandibular first molar, provided with rounded internal line angles and 1.0 mm-wide chamfer. Subsequently, IPS e.max ceramic (Ivoclar Vivadent, Schaan, Liechtenstein) onlay was fabricated in the dental laboratory and eventually bonded to the patient's tooth with adhesive resin (Variolink N assortment/Syntac; Ivoclar Vivadent) (Fig 6).

A subsequent measurement of the lower-face height as a reference for occlusal vertical dimension (OVD) by application of cephalometric evaluation was determined by the distance from the anterior nasal spine (ANS) to Menton (Me). The original measurement was 70.2 mm, changing to 74.3 mm immediately

Figure 5 Intraoral photographs after a month of intrusion. (A) Maxillary occlusal view. (B) Frontal view. (C) Mandibular occlusal view. (D) Right buccal view. (E) Left buccal view.

Figure 6 Intraoral photographs with the ceramic onlay. (A) Frontal view. (B) Left buccal view. (C) Lower occlusal view.

upon wearing the interim resin restoration, but it returned to 70.3 mm after treatment. It is clear that the resin restoration led to an increase of OVD, yet the increased OVD gradually retuned to the primary value after the therapy, proving that the disappearance of the interocclusal gap was attributable to the molar intrusion rather than the extrusion of all the other teeth. Compared with the pretreatment radiograph, no appreciable differences in periodontal membrane, alveolar bone, or root apex were detected in the posttreatment film (Fig 2B).

With the comparison made on analysis of the full recorded models (Fig 7), we took the straight line between the buccal cusps of the mesial tooth and distal tooth as a datum line, four cusps as mark points for #26, and mesial and distal margin as mark points for #36. We measured the vertical distance

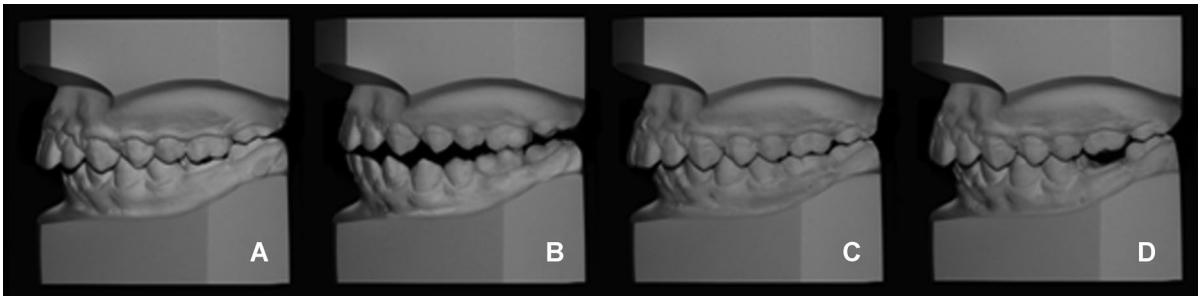

Figure 7 Full recorded models in left buccal view. (A) Pretreatment. (B) After the high filling was cemented. (C) After 1 month of intrusion. (D) After the removal of the interim prosthesis.

Table 1 TMJ space at different periods of the treatment (mm)

	Left			Right		
TMJ space	Superior	Anterior	Posterior	Superior	Anterior	Posterior
Pretherapy	3.3	1.7	2.4	3.5	1.9	2.5
With resin mock-up	4.3	1.5	3.6	4.5	1.6	3.7
Posttreatment	3.0	2.0	2.4	3.5	2.1	2.5

between the mark points and the datum line on the models. The cast analysis showed that the maxillary molar was intruded for 2.0 mm, and the mandibular molar was intruded for 0.4 mm in the vertical dimension compared to the adjacent teeth separately.

A cone beam computed tomography (CBCT) scan (NewtomVG; Quantitative Radiology, Verona, Italy) of the TMJs in the closed-mouth position showed no visible bone remodeling or degeneration imaging around the TMJ during the therapy. The joint space measurement was analyzed using Kamelchuk's method based on the joint sagittal lateral middle layer of TMJ images. Table 1 indicates TMJ spaces changed during the treatment. The mandibular condyle moved downward and forward in the articular fossa after the composite resin restoration, but was finally repositioned when the definitive prosthesis was made (Fig 8).

During follow-up, the patient showed a stable occlusion, and no visible difference was detected by model analysis. He reported no complaints, and nothing abnormal was observed during clinical examination conducted in the past 12 months.

Discussion

With provision for the aggressive operation necessary for a subapical osteotomy and the endodontic treatment required in the occlusal reduction of an extruded upper molar, tooth intrusion may be considered a preferable option for this condition.[1] Thanks to the development of resin performance and adhesion technology, direct composite became more appropriate to use as an appliance for the intrusion treatment. In 2011, Kalsi and Wilson[19] reported a patient with a worn maxillary first molar tooth accompanied by dentoalveolar compensation into the space. They restored the molar with high direct composite resin, which allowed for adequate strength in bulk for retention while acting as fixed intrusion devices. The occlusion was reestablished within 4 months by the composites. This approach might be a treatment protocol to consider when the interocclusal space needed for a restoration is insufficient.

Force results in tooth movement. Currently, orthodontic approaches are the most commonly used methods to achieve the changes to the occlusal relationship using traditional devices or mini-implants as anchorage.[4] The forces loaded on the extruded tooth have been reported as wide ranging (from 50 to 1000 g). Nevertheless, no matter how much the value, it is relatively continuous and almost constantly out of the control of occlusion.[5-14] However, in the present patient, the load for intrusion was provided by biting force; therefore, it changes distinctly in different functional or nonfunctional movements, especially in the masticatory cycle. According to the principle of the periodontal potential, the occlusal force of chewing foods in normal masticatory movement is half that of the strength the periodontal membrane can bear.[20] Anderson and Picton reported that with a molar surface artificially raised above the general occlusal level by 0.5 mm, the loads were at most twice the normal, much less than would be expected from a simple physical system if no force-regulating mechanism were operating.[21] Considering the difference in size and height of the block, further research is required to explore the load in specific cases. The upper molar intrusion was achieved with a vertical movement of about 2.0 mm in about 1 month, which confirmed that biting force was evenly applied, discontinuous, and unsteady, and could take quick effect on the opposing maxillary molar intrusion; however, further studies with more patients to clarify the reliability of this method are needed.

Newton's third law states that the force loaded on the two first molars in the left side will be equal in magnitude and opposite in direction; however, under the same load, the maxillary first molar had an intrusion of 2.0 mm, while the mandibular molar only had 0.4 mm in vertical dimension. We surmised that the difference might be attributed to the discrepancy of periodontal tissues. It is proposed that the pressurized tooth tends to move away from adverse occlusal force. The tooth movement is accompanied and followed by long-term periodontal tissue reconstruction. The density of newly formed bone at the side opposed to the movement direction was relatively

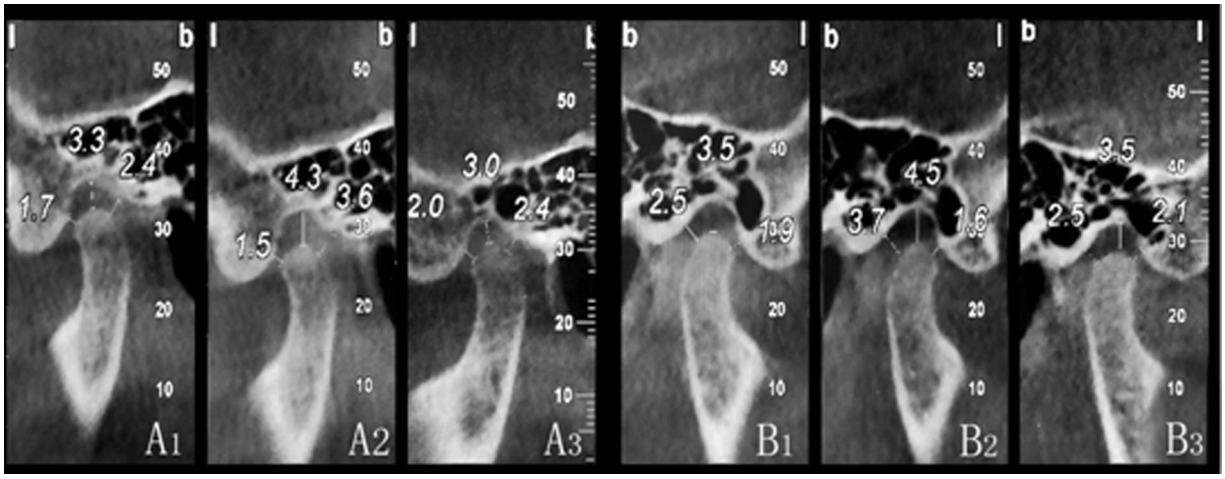

Figure 8 TMJ spaces at closed-mouth position with CBCT scanning. (A1) Left side pretreatment. (A2) Left side after the resin mock-up fabricated. (A3) Left side posttreatment. (B1) Right side pretreatment (B2) Right side after the resin mock-up fabricated. (B3) Right side posttreatment.

lower,[22] and periodontal ligament remodeling proved to be a time-consuming process.[23] Therefore, comparatively speaking, the extruded maxillary tooth was in an unstable position with the periodontal tissues still developing, and so it could be more liable to be reintruded. Moreover, the limited data reviewed suggest that density of alveolar bone is generally greater in the mandible than in the maxilla. In this patient, the cortical bone density in the molar areas was reported between 884 and 924 Hounsfield units (HU) for the maxillary alveolar bone, while for the mandibular alveolar bone it was between approximately 1280 and 1320 HU.[24] This discrepancy may force the maxillary molar to be intruded at a higher level than the opposing lower one, which may explain why this method for intrusion is usually used in the extruded maxillary molar rather than in mandibular molars.

As displayed in this case, no marked change indicated damage during the treatment as assessed by clinical and radiological examination. But side effects of this intrusion method, namely a transient occlusal interference and an increase of OVD, both of which are considered potential threats to stomatognathic system health, are possible.[25,26]

Previous studies have shown induced inflammatory or injurious changes are largely temporary and best considered as functional adaptation to the increased load. With regard to pulpal tissue damage, the majority of teeth with a high restoration manifest a predictable decrease in pain threshold on electrical pulp vitality test. This threshold appears to return to normal in a majority of teeth, after the high onlay is removed, intruded, or reduced by occlusal adjustment.[27] It is thought that osteogenesis occurs in the alveolar bone on the tension side with bone resorption more common on the compressive side. In most cases, the tooth tends to move within the alveolus to a new position such that the loaded forces decrease gradually until vanishing. This process is considered fundamental to orthodontics, distraction osteogenesis, and tooth intrusion.[28] Functional adaptability widely exists, for example, condylo-discal and condylo-fossa repositioning,[29] osseous remodeling,[30] cartilage viability,[31] disk reshaping,[32] and adjustment of TMJ mechanoreceptors.[33] Several researchers proposed in a similar experiment that occlusal interference elicits a significant increase in the resting electromyography (EMG) activity of temporal and masseter muscles, whereas the postural activity returned to its original pattern with the removal of the interference. The process allows the muscle to adapt to the new postural position.[34] It is suggested that the reversible increase in vertical height before irreversible intervention must be carried out for a minimum of 3 months to achieve neuromuscular deprogramming.[35] Overall, the correlation between interim occlusal interference and tooth damage still remains controversial.

To date, scientists still argue on the question of whether high restoration can lead to jaw dysfunction. Several recent extensive reviews on this topic do not support the notion that occlusal interference is either predictive or causative of temporomandibular disorders (TMD), although some symptoms such as chewing stroke patterns, slight change in postural muscle tension levels, transient sore jaw muscles, and joint click are reported to be induced by an experimental occlusal interference in some individuals. At the same time, these changes are transient, so they routinely resolve after adaption or removal of the high filling.[36] What is more, the present data on this subject are based on observations without carefully calibrated blind-to-status examinations, and such symptoms are also present in relatively asymptomatic patients. Assessment of evoked hypersensitivity might be practical to acquire but provides little information on spontaneous chronic pain or jaw dysfunction.[37] On all accounts, as the causal relation between the two items still lacks definite evidence, we expect more effective research to appear in the future.

Conclusion

An iatrogenic high interim restoration on a defective mandibular molar was an effective and time-saving method for the

intrusion of an extruded maxillary molar. Effectual molar intrusion could be achieved with a discontinuous and changing load in a short time. No pulp changes, periodontal lesion, apical root resorption, TMJ damage, or jaw malposition were detected by clinical and radiologic examination in the intrusion process. More research is needed regarding the influence that the new method has on the tooth, periodontal tissue, TMJ, and especially on mandibular movement.

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