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CASE REPORT

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Restoration of the dentition in a patient with a history of bruxism and amelogenesis imperfecta: A clinical report

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Abstract

The report describes a 27-year-old female patient with amelogenesis imperfecta (AI) accompanied by nocturnal bruxism, who was treated with a combination of occlusal splint and full-mouth fixed prosthetic rehabilitation through follow-ups within 2 years. Soft splint protection, regular follow-up, and monitoring of carries are guaranteed to maintain a long-term curative effect.

KEYWORDS

amelogenesis imperfecta, bruxism, occlusal rehabilitation, T-scan III, vertical dimension of occlusion

1 | BACKGROUND

Amelogenesis imperfecta (AI) is a group of hereditary diseases that affect facial esthetics and oral function, often accompanied by function and dysfunction of stomatognathic system, especially in young patients with severe occlusal wear and the habit of grinding teeth at night. Full-mouth reconstruction in these patients is very challenging. Dentists need to consider how to restore oral function, improve facial esthetics, and ensure the long-term efficacy of prostheses. The report describes a 27-year-old healthy female patient with nocturnal bruxism and AI, who was treated with a combination of occlusal splint and full-mouth fixed prosthetic rehabilitation, and who fully met the patient's functional and esthetic requirements through follow-ups at 4 months, 10 months, and 2 years. Through detailed examination and complete design before occlusal rehabilitation, and reasonable application of resilient occlusal splint after treatment, a predicted and satisfactory result can be obtained.

Amelogenesis imperfecta (AI) is a term for a clinically and genetically heterogeneous group of conditions that affect the dental enamel. Dental features related to AI include enamel deficiencies, pulpal calcification, taurodontism, root malformations, failed tooth eruption, impaction of permanent teeth, progressive root and crown resorption, congenitally missing teeth, and anterior and posterior open bite.[1] However, the rarity of AI makes it difficult to obtain large study groups. In several systematic literature reviews, researchers found a number of

aberrations associated with AI, but not sufficiently systematic to allow for secondary analysis and synthesis of the findings.[2,3]

Most patients with AI, with the passage of time, are often accompanied by alteration of vertical dimension of occlusion (VDO). Therefore, the clinician's primary goal is to restore the patient's dentition for ideal or adaptable VDO and function. It is needed for these patients to take a careful and comprehensive therapy strategy. Many options such as adhesive restorations, overdentures, porcelain-fused-to-metal crowns, fixed partial dentures, full ceramic crowns, and inlay or onlay restorations are all used for prosthodontic treatment of AI patients.[1,4,5] However, the investigation of patients with removable overdenture showed that patients are uncomfortable to wear splint denture continuously and cannot prevent further abrasion of teeth within 2 years.[6] For young patients, fixed prostheses are their preferred option, but it takes a lot of time and the treatment process is more complicated. They will choose destructive, but esthetically more attractive restorations of dental tissue in the early stages of puberty, obtaining desirable look.[7] Zirconia is the strongest and toughest ceramic material available so far. Fixed partial denture (FPD) is the last and most challenging mechanical and functional clinical test.[8] Clinicians often must decide not only the type of restoration but also the material used for restoration to provide esthetics and longevity. They should be aware of the advantages and disadvantages of different types of crowns and veneers in terms of survival, success rate, and esthetic results. This is in agreement with other reports.[5,9]

The T-scan III occlusal analysis system is a quantitative and reliable method for occlusal evaluation. The parameters of it can provide an extensive reference for analyzing instant occlusal condition.[10] It is necessary to use the T-scan III system to measure and evaluate occlusal function before and after full-mouth occlusal rehabilitation. This is helpful for dentists to mark and eliminate occlusal interference during occlusal path and finally achieve occlusal stability. In this report, we presented an AI and sleeping bruxism patient with fixed occlusal rehabilitation and discussed the treatment strategies for such disease. This will provide a reference for the dentists to design and fabricate the final prostheses with the new vertical dimension of occlusion vertical distance and ensure that the ideal prostheses have normal occlusal function and esthetics.

Though case reports are useful for communicating information on rare conditions such as AI, but related findings should also be considered and a long follow-up is necessary.

2 | CASE PRESENTATION

A healthy 27-year-old female was referred to the Department of Prosthodontics of Lanzhou University College of Dentistry for the treatment of her severely worn dentition. The patient's chief complaint was the appearance of her full teeth, which are discolored and small-sized teeth since her childhood (Figure 1A). She works as an accountant and cares for her dental smile. Her medical history included sleeping bruxism, right masticatory habit, and the right mandibular incisor, which was treated by root canal therapy (RCT) 1 week ago. The patient did not report any symptoms or signs of temporomandibular joint disorders (TMD). However, when all teeth were provoked by something cold, pain occurred in the other three mandibular incisors. She showed a distance of 64 mm in the lower third of the face, slightly shorter than the middle height of the face as 68 mm (Figure 3A).

The intraoral examination revealed widely enamel hypoplasia, which presents a mixed brown and yellow color, mild-to-moderate generalized attrition of dentition, especially the lower anterior teeth (Figure 1A). The right lower incisor was treated by root canal therapy according to the X-ray image. The patient had acceptable oral hygiene, no obvious plaque buildup, no calculus, and no visible periodontal disease.

According to the T-scan III system examinations (Figure 2A, before occlusal rehabilitation), the maximal bite force (MBF) in intercuspal position (ICP) was slightly different between the left and right sides. It had more occlusal force on the right side (56.4%) than on the left side (43.6%). The ratio of the anterior and posterior occlusal force distribution was 37.3% and 62.7%, respectively. The center of the bite force (COF), indicated as the diamond block, was located within the ellipse (gray circle), and the occlusion time (OT) and disclusion time (DT) were 0.22 and 0.18 seconds, respectively. The results showed that the patients had normal occlusion except for the slight asymmetry of MBF and A/P occlusal bite ratio.

Cone-beam computed tomography (CBCT) examination of the patient revealed a slight posterior displacement of condyles bilaterally. The cephalometric analysis showed that the angle between the SN plane and the mandibular plane (SN-MP) was 33°.

Based on the problems such as moderate to severe dental wear, short clinical crowns, gray and yellow colors of the teeth, and some pulpal sensitivity of the mandibular anteriors, the definitive diagnosis included hereditary hypoplastic-type amelogenesis imperfecta and severely worn dentition with loss of VDO caused by a history of sleeping bruxism.[11,12] The treatment objectives were to avoid the teeth from becoming shorter by wearing a resilient night splint, to prevent dentin sensitivity, and to meet requirements for function and esthetics by dental restorations. The patient consented agreement and planned to restore the natural contours of the tooth with all-ceramic crowns (In-Ceram Zirconia; VITA Zahnfabrik). Four mandibular

FIGURE 1 Frontal view of dentition before and after occlusal reconstruction (OA). A, The enamel is irregular in shape, colored dark yellow-brown and hypoplastic before occlusal reconstruction. B, Frontal view of occlusion in maximum intercuspation (MI) after treatment. C, Anterior view of 4 mo later. D, Anterior view of 10 mo later

incisor teeth were treated by root canal therapy before rehabilitation because of insufficient tooth preparation space.

It was necessary to fabricate a diagnostic wax-up and mock-up to help the technician create a proper emergence profile and contour in the final restorations. Accordingly, the provisional restoration of maxillary dentition (stabilization splint) with 3 mm thickness was made. The vertical distance of 3 mm is an empirical value. Following a 2-month period of wearing a splint, the patient was fully accustomed to the new VDO as determined by the provisional prosthesis. No discomfort was found in the masticatory muscles and joints.

The maxillary and mandibular anteriors and premolars were designed and made by a single crown restoration. Two-unit crowns were fabricated for FDI teeth numbers 16-17, 26-27, 36-37, and 46-47, respectively (Figure 1B). The laboratory technician designed the posterior occlusal tables according to condyle position in TMJ fossa determined by CBCT and incorporated immediate disclusion

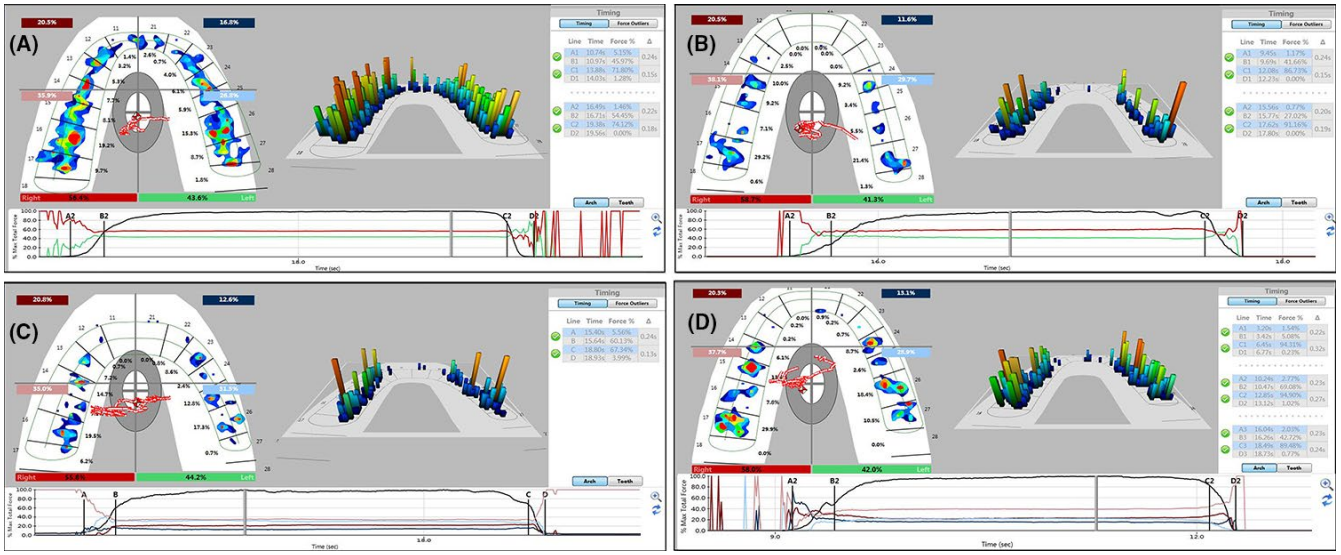

FIGURE 2 Bite force in a T-scan movie. Maximal bite force (MBF), center point of the occlusal force (COF), occlusal time (OT), and disclusion time (DT) in each graph were recorded before OA (Figure A), immediately after OA (Figure B), 4 mo later (Figure C), and 10 mo later (Figure D). It showed a symmetrical, stable occlusion and smooth curve of occlusal force. In each figure: Top, left side: two-dimensional graphs of the occlusion and occlusal force distribution and the left/right symmetry; the lozenge trajectory in the ellipse represents the movement of the center point of the occlusal force (COF) during dynamic occlusion. Top, middle: three-dimensional graphs of the occlusion and occlusal force. The blue columns represent the area of lower force; the red columns represent the area of high force. Top, right side: occlusion time and disclusion time. The different change between A1 and B1 is occlusion time, which marked as OT. The different change between D and C is disclusion time, which marked as DT. Bottom: The graph shows occlusal force over time for the overall dynamic occlusal contact process. A1 is the point that the teeth start to occlude, B1 is the point the dentition is fully occluded, C1 is the point that excursion movement starts, and D1 is the point the dentition is fully separated. A, The distribution of the left and right force was 56.4% and 43.6%. The COF was within the ellipse, and the OT and DT were 0.22 and 0.18 s, respectively. B, The distribution of the left and right force was 58.7% and 41.3%. The COF was within the ellipse, and the OT and DT were 0.20 and 0.19 s, respectively. C, The distribution of the left and right force was 55.8% and 44.5%. The COF was within the ellipse, and the OT and DT were 0.24 and 0.13 s, respectively. D, The distribution of the left and right force was 58.0% and 42.0%. The COF was within the ellipse, and the OT and DT were 0.23 and 0.27 s, respectively

during excursive movements (canine guidance). The restorations were cemented with resin cement (RelyX Unicem (3M ESPE)) and were equilibrated to ensure no interferences were present. The T-scan III (bioresearch Co, T-Scan III v8.01) was used for examination of the force distribution (Figure 2). Compared with the preoperative recording, the patient's face shape became more natural and harmonious, and the lower third height of the face recovered to 67 mm (Figure 3B). A soft resilient night guard was fabricated (EKRODENT) for the upper dentition of the patient to prevent nocturnal bruxism from damaging on crowns. Oral hygiene instruction and regular checkups were administered regularly. Follow-ups were conducted in 4 months, 10 months, and 2 years. The intraoral views were observed in Figure 1C and D. The occlusal recordings were measured by the T-scan III system and revealed in Figure 2C and D.

In this case, we used a cephalometric analysis to determine the mandibular angle of the patient. In addition, we also added the CBCT panoramic images (Figure 4) and condylar position photographs (Figure 5) after occlusal reconstruction to further indicate the results of this process.

3 | DISCUSSIONS

The evidence-based recommendations of the planning of prosthetic rehabilitations in patients with TMDs and/or bruxism are still on the way. However, caution when planning irreversible occlusal changes in healthy individuals and patients with TMDs and/or bruxism is recommended.

Change of vertical dimension of occlusion is a critical point in the severely worn dentition. Spear[13] clearly demonstrates that patients can function at many acceptable vertical dimensions, provided that the condyles are functioning from centric relation, and the joint complex is healthy.

The increase of VDO should consider the structure of residual teeth, the space available for restoration, occlusal variables, and esthetics.[14] However, if the patient's preoperative physiology is not carefully evaluated and the vertical distance is arbitrarily increased, the treatment time will be prolonged. It may be accompanied by many complications.[15] Therefore, the adaptability of TMJs and muscles should be carefully evaluated and monitored during wearing the interim prosthesis. Freeway space (FWS) is an important reference in determining whether the VDO is appropriate

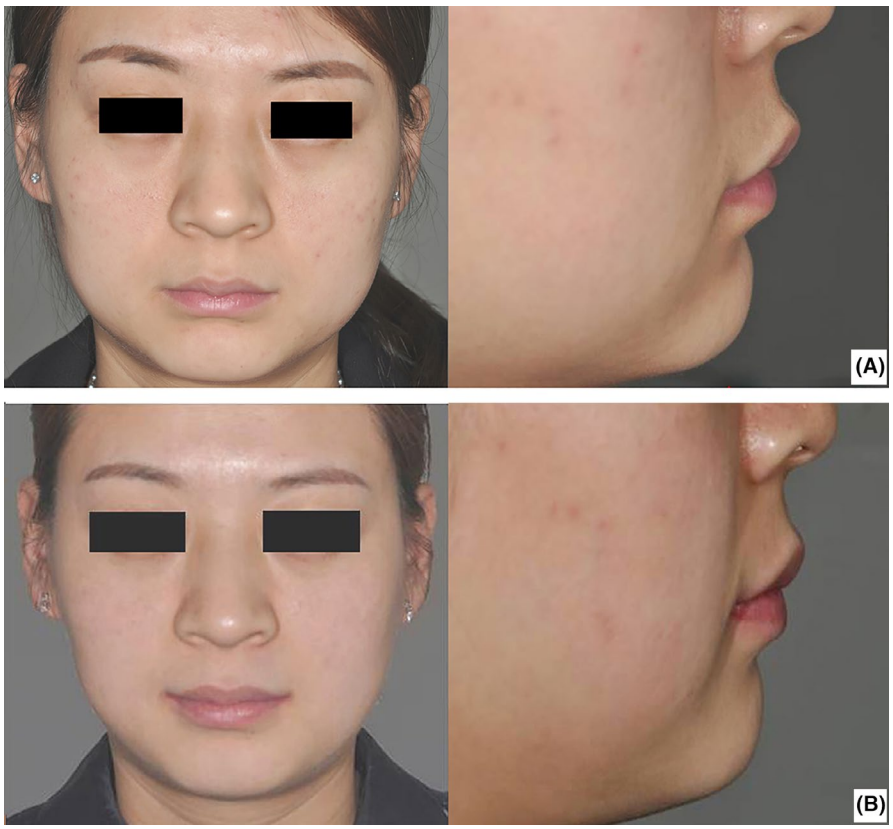

FIGURE 3 Extraoral view before and after treatment. A, A preoperative view of the patient's full face and the lower third of the lateral profile, which has a deep nasolabial groove. B, A better postoperative view of the patient's full face and the lower third of the lateral profile

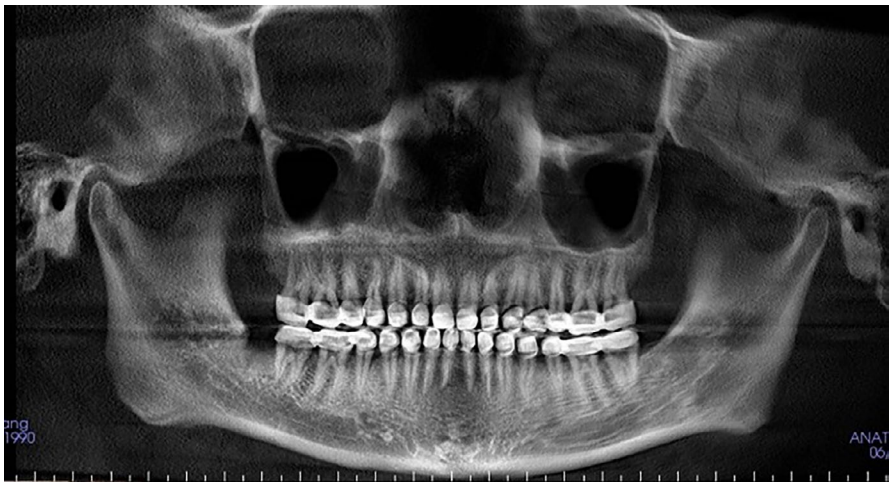

FIGURE 4 CBCT panoramic view of the patient after occlusal reconstruction

or not in clinical practice. A 2 mm FWS indicated that the VDO could be safely increased.[16] Additionally, the current evidence showed that the stomatognathic system could adapt quickly to changes in vertical distances of <5 mm.[14]

Also, we believe that the skeletal growth pattern is one of the factors that need to be considered when increasing the vertical distance.[17] Different vertical growth patterns were categorized depending on the SN-MP angle[18] (low angle, <26 degrees; normal angle, 26-38 degrees; and a high angle, ≥38 degrees). Hypodivergent shows a forward rotation tendency while hyperdivergent means a backward rotation tendency. The cephalometric analysis in this patient illustrated that the angle of the SN-MP is 33° and suggested that the patient is an average angle. It can be possible to conclude that the effect of the rotation of the mandible on the change of the vertical distance is mild.

The T-scan III system can be used to measure occlusal force on each tooth, anterior-posterior occlusal force proportion as well as left-right occlusal force proportion, the location of the center of occlusal force (COF), the occlusal time (OT), and disclusion time (DT).[19] Masticatory efficiency of dentition is affected by occlusal contact area, occlusal force, tactile sensitivity, and oral motor function.[20,21] The number of occlusion contact points can reflect the occlusion force.

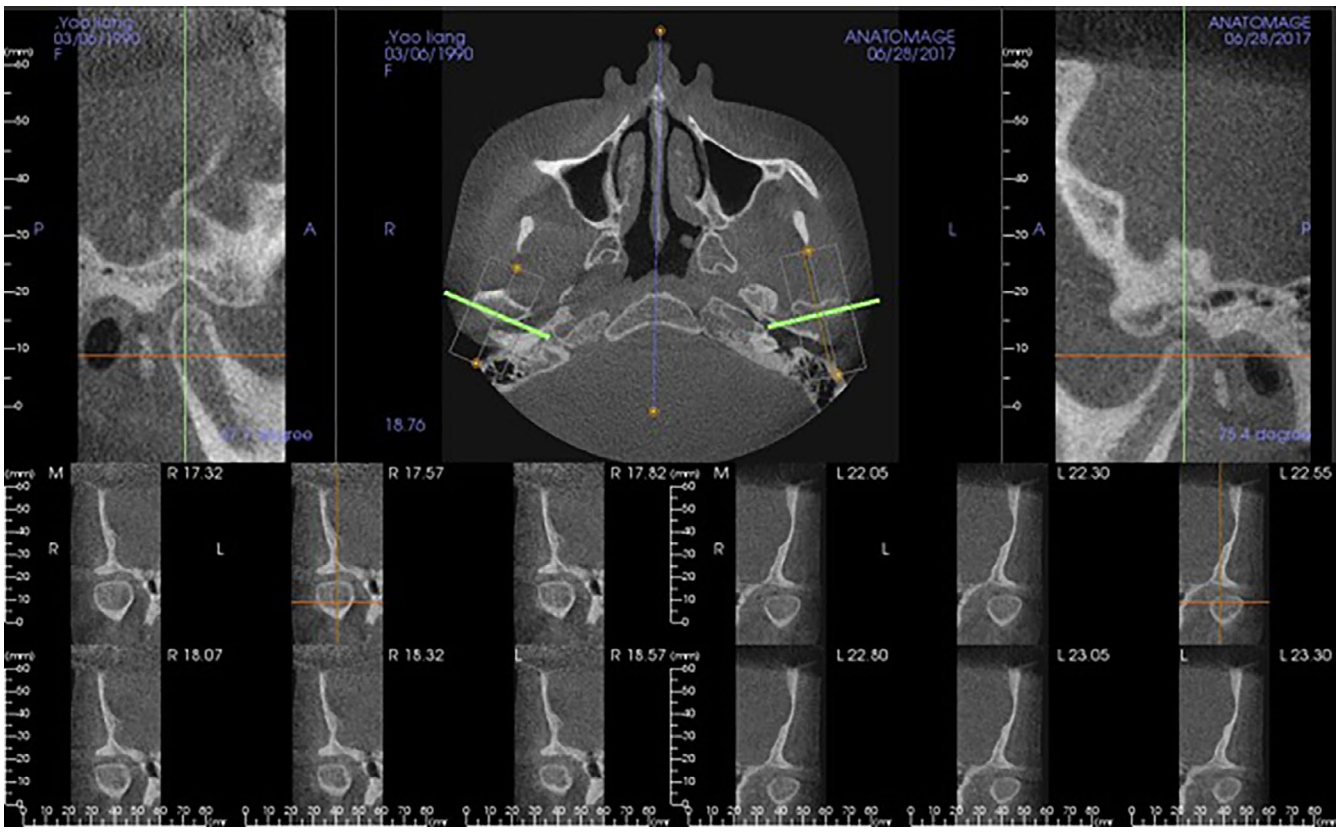

FIGURE 5 CBCT view of the TMJ images after occlusal reconstruction

In this clinic report, the number of contact point in the post-reconstruction, compared with pre-reconstruction, reduced the number of occlusal contacts due to completely restoring the cusp contour of the teeth. This phenomenon was possibly associated with severe dental attrition of the patient and reduction of cusp height, resulting in an increase in the contact area between the upper and lower teeth. In this study,[19] the asymmetry index of occlusal force (AOF) implies the difference of occlusal force between right and left sides, and it can be calculated as follows:

> Left–right asymmetry = (total right occlusal force − total left occlusal force)/(total right occlusal force + total left occlusal force) × 100%

In this case, preoperative and postoperative examinations demonstrated that the right occlusal force was higher than the left occlusal force, which may be related to the patient's right chewing habits and muscle contraction memory, but was not related to reconstruction. In previous literature by T-scan system study indicated the difference in bilateral force percentage within the 95% confidence interval is between −15.50%~12.10%. The study indicated that the difference in bilateral force percentage before occlusal rehabilitation, after occlusal rehabilitation immediately, 4, and 10 months was 13%, 17.4%, 11%, and 16%, respectively. There was no evident difference in left and right occlusal force in the three times comparing with preoperation, the postoperative rehabilitated occlusion was stable. Although the MBF thresholds among individuals vary widely, there is a high reproducibility for each individual, which served as one of the reference standards for the examination of occlusal balance at ICP.[23] In T-scan III system, COF is represented as a point, and its position is defined as the distance from the point to the center line of the dental arch. Mizui et al[23] used the T-scan system to evaluate the distribution of force; they found that 60 normal subjects exhibited bilateral balance and an anteroposterior center of force in the first molar region, which conducive to refine the stability of ICP and normal mastication efficiency.[22] The COF served as a balance point for the torque of occlusal force. Chen[24] in a study found that the closer the COF to the center point of the ellipse on the T-scan recording, the more balanced the occlusal forces on both sides. In this case, after restoration, three follow-up examinations showed that the COFs were located within the ellipse and closed to the molar area. It proved that postoperative occlusal stability is a benefit to maintain the stability of ICP and mastication efficiency.

Occlusal time (OT) and disclusion time (DT) are two parameters of occlusal contact characteristics. OT, defined as the time from first tooth contact to maximum intercuspation; DT, defined as the time from the largest intercuspal to the

last tooth contact.[25] OT is directly related to the patient's occlusal contact pattern,[26] DT can correlate the tooth contact with muscle activity,[27] and abnormalities in DT can lead to changes in muscle activity. According to the manufacturer, it is recommended that the OT is <0.2 or 0.3 seconds and the DT is <0.4 seconds.[27] After 4 and 10 months follow-up, the changes of OT were observed to evaluate the stability of occlusion. Kerstein and Wright found that disclusion time increases in patients with myofascial pain dysfunction.[28] The postreconstruction, in this case, showed that the DT was longer than before reconstruction but within the limit of the manufacturer's regulations, reflecting the stability of the muscle activity after the patient's reconstruction. It is worth mentioning that the simultaneous chewing muscle activity record should also be recorded with the Bio EMG system, excepting for using the T-scan III system to record the accuracy of occlusal contact and force.[29] The shortcomings of this case are that it does not measure the patient's chewing efficiency, nor does it use the Bio EMG system to record the functional status of the masticatory muscles, so it is difficult to clearly indicate the degree of loss or increase in the patient's bite force. It should be emphasized that the examination of T-scan and EMG before and after occlusal reconstruction should be paid more attention in future clinical work.

The occlusal splint is an auxiliary tool to control the habit of grinding teeth and prevent tooth damage. However, caution and close attention should be paid to any responses from the stomatognathic system. The splint with this case is made by <2 mm thicknesses and applied at night no more than three times per week. In this case, the splint was <2 mm thick and was worn only at night, not more than three times a week. The patient did not have any discomfort or any other symptoms and signs of TMD.

Regular follow-up, plaque control, oral hygiene education, carries monitoring, and treatment are the keys to maintain the long-term efficacy of bruxism and AI patients.

4 | CONCLUSIONS

Full-mouth rehabilitation for patients with bruxism and enamel hypoplasia is very challenging because of the need to consider how to restore oral function, improve facial esthetics, and maintain the health of the stomatognathic system. To achieve these objectives, medical treatment needs to be performed, including the design of esthetic features, appropriate VDO changes, precise occlusion, and evaluation of TMJ. The prosthetic rehabilitation should be planned to be a part of the systemic treatment strategy, which is very important to improve the quality of life of patients. For patients with nocturnal bruxism and AI, successful treatment depends not only on detailed examination and complete design before rehabilitation, but also on the perfect implementation of surgical procedures such as alveolar ridge repair, crown lengthening before treatment and the favorable application of resilient occlusal splint after treatment. Dentists should be taken into account the long-term effects of occlusal rehabilitation by insisting on maintaining oral hygiene combined with occlusion monitoring and adjustment regularly. Successful oral reconstruction must meet the aim of esthetics and oral function simultaneously.

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CONFLICT OF INTEREST

The authors do not have any financial interest in the companies whose materials are included in this article.

AUTHOR CONTRIBUTIONS

YT and TC: contributed to the prosthetic treatment of the case, and prepared and drafted the manuscript; LZ: contributed to perform the T-scan analysis; GB and HK: designed and reviewed the paper.

ETHICAL APPROVAL

The complete occlusal rehabilitation procedure was explained in detail to the patient, and we signed a consent document before the submitted work commencement. We have no conflict of interest and guaranteed the reliability and accuracy of data sources.

INFORMED CONSENT

The complete occlusal rehabilitation procedure was explained in detail to the patient, and we signed a consent document before the submitted work commencement.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author.

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