Journal of Vocational Health Studies

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MAKING DIAGNOSTIC WAX UP OF MAXILLARY ANTERIOR TEETH IN CROSS BITE CASES

PEMBUATAN DIAGNOSTIC WAX UP GIGI ANTERIOR RAHANG ATAS PADA KASUS CROSS BITE

Case Study
Studi Kasus

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A B S T R A C T

Background: *An anterior crossbite is a type of malocclusion in which one or more maxillary anterior teeth are positioned lingually to the mandibular anterior teeth, compromising aesthetics and reducing patient confidence. A thorough understanding of the patient's chief complaint is essential for developing an effective treatment plan. A diagnostic wax-up is recommended to improve predictability and facilitate the modification of maxillary and mandibular relationship ultimately enhancing aesthetic outcome.* ***Purpose:*** *To describe the procedure for creating a diagnostic wax-up of the maxillary anterior teeth in an anterior crossbite case for aesthetic purposes.* ***Case analysis:*** *Maxillary and mandibular working models were received, showing an anterior reverse bite malocclusion, with an overjet of -3 mm and an overbite of 2 mm. The dentist requested a diagnostic wax-up of the maxillary anterior teeth to achieve optimal aesthetic results.* ***Result:*** *The master model was received, marked, occluded, and mounted on an articulator. Wax was then applied and shaped to refine the anatomy of tooth 21, with the point and line angles adjusted toward the center to create a smaller appearance while carefully considering the height and convexity. Wax restorations were made covering 6 anterior teeth from maxillary left canine to maxillary right canines with the occlusal relationships adjusted to approximate a normal appearance.* ***Conclusion:*** *The diagnostic wax-up procedure involves preparing the working models, establishing the median line, mounting the models on an articulator, and sequentially waxing teeth numbers 11 and 21 first, followed by teeth 12 and 22, and finally teeth 13 and 23. The overjet is increased to achieve a more normal maxillomandibular occlusion, followed by careful evaluation.*

A R T I C L E I N F O

Received 10 February 2025
Revised 21 February 2025
Accepted 01 July 2025
Available Online 31 July 2025

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Keywords:
Aesthetics, Anterior cross bite, Diagnostic wax up

A B S T R A K

Latar belakang: Gigitan silang anterior merupakan maloklusi di mana satu atau lebih gigi anterior maksila berada di posisi lingual terhadap gigi anterior mandibula, sehingga mengganggu estetika dan kepercayaan diri pasien. Pemahaman menyeluruh tentang keluhan utama pasien sangat penting untuk mengembangkan rencana perawatan yang efektif. *Wax-up* diagnostik direkomendasikan untuk meningkatkan prediktabilitas dan memfasilitasi modifikasi hubungan maksila dan mandibula untuk meningkatkan estetika. **Tujuan:** Untuk menentukan prosedur *wax-up* diagnostik pada gigi anterior maksila pada kasus gigitan silang anterior untuk tujuan estetika. **Analisis kasus:** Teknisi gigi menerima model kerja maksila dan mandibula dari dokter gigi dengan kondisi maloklusi gigitan terbalik anterior, overjet -3 mm dan overbite 2 mm, serta meminta diagnostik *wax-up* pada gigi anterior maksila untuk memperoleh hasil estetika yang maksimal. **Hasil:** Model kerja diterima, ditandai, dioklusi, dan dipasang pada artikulator. *Dental wax* diaplikasikan dan dibentuk untuk menyempurnakan anatomi gigi 21, dengan sudut titik dan garis disesuaikan ke arah tengah untuk menciptakan tampilan yang lebih kecil sambil mempertimbangkan tinggi dan konveksitas secara hati-hati. Restorasi *wax-up* dibuat untuk 6 gigi anterior dari kaninus kiri atas hingga kaninus kanan atas dengan relasi diusahakan senormal mungkin. **Kesimpulan:** Pembuatan *wax-up* diagnostik meliputi persiapan model kerja, pembuatan garis median, pemasangan pada artikulator, pembuatan *wax-up* diagnostik pada 2 gigi pertama, gigi nomor 11 dan 21, kemudian dilanjutkan pada gigi nomor 12 dan 22, kemudian terakhir pada gigi nomor 13 dan 23, meningkatkan overjet untuk mencapai oklusi maksilomandibular yang terlihat normal, diikuti dengan evaluasi.

Kata kunci:
Estetika, Gigitan silang anterior, *Wax-up* diagnostik

Journal of Vocational Health Studies p-ISSN: 2580–7161; e-ISSN: 2580–717x
DOI: 10.20473/jvhs.V9.I1.2025.70-76

INTRODUCTION

Anterior crossbite is a condition in which one or more maxillary anterior teeth are positioned on the lingual side of the mandibular anterior teeth, resulting in a negative overjet when the jaw is in a centric relationship. Anterior crossbite can affects smile esthetics (Nasir *et al*., 2021). Anterior crossbite, often observed as a key feature of Class III malocclusion, reflects a developmental anomaly marked by a mesial molar relationship. This condition typically arises from a complex interplay of genetic predisposition and environmental influences during a child's growth and development (Amudala *et al*., 2023). The presence of malocclusion also leads to psychological effects on patients (Taibah and Al-Hummayani, 2017).

Anterior crossbites can result from one or a combination of several etiologic factors (Kumar *et al*., 2016). These factors include palatally erupting maxillary anterior teeth, over-retained deciduous tooth or root, presence of supernumerary teeth or any periapical pathology (Kumar and Kumari, 2024). Other etiologies include trauma in anterior primary teeth resulting in displacement of the permanent tooth seeds lingually, premature loss of primary teeth resulting in bone sclerosis or fibrous connective tissue, bad habits, and an inadequate arch length due to eruption of the maxillary permanent teeth lingually. Crossbites can also be caused by ectopic eruption or a displaced tooth position, such as buccal displacement in the mandible or palatal displacement in the maxilla (Thirunavukkarasu *et al*., 2015). The prevalence of anterior crossbite varies significantly among and within populations, with studies reporting rates of 2.14% in Brazil and 6.25% in Saudi Arabia (Lira and Fonseca, 2019).

The aesthetic success of dental restorations relies on the ability to clearly understand the patient's chief complaint and expectations. Restorations can be an option to significantly improve and enhance aesthetics, especially by affecting the contour, dental arch, and occlusion that was originally less aesthetic. Occlusion is crucial for the long-term success of dental restorations by ensuring stability, durability, and functional harmony. Proper occlusion during the provisional phase minimizes postoperative adjustments and improves long-term results (Aldowish *et al.*, 2024).

The case presented was an anterior cross bite with an overjet of - 3 mm and overbite of 2 mm. Illustrating the results of restoration modification before placing definitive restorations is essential to prevent patient's disappointment and unnecessary remakes. A diagnostic wax-up is one of the pre-restorative procedures that illustrating the results of restoration modification before placing definitive restorations is essential to prevent patient's disappointment and unnecessary remakes. In addition, a diagnostic wax-up provides valuable information by estimating the available restoration space, setting occlusion, and defining the dental arch, thereby allowing for thorough evaluation of the proposed restoration. The tooth to be restored is shaped using a wax inlay, while the natural and other teeth act as guides. In addition, a diagnostic wax-up provides valuable information by estimating the available restoration space, setting occlusion, and defining the dental arch, thereby allowing for thorough evaluation of the proposed restoration, waxed-up serve as a valuable tool for analyzing potential treatment outcomes and enable the precise fabrication of mock-ups for restorations within the patient's oral cavity (Furuse *et al*., 2016). Then, the results of the diagnostic wax-up are used as a communication tool between dental office and dental laboratory and, implicitly, between the dentist and the dental technician (Drafta *et al*., 2022).

Modification of the natural teeth can be achieved by designing the restoration into a near-normal relationship. In this case, the maxillary and mandibular anterior teeth are positioned edge-to-edge because the distance is too large to allow for a normal occlusion. Through diagnostic wax-up, the dental technician can provide a tentative visual outcome for patient evaluation (Villalobos-Tinoco *et al*., 2022). Therefore, the purpose of this report is to describe the procedure for creating a diagnostic wax-up of maxillary anterior teeth in crossbite cases, serving as a means of communication between dentists, patients, and technicians to achieve optimal functional and aesthetic restorations.

CASE STUDY

Based on the study models can be seen in Figure 1 and the dental technician's work order letter, a set of type III gypsum casts from a female patient with an anterior crossbite was received. The maxillary anterior teeth exhibited excessive lingual inclination relative to the mandibular teeth, with an overjet of -3 mm, an overbite of 2 mm, and a midline deviation of 2 mm to the left. The technician was instructed to perform a diagnostic wax-up of the maxillary anterior region, to simulate ideal tooth relationships thereby improving) function and esthetics. The material used was inlay wax (Renfert, Germany).

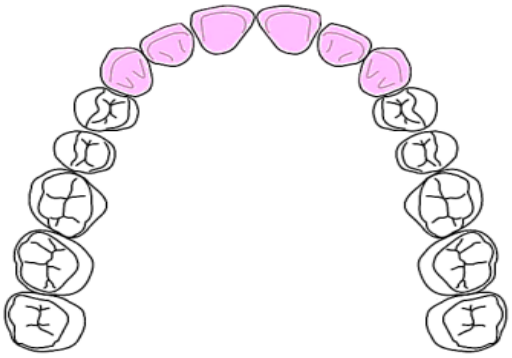

Figure 1. Appliance design

RESULT

The diagnostic wax-up procedure in anterior cross bite cases, begins with carefully reading and interpreting the work order letter to minimize potential errors, during the subsequent work process. In this case, the work order letter specified that the working model presented an anterior crossbite, and the dentist requested a diagnostic wax-up to assist in designing the final restoration. The restoration is intended to correct the crossbite, ensuring that the relationship between the upper and lower anterior teeth appears as normal as possible.

The manufacturing stage, began with the receipt of the master model of the upper and lower jaws. After the median line was drawn, the model was occluded and secured with a stick and sticky wax and then mounted in the articulator. The horizontal pin was positioned at the contact points of the mandibular incisors, and the vertical pin was adjusted to touch the articulator table. Mounting on the articulator using gypsum type II was completed can be seen in Figure 2. It is important to emphasize that the effectiveness of an articulator usage depends on the skill and knowledge of occlusion (Abu Zaghlan *et al*., 2021).

Subsequently, the labial surface was carefully coated with die lubricant to facilitate the waxing process. On the labial part of tooth 21 a thin layer of wax was applied considering the maxillary and mandibular relations. The point and line angles were then shifted toward the center to create a narrower appearance, carefully accounting for convexity and contact points with the opposing and adjacent teeth. When occluded, the height, convexity of the teeth could be observed and easily adjusted. The frame that had been prepared was filled using inlay wax. The labial surface was then smoothed and polished using a cotton swab moistened with soapy water. The same step was repeated with subsequent teeth, taking into account the each tooth's individual anatomy can be seen in Figure 3. The final result after the wax-up procedure for the anterior crossbite case is presented.

The wax-up serves as an illustrative guide for the dental technician to assist the dentist in planning the tooth restoration. The restoration outcome on the patient's six anterior teeth demonstrates an improved relationship between the upper and lower jaws and visually corrects the previously existing crossbite can be seen in Figure 4.

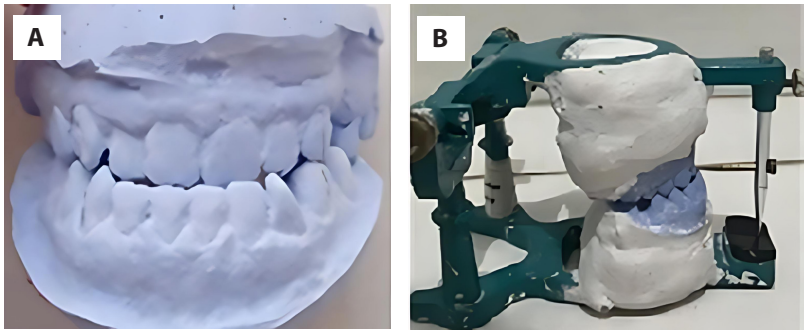

Figure 2. The initial preparation stage after receiving the master model. (A) Master model and (B) Mounting process on the articulator

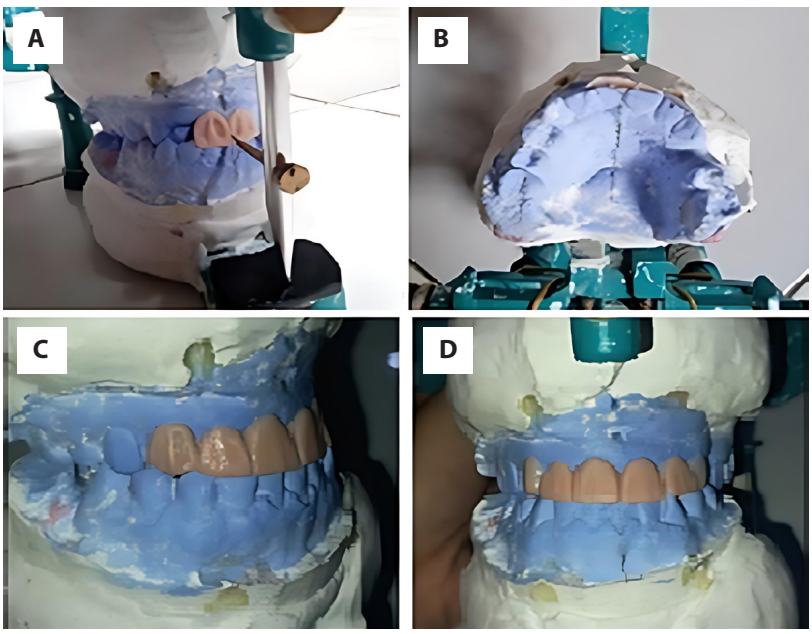

Figure 3. The waxed-up process on the master model. (A) Wax formation on the labial area, (B) Wax formation on the occlusal surface, (C) Anatomical adjustment, and (D) Wax polishing

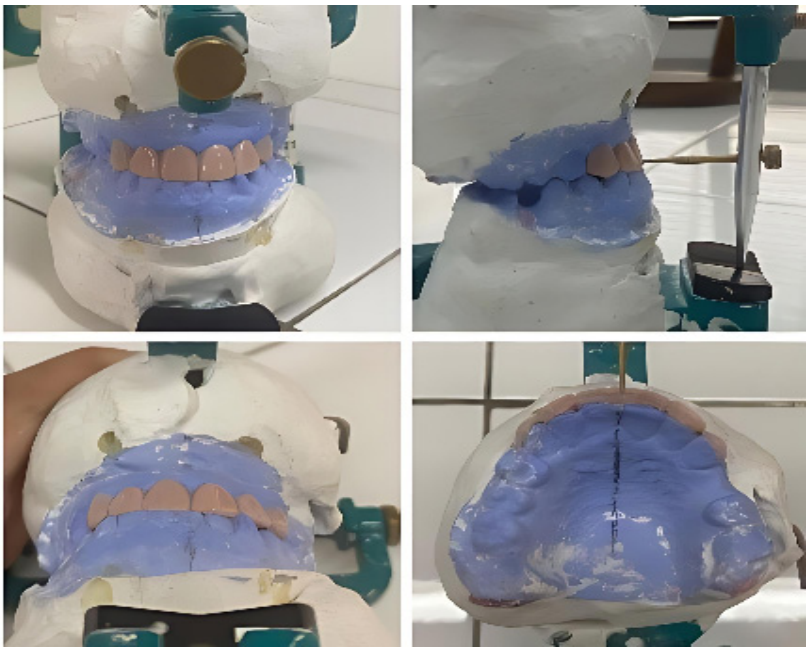

Figure 4. The final results of waxed-up

DISCUSSION

The challenge in creating the wax-up for an anterior crossbite case is to make the bite between the upper and lower jaws appear as normal as possible. In this case, a near-normal occlusion was achieved by establishing an edge-to-edge relationship, with an overjet of 0 mm and an overbite of 0.5 mm allowing the maxillary and mandibular anterior teeth to be in light contact. This modification will cause excessive chewing load, therefore light contact should be made to reduce chewing load so is recommended to reduce occlusal forces, minimizing the risk of abrasion to opposing teeth and fracture of the restoration (Kaddah, 2021).

The material used in diagnostic wax-up is inlay wax. Inlay wax is typically composed of a combination of different waxes, including paraffin, ceresin, and beeswax, which provide beneficial properties such as dimensional stability and ease of handling (Okorie *et al*., 2019) . At the initial stage after receiving dental cast from the dentist, the working model must first be carefully examined for pores or nodules, or improperly formed impression to avoid errors or failures in making diagnostic wax-up. Waxing is performed on the labial, lingual, incisal, and mesial surfaces, as well as the mesial contact and marginal ridge of the teeth (Abdalla, 2018). A median line was then determined and serves as a guideline when mounting on the articulator. Aligning the dental midline with the facial midline is critical for achieving esthetically pleasing and symmetrical anterior restorations. Therefore, dental technicians should use facial landmarks such as the glabella, philtrum, and chin point to guide accurate midline placement in wax-ups and prostheses. It is important to ensure that the median line of the working model is parallel to the median line of the articulator adjusted using the vertical pin. The median line is made straight guided by the middle of the lip phylltrum or adjusted to the position of the upper labial frenulum. However, in this case, the median line was slightly shifted to the right. In this case, the midline was observed to be slightly shifted to the right, presenting a minor asymmetry in the anterior segment to address this, the wax-up was strategically designed to camouflage the deviation and create a more harmonious esthetic outcome. In addition, the median line plays an important role in supporting aesthetics or facial beauty because it will determine the symmetry of the teeth against the patient's face (Niraula *et al*., 2021; Rahma *et al*., 2023). The occlusion was adjusted according to the median line to further enhance the overall aesthetics of a person's smile (Farahani *et al*., 2019).

Mounting on the articulator aims to position the model so that it accurately resembles the arrangement of the teeth in the jaws, simulating the actual intraoral condition. This process is performed carefully to ensure that when occluded the model is in the right position and does not experience bite elevation which can affect the accuracy of the diagnostic wax-up (Lina *et al*, 2017).

The first step in crating) diagnostic wax-up is to coat the labial surface with die lube which lubricates the tooth surfaces to allow the wax pattern to be easily removed from the working model. A thin wax layer was then applied to the labial surface of teeth 11 and 21 and then a framework was made by defining point and line angles so it would be easier when adjusting the convexity, height, contact points, and also the contours of the teeth. Diagnostic wax-up were made according to the patient and dentist's request, which is as normal as possible so that in this case the wax-up is guided by mandibular anterior teeth and also the median line.

When filling the framework, the anatomy and morphology of the teeth should be carefully considered. Every prosthetic rehabilitation starts by determining the

position of the incisal crest, followed by the refinement of functional parameters (Duarte, 2022). The dimensions of upper anterior teeth in males generally have larger mesiodistal widths and crown lengths than in females, confirming the presence of gender-related differences in tooth size (Rosenstiel and Land, 2015; Singh *et al*., 2015). In central incisive teeth, the mesial and distal incisal edge heights should be harmonized and shaped according to natural anatomy to ensure proper thickness and occlusion with the opposing teeth. On the labial surface, the disto-incisal angle was made more rounded than the mesio-incisal, and the mesiolabial groove and distolabial groove are shaped more subtly and less deeply than in natural incisive shapes. The same method was applied to teeth 12 and 22, continued to teeth 13 and 23. Lateral incisor tooth is shaped similarly the central incisor but smaller in size. In canine, the mesial slope was made shorter that the distal slope, and the cusp was inclined messially to mimic natural canine anatomy. The cervical line was curved towards the apex. The mesial contact point was ± 1/3 incisally, and the distal contact point was ± ½ incisally. The mesial slope of the upper canine is parallel to the distal slope of the lower canine, from the labial perspective, the canine exhibits a pentagonal outline with a single cusp. The distal cusp ridge extends longer than the mesial cusp ridge, resulting in the cusp tip being positioned mesially (Abdalla, 2018).

Evaluation is essential to ensure anatomical accuracy and proper fit. The margins were sealed with wax and the edges were shaped to match the intended teeth dimensions. The size of the labial surface can be adjusted to achieve a harmonious smile line. This step was followed by carving the embrasure. The incisal embrasure was rounded at the point angles. The first embrasure was carried out between the central incisors which is the smallest embrasure shape. The embrasure between the central incisors and lateral incisors were larger, and the embrasure between the lateral incisors and canines were the largest. In order to create the appearance of narrower teeth, the line angles and contour heights should be repositioned closer to the tooth centerline, the labial ridge of the canines should be repositioned more mesially and the incisal embrasure should be widened to reduce the mesiodistal width of the incisal edge. Additionally, the wax thickness is also adapted to match the contours of the maxillary posterior teeth (Rosenstiel and Land, 2015).

Several factors must be considered when designing and waxing each tooth, including its physiological and morphological anatomy, embrasure shape, interproximal space, inclination, contact points and overall contour. The embrasure is an open space formed between two adjacent and contacting teeth. The shape of the embrasure is made more open compared to natural teeth to create a spillway that facilitates food passage and promotes self-cleansing An improper embrasure shape and surface will cause pathological changes into the supporting tissue. The interproximal space is a triangular-shaped area bounded by the gum or processus alveolaris at the base, the proximal surfaces of adjacent teeth at the sides, and the contact point at the apex.

The inclination of each tooth refers to its position relative to its long axis. Each tooth in the human oral cavity has a unique inclination depending on the position of the tooth in the jaw. Abnormal or unbalanced tooth inclination can cause problems such as uneven pressure on adjacent teeth or excessive pressure on the supporting tissues.

The contact point or proximal contact area indicates the proper mesial and distal contact position relationship. The contact area can be evaluated from two directions to get the correct point: from the labial or lingual and from the incisal or occlusal. A proper contact point can prevent tooth drifting, avoid food accumulation, and stabilize the dental arch. The abnormal loss of contact areas or points can cause food to become trapped between the teeth, leading to gingivitis, tissue damage, alveolar bone deterioration, and potentially tooth loss (Abduo and Lau, 2022; Truong *et al*., 2023).

The waxing process must preserve the natural contour of the tooth and should not significantly alter its original anatomical form, as maintaining the authentic shape is essential for both functional integrity and esthetic outcomes. The contour of the tooth as the outer silhouette visible and tactile on the surface, plays a crucial role in maintaining gingival health. Proper axial contours enhance gingival health and promote plaque control. In contrast, over-contoured or excessively convex restorations hinder self-cleansing, leading to plaque accumulation, inflammation, and apical gingival recession (Cho *et al*., 2023).

Under these circumstances, shifting the inclination to create a near-normal relationship, where anterior teeth contact simultaneously in centric relation, would increase the chewing load on the patient's teeth. This requires a restoration that is both strong and aesthetically pleasing. Although zirconia crowns are generally contraindicated for anterior teeth, this limitation can be addressed by selecting Yttria-Stabilized Tetragonal Zirconia Polycrystals (Y-TZP) zirconia because of its high strength and durability (fracture toughness ± 7 - 10 Mpa/m). Y-TZP's strength arises from its phase transformation that prevents crack growth, making it ideal for thin, precise, biocompatible anterior restorations with superior aesthetics and translucency (Tzanakakis *et al*., 2016; Warner, 2017).

No tooth preparation has been done, thus the teeth on the submitted working model remained intact. The dentist wanted to determine the appropriate thickness for the planned restoration. Therefore, only the labial part was subjected to diagnostic wax-up. This approach made it easier for the dental technician to visualize and clearly assess the convexity, contours, and contact points with adjacent and opposing teeth. During the wax-up process, articulator played an important role in monitoring the relationship with the lower jaw.

Diagnostic wax-ups are useful as a means of communication between the dental technician, dentist and patient as they provide information through a three-dimensional representation of the planned restoration, helping to avoid patient disappointment with the final result (Drafta *et al*., 2022). In addition, it is also useful for functional planning masticatory function and dental articulation as well as for aesthetics planning. The benefits include include the dentist and patient a clear visualization of of the expected outcome, allowing the patient to actively participate in treatment planning and give informed consent before the procedure begins. Diagnostic wax-up can also serve as a tooth preparation guide so that it can ensure appropriate tooth reduction (Ho, 2015).

CONCLUSION

Diagnostic wax-up is a medium of communication between dentists, dental technicians, and also patients in determining treatment planning, particularly regarding aesthetics and is useful for preventing patient disappointment with the final result. The stages carried out in making diagnostic wax-ups in anterior crossbite cases include receiving a working model, establishing the median line, mounting the model on the articulator, performing diagnostic wax-ups on the central incisors, increase overjet and overbite so that the maxillary and mandibular anterior teeth are in light contact (teeth 11 and 21) and maxillary and mandibular teeth appears to be in near-normal occlusion. Waxing is then continued by teeth 12 and 22, then finally on teeth 13 and 23. The final stage involves careful evaluation.

ACKNOWLEDGMENTS

The author would like to thank all parties who have provided support in the preparation of this case report and declare no conflicts of interest.

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