Journal of Vocational Health Studies

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PROCESSING REMOVABLE ORTHODONTIC APPLIANCE FOR SINGLE TOOTH ANTERIOR CROSSBITE USING EXPANSION SCREW

PROSES PERANTI ORTODONTI LEPASAN UNTUK CROSSBITE ANTERIOR MENGGUNAKAN SEKRUP EKSPANSI

Case Study
Studi Kasus

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A B S T R A C T

Background: *Anterior crossbite is a case that when upper anterior are positioned palatally than lower anterior teeth in centric occlusion. Orthodontic appliances using expansion screw could be solution for tooth anterior crossbite treatment.* ***Purpose:*** *To figure out the optimal fabrication process of orthodontic appliances in single tooth anterior crossbite case using expansion screw.* ***Case analysis:*** *Dental laboratory provided the maxillary dental appliance with single tooth anterior crossbite on teeth 21. Dental technician also received orthodontic appliance using expansion screw.* ***Result:*** *Orthodontic appliance design was Adams claps on teeth 16, 26, labial bow on teeth 13, 12, 11, 21, 22, 23. Additional posterior bite plane, also expansion screw was located on maxillary left first incisor, palatal section.* ***Conclusion:*** *Design and making orthodontic appliances using expansion screw begins with drawing design, positioning Adams clasps and labial bow sectional screw mini mounting, then acrylic packing. Final step was finishing polishing acrylic plate.*

A R T I C L E I N F O

Received 28 February 2022
Revised 22 April 2022
Accepted 03 February 2023
Available online 30 March 2023

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Keywords:
Expansion screw, Orthodontic appliance, Single tooth anterior crossbite

A B S T R A K

Latar belakang: *Crossbite* anterior adalah kondisi rahang dalam relasi sentris, satu atau lebih gigi anterior atas berada pada posisi lingual dari gigi anterior bawah. Perawatan *crossbite* anterior gigi tunggal ini dapat dilakukan dengan menggunakan peralatan ortodontik dengan *expansion screw*. **Tujuan:** Untuk mengetahui proses fabrikasi peralatan ortodontik untuk *crossbite* anterior gigi tunggal dengan menggunakan *expansion screw*. **Analisis kasus:** Laboratorium kedokteran gigi menerima gips gigi rahang atas dengan *crossbite* anterior gigi tunggal pada gigi 21 dan menerima permintaan pembuatan alat ortodonti menggunakan sekrup ekspansi. **Hasil:** Desainnya meliputi *Adams clap* pada gigi 16, 26, *labial bow* pada gigi 13, 12, 11, 21, 22, 23, penambahan posterior *bite plane*, dan *expansion screw* yang terletak di palatal gigi insisivus pertama kiri rahang atas. **Kesimpulan:** Fabrikasi alat ortodontik menggunakan ulir ekspansi mulai menggambar desain pada model, membuat *Adams clap* dan *labial bow*, *sectional screw mini mounting*, *acrylic prossesing*, *finishing polishing*, dan *cleavage* plat akrilik.

Kata kunci:
Alat ortodontik, Sekrup ekspansi, *Crossbite* anterior gigi tunggal

Journal of Vocational Health Studies p-ISSN: 2580–7161; e-ISSN: 2580–717x
DOI: 10.20473/jvhs.V6.I3.2023.180-184

INTRODUCTION

Crossbite is a case that centric relation inverse normally, there is an abnormality in the transverse direction of the maxillary teeth to the mandibular teeth which can affect all or half of the jaw, a group of teeth or only one tooth. Anterior crossbite is a condition when the jaw in a centric relation is found one or more maxillary anterior teeth whose position is located lingual to the mandibular anterior teeth (Santoso and Sutardjo, 2012).

Tanaka *et al.* (2016) said that anterior crossbites are often found in children in the mixed dentition. A number of studies have been conducted to determine the prevalence of anterior crossbite cases in various countries around the world varying between 2.2% and 36% (Ceyhan and Akdik, 2017). Bittencourt and Machado (2010) conducted a study conducted in Federal Districts in Brazil on 4776 children aged 6 -10 years. Finding was 14.83% of children had normal occlusion, but 85.17% had various types of malocclusion. The prevalence of anterior crossbite found was 10.41%. The results of this study are similar to the results of studies conducted on children in Rio de Janeiro, Paraiba, and Canada.

This anterior crossbite usually occurs because it is caused by conditions such as supernumerary teeth, odontomas, persistent deciduous teeth, primary incisors experiencing dental trauma, lip biting habits, and lack of space (Ceyhan and Akdik, 2017). Anterior crossbites can interfere with the aesthetic appearance of the teeth and face. In addition, anterior crossbite results in abnormal enamel abrasion of the mandibular incisors, dental compensation resulting in thinning of the alveolar bone layer of the labial mandible and gingival recession, and can result in traumatic occlusion with the mandibular incisors which can result in periodontal problems, mobility, and fracture (Prakash and Durgesh, 2011).

There are two types of anterior crossbites, namely segmental anterior crossbite and single tooth anterior crossbite. Teeth with anterior crossbite rarely have self-correction because the maxillary incisors are stuck behind the mandibular incisors and if left unchecked will cause severe malocclusion (Prakash and Durgesh, 2011). Simple anterior crossbites that involve one or two teeth and allow space in the dental arch can usually be treated with a simple procedure using removable orthodontic appliances.

Removable orthodontic appliances are orthodontic appliances which can be installed and removed in patients. The maintenance capability of a removable appliance is easier than fixed appliances. The risk of failure is higher if patient is not disciplined when using removable appliances according to the instructions. Components of the appliance consist of active, passive/retentive components, anchors, and acrylic plates. The active component functions to move the teeth, the passive/retentive component acts as a brace to removable orthodontic appliances. Both components are made of rust-resistant stainless steel wire. The acrylic plate, made of self-cured acrylic, serves as a connector for these components Removable orthodontic appliances have several advantages, such as maintaining oral hygiene because the appliance can be removed and cleaned, has a simple shape and is easy for dentists to do the insertion (Staley and Reske, 2011).

Expansion screws are an active component in removable orthodontic appliances that are used to enlarge the dental arch. In the treatment of a single tooth anterior crossbite, expansion screws are used to move the teeth labially to their proper position (Ulusoy and Bodrumlu, 2013). The use of expansion screws can be combined with a bite plane so that tooth movement can occur (Naif A. Bindayel, 2012). Appliances with expansion screws have the advantage that the force produced is as desired and have better stability (Ulusoy and Bodrumlu, 2013). The purpose of this paper is to explore the fabrication of making orthodontic appliances, especially the case of single tooth anterior crossbites using screws.

CASE STUDY

The dental laboratory received a maxillary model from a dentist with a case of anterior crossbite on tooth 21 in a 9 year old male patient and was asked to make a removable appliance using a single tooth expansion screw. The design of the appliance consisted of *Adams clasps* on teeth 16 and 26, labial bow, expansion screws on teeth 21, and the addition of a posterior bite plane. (Figure 1).

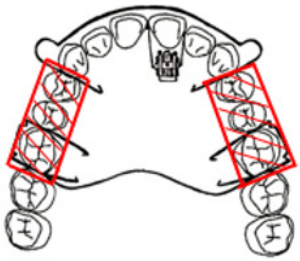

Figure 1. Appliance design

The procedure for making removable orthodontic appliances with single tooth expansion screws in an anterior crossbite case includes preparation of the dental cast, clasps making, installation of single tooth expansion screws, and acrylic processing (Figure 2-5).

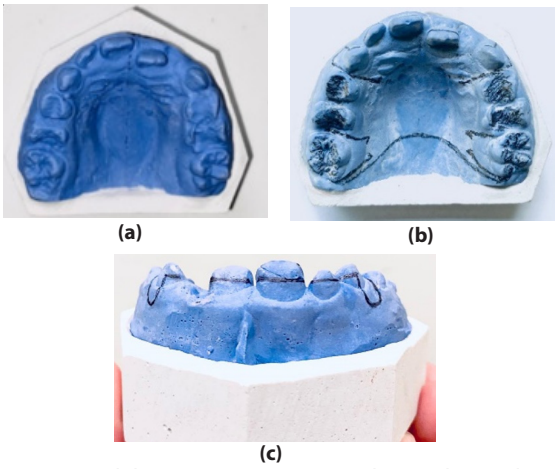

Figure 2. Model preparation: (a) Dental cast; (b) Appliance design; (c) Labial bow

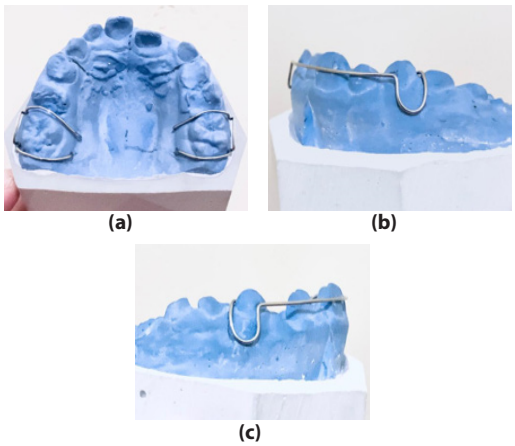

Figure 3. (a), (b), (c) *Adams clasps* and labial bow

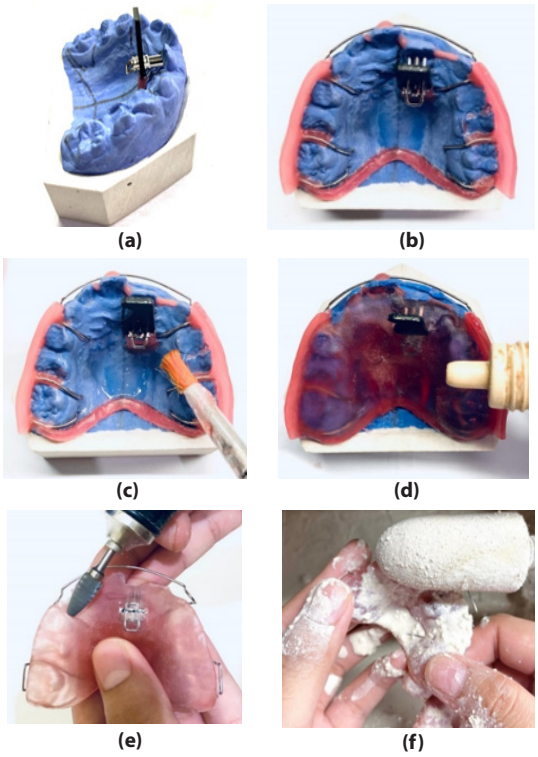

Figure 4. Installation of screw expansion and acrylic processing. (a) Screw fixation; (b) *Adams clasps* and labial bow fixation; (c) Application of Could Mould Seal (CMS) (Hillon 99, Germany); (d) Acrylic processing; (e) Finishing; (f) Polishing

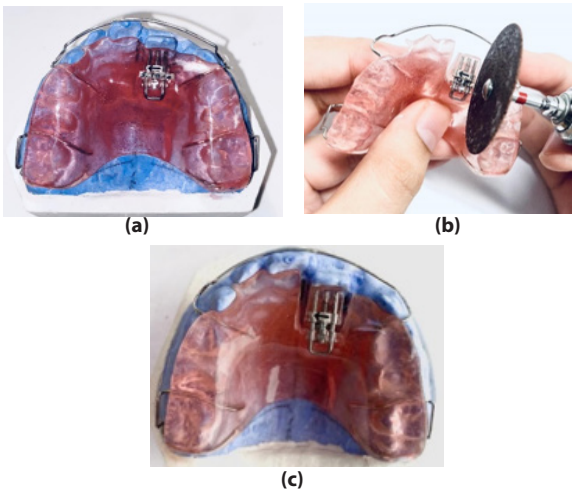

Figure 5. (a) After polishing; (b) Cleavage the plate; (c) End result

RESULT

Orthodontic appliance design was *Adams clasps* on teeth 16 and 26, labial bow on teeth 13,12,11,21,22,23. In additional posterior bite plane, expansion screw was located on maxillary left first incisor, palatal section then acrylic packing. The last steps are polishing acrylic plate.

In a working model with 21 teeth located more palatal. Draw the *Adams grip* design in gears 16 and 26. Draw the labial arc design on teeth 13, 12, 11, 21, 22, 23. *Adams clasp* is made with 0.7 mm diameter wire on teeth 16 and 26. The labial arc is made with 0.7 mm diameter wire on teeth 13, 12, 11, 21, 22, 23.

Design drawings and screw locations on 21. For fixation of expansion screws use red wax with a position parallel to the occlusal plane. Fix *Adams grip*, labial arc, make plate boundaries according to design, and make elevating limits of bite using red wax. The working model is smeared with the Could Mold Seal using a brush. Acrylic filling uses self-cured material, with a layering technique by sprinkling polymer onto the working model and dripping monomer to be absorbed by the polymer powder. Acrylic plates are made region by region, layer by layer until the desired thickness.

The working model was put into a polyclav containing warm water with a temperature of 45-50^{o}C and given a pressure of 2 atmospheres for 15 minutes. After being removed from the polyclav, the plate was removed from the working model and the screw handle was removed using cutting pliers and finishing was carried out. Finishing is done by grinding using a freezer to reduce the thickness of the plate that is not needed until the desired shape and thickness of the plate are obtained.

The acrylic plate was smoothed using coarse sandpaper to remove the roughness on the surface of the acrylic plate, then continued with fine sandpaper to obtain a smooth surface. After that, the polishing process is carried out using a slumbering machine. At the initial stage a smooth and even surface is obtained by using a cone and pumice powder. Furthermore, after the surface of the acrylic plate is smooth and flat, then a brush and kryte are used to polish the acrylic. The acrylic plate is finished with finishing and polishing. The acrylic plate was cleaved using a carborundum disk at the intersection of the right and left first incisors, and the first and second incisors in the maxilla.

DISCUSSION

Anterior crossbite is an aesthetic and functional problem that is usually a major complaint for parents during child development (Bansal *et al*., 2013; Prakash and Durgesh, 2011). Anterior crossbite is case one or more mandibular incisors occlude labially to the opposing teeth (Naif A. Bindayel, 2012). Anterior crossbites are classified based on the number of teeth involved, namely a single tooth or single tooth anterior crossbite and a segmental or segmental anterior crossbite (Staley and Reske, 2011). This

anterior crossbite results from various factors of palatal eruption of maxillary incisors, trauma to primary incisors, supernumerary anterior teeth, incisor crowding, bad habits, and inadequate arch due to lingual eruption of maxillary permanent teeth. Anterior crossbites can also cause abnormal enamel abrasion. Proclination of mandibular incisors could result labial alveolar plate and/or gingival recession (Naif A. Bindayel, 2012).

The presence of an anterior crossbite can cause mandibular displacement and temporomandibular joint (TMJ) disorders. Anterior crossbites if not treated immediately will result in maxillary growth restriction, traumatic occlusion, can prolong treatment time and require more complicated treatment (Prakash and Durgesh, 2011; Ulusoy and Bodrumlu, 2013; Batra *et al*., 2022). Correction of single tooth anterior crossbite can use expansion screws (Prakash and Durgesh, 2011; Ulusoy and Bodrumlu, 2013), so that it can gain space without performing tooth extraction (Naif A. Bindayel, 2012; Vania *et al*., 2016). The force resulting from the use of expansion screws in removable orthodontic appliances is light and easy to control so that ideally the resorption that occurs is frontal resorption (Proffit *et al*., 2018; Singh, 2015; Zezo, 2015).

In the treatment of anterior crossbite, one or two teeth usually involve lingual movement of the maxillary teeth, labial movements of the maxillary teeth, or both. Correction of anterior crossbites is often performed using removable orthodontic appliances. Removable orthodontic appliances are used for cases that can be overcome by expanding the dental arch, by moving the teeth so that the teeth occupy a wider arch or repositioning the teeth individually to fit into the arch. Removable orthodontic appliances are still often used because the manufacturing process is simple, the price is affordable, and the results are quite satisfactory, especially in the simple treatment. In addition, when working time in the patient's mouth is shorter, only the upper and lower jaws are molded (Singh, 2015).

Single anterior crossbite on tooth 21 can be resolved by performing orthodontic treatment using removable orthodontic appliances. This removable orthodontic appliance uses an active component in the form of an expansion screw and a passive component in the form of an *Adams clasps* on teeth 16, 26, and a labial bow on teeth 13, 12, 11, 21, 22, 23. Expansion screws are active components of orthodontic appliances that are used to expand the dental arch in a transverse or sagittal direction, and also anteriorly or posteriorly depending on the type and placement of the screw (Rahardjo, 2009; Alam, 2012). A sectional type expansion screw can be used in this case. Sectional screw is an expansion screw that is used for distal movement and movement of one tooth or one segment of anterior teeth (Dentaurum, n.d.).There are two sizes of sectional screw sizes: mini and medium. The sectional screw used in this case is a 25 mini sectional screw. Sectional screw mini is an expansion screw that move one tooth only. The maximum expansion of the mini sectional screw is 4.00 mm (Manoharan *et al*., 2016). The advantages of the mini sectional screw are that it has better stability and retention than a single cantilever spring, control time is not time consuming, and is efficient for anterior crossbite cases (Staley and Reske, 2011).

Removable orthodontic appliance with expansion screw is a simple appliance as an alternative to repair anterior crossbite. The treatment is not only done using expansion screws, but also needs to be added to raise the posterior bite. Elevation of the posterior teeth aims to free the occlusion of the anterior teeth. The advantages of anterior crossbite treatment using removable orthodontic appliances with expansion screws are that the manufacturing process and maintenance are simple, the screws produce force when adjusted as desired, have better stability and retention than orthodontic appliances using springs, and treatment time efficiency. However, anterior crossbite treatment using removable orthodontic appliances with expansion screws also requires cooperation between the patient and parents because parents are expected to support the patient to diligently carry out treatment with expansion screws (Ulusoy and Bodrumlu, 2013; Dentaurum, n.d.).

Orthodontic treatment in this case was performed using removable orthodontic appliances. The fabrication of this orthodontic appliance began with the making of *Adams clasp* using stainless steel wire diameter of 0.7 mm (Mansuri and Singh, 2014). Labial bow was also made using stainless steel wire with a diameter of 0.7 mm (Ardhana, 2011). The mini sectional screw was placed palatal of the maxillary left first incisor.

Prior to acrylic processing, the *Adams clasps*, labial bow, and expansion screw were fixated to the model to prevent changes in position during acrylic filling. The purpose of adding a posterior bite plane is to relieve the occlusion of the anterior crossbite. Acrylic filling is done using self-cured material with layering technique by sprinkling polymer powder and dripping monomer liquid from region to region to the appropriate thickness. Then it is put in a polyclav for 15 minutes with a pressure of 2 atm to minimize porosity. After being removed from the polyclav, the finishing and polishing were carried out until it is shiny. The acrylic plate was cleaved using a carborundum disk so that it formed a U-like shape on the mesial and distal maxillary left first incisors. The cleavage process must be carried out carefully so that the carborundum disk is not too close to the screw and it will not be exposed to the screw body and defect the labial bow.

The use of expansion screws is beneficial since the amount of force generated can be adjusted as needed (Staley and Reske, 2011; Singh, 2015). The use of orthodontic appliances in this case only takes a few months. The results can be influenced by many factors other than the type of appliance used, such as the number of activations and the control time (Rahmaningrum *et al*., 2021; Agarwal and Mathur, 2011).

The success of treatment with expansion screws in each individual is different. Such factors as the patient's motivation, desire to control, cooperation to wear removable appliance and the patient's awareness in maintaining oral hygiene can also influence the results (Oliveira *et al*., 2011; Biradar *et al*., 2012).

CONCLUSION

To overcome the case of single anterior crossbite on tooth 21, removable orthodontic appliances using expansion screws can be used to move the tooth in a labial direction. The procedure for making removable orthodontic appliances with expansion screws is drawing 'a' in the work model, then positioning *Adams clasps* and labial bow using 0.7 mm diameter wire, installing a mini sectional screw, acrylic processing, finishing and polishing, followed by plate splitting.

ACKNOWLEDGMENTS

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

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