

Mandibular corpus horizontal distraction in an edentulous case and its effects on the contralateral coronoid processus-arcus zygomaticus relation

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Abstract

Interaction between the coronoid processus and the arcus-zygomaticus on contralateral hemi-mandible often drops off the radar in case of distraction osteogenesis of the mandibular corpus. We presented a 42 years old male without any teeth applied to hospital for facial asymmetry, short hemi-mandible and chewing problems. 2D and 3D computerized tomography and stereo-lithographic models were used for planning, predicting possible movements on the contralateral condyle and anticipate the relation of contralateral coronoid process the with zygomatic arc. Maximum safe amounts of distraction were calculated with cooperation with orthodontics and radiology. The rotation angle on the axis of the contralateral condyle is calculated in order to measure the defect to be corrected to take the maxillary and mandibular midlines to the same plane. Total calculated defect were shortened for preventing any interaction between the coronoid processus and the arcus-zygomaticus on contralateral hemi-mandible. Patient was satisfied and started to use new dentures two months after removal of the distraction device. In order to achieve successful distraction without any problem regarding to opposite side rotation angles of the condyle, and position changes in the coronoid processus, collaboration and multidisciplinary approach are essential with orthodontics and radiologist in case of unilateral mandibular corpus distraction.

Keywords: Mandible distraction, edentulous, coronoid process

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Introduction

Mandibular distraction osteogenesis is first described in 1992s and has been used for retrognathia, cross-bite secondary to unilateral mandibular hypoplasia and deformities (1). The aim of the study is showing correction of aesthetic and functional problems due to laterognathia in an edentulous case with help of 3D CT modeling, radiologic evaluation and orthodontic planning without necessity of presurgical orthodontic treatment, and discussing the effect of augmentation of hemimandible to contralateral coronoid processus position.

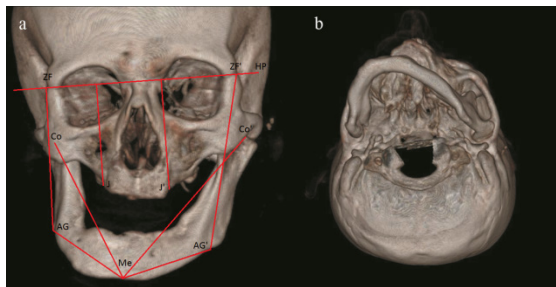
Figure 1. a: Preoperative view, b: Early postoperative view



Case

42 years old male patient was presented to our clinic with asymmetry on his face and pain during mastication. Physical examination and history revealed that patient had a condylar fracture due to trauma at seven years old, and he had no surgery since that time. After a while, ankylosis developed and he had a surgery for ankylosis 20 years ago. But he did not have any further treatment, and he has not got proper bite, and lost all of his teeth in a short time period. He started to use total denture since he was 30 years old. Multi-slice computerized tomography (CT) and three dimensional (3D) reconstruction images revealed that lower chin is 18 mm deviated to the right side on median line (laterognathia) (Supp. data 1c,d). In addition, patient consulted with orthodontics and radiology departments. To assess and compare the right and left sides, skeletal measurements including ramus and maxillary heights, effective mandibular and corpus lengths were made on 3D CT images (Supp. data 1c) and it concluded that there was deficiency on vertical and sagittal planes, especially significant deficiency on corpus length.

Figure 2. 3D reconstruction of the patient's CT was used to evaluation and planning of the vector preoperatively. One vector distraction of right corpus needed for optimal result. a: Reference points and skeletal measurements on the frontal view of the 3D CT: Horizontal plane (HP) equals line connecting right and left (') lateral margins of zygomaticofrontal (ZF) suture; maxillary height is perpendicular line from J point to HP; ramus height is linear distance from antgonial notch (AG) to ZF suture; corpus length is linear distance from AG to menton (Me) and effective mandibular length is linear distance from the most superior point of condylar head (Co) to Me. b: Submentovertex view of the 3D CT.



So two-treatment plane was prepared and presented to the patient. The first was including two-vector mandibular distraction with maxillary Le Fort-I osteotomy (to correct maxillary transversal cant with maxillary vertical heights) and the second was one vector distraction of right corpus needed for patient's aesthetic expectations. The patient didn't want to be operated the upper jaw so he refused the first treatment plane. The application of two vector distraction to the right hemi mandibula is not recommended as an option since it may cause increased distance between superior and inferior alveolar crest on the right side, and subsequent deleterious effect on the future total denture application. For this reason, we focused on second treatment plan. Since the patient has no teeth, no presurgical orthodontic treatment applied to the patient. On the other hand, consultation of the patient with the orthodontic department resulted with the conclusion as parallel vector to the Camper's plane (ala nasi - tragus plane) determined as a reference plane since the distractor plugged to the right mandibular corpus on the sagittal plane (2). Calculation with the radiologist on patients CT images revealed that, distraction osteogenesis in right mandible with single parallel vector to the Camper's plane may result in coronoid process and arcus zygomaticum contact on the contralateral side, and this situation may compromise proper painless bite. So simulation on 3D model was done before the surgery and 15 mm distraction planned in order to correct 18 mm total defect since overrotation of the mandible may result contralateral coronoid process

and zygomatic arcus contact. Based on the 3D reconstructed CT images findings, 9.64 degree rotation on the axis of the left condyle was needed for bringing lower jaw to the midline (Figure 1a). Contralateral coronoid processus- arcus zygomaticus contact was predicted on 8.45 degree rotation on the axis of the left condyle (Figure 1b). Therefore 15 mm (14.9) lengthening with 8 degree rotation on the left condyle planned for keeping secure distance between coronoid and arcus on the left side. The distraction vector applied on the right corpus is aligned with a 90 degree angle in order not to cause a rotation force on the pseudoarticulation on the right. Since the vector of the distractor has 90 degree angle with the right ramus which pseudoarticulation, minimal rotation on the right pseudo temporomandibular joint area is ignored. 2.0 mm 25 mm single vector internal distractor (Cranio-maxillofacial Distractor System, Synthes Inc. West Chester, PA, USA) shaped on 3D model of the patient's mandible regarding to the orthodontics suggestions as parallel to the Camper's plane (Supp. data 2a). Under the general anesthesia, external incision was used on previous scar, distractor applied as prepared after subperiosteal dissection and corticotomy was done (Supp. data 2b). After one week latent period, 0.5 mm twice a day distraction was done for 15 days. Distraction is ended with relatively symmetrical result without absolute symmetry and the rod of the distractor is removed with no local anesthetic application. After six months consolidation, osteogenesis was seen on patients control CT and distractor is removed under general anesthesia. Patient was satisfied from the aesthetic improvement of his face (Supp. data 1b), and processed to department of the prosthetics for renewal of the denture two month after distraction ended.

Figure 3. The expected rotation on the left condyle was calculated (a) and possible rotation amount result with the coronoid processus and the arcus zygomaticus contact (b) calculated on 3D reconstructed CT images. Final decision for lengthening decided based on these calculations.

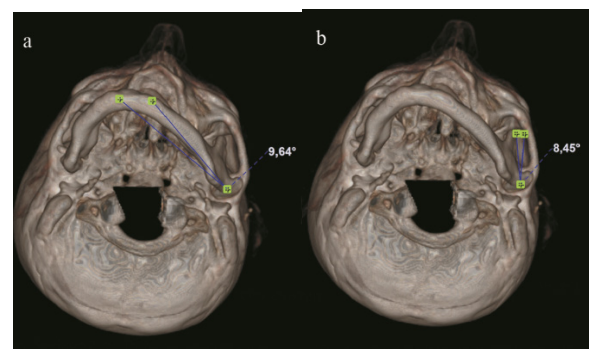
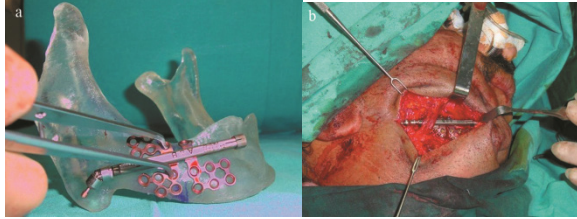


Figure 4. a: Distractor was bent and prepared on real 3D model of the patient's mandible as planning. b: After distractor applied to the mandible, intra-operative view.



Discussion

Orthodontic treatment and preparation to the surgery is inevitable for correcting malocclusion in ordinary cases have most of the teeth (3). But in our case, patient was consulted with orthodontics but no presurgical orthodontic treatment was needed. However preoperative detailed evaluation was made with orthodontics for one vector or multivector distractor preference and best direction of the vector for the distraction. Orthodontics, radiology and surgery departments' collaboration needed for detailed planning as well.

The case presented in this study has a story of condylar fracture and subsequent condyle-temporal fossa ankylosis. Patient had adequate opening of the mouth and the main complaint was asymmetry of the face and pain in the affected side's temporomandibular joint at the time of presentation to our clinic. The defect size, possible deleterious effect on the contralateral temporomandibular joint, zygomatic arcus and coronoid processus contact risk were predicted and discussed on the planning of the surgery. However we could not predict the ipsilateral pseudo joint which previously developed between ramus and condylar remnants fate after the distraction. Therefore we suggested to the patient continuing using previous denture during the distracting period to prevent possible impaction or any change of pseudojoint on affected hemi mandible.

Figure 5. Postoperative 6 month' CT revealed ossification on distracted segment.

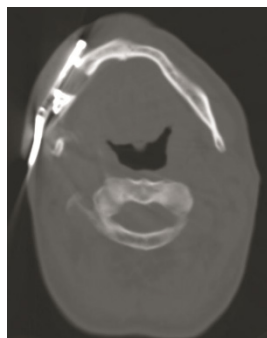


Figure 6. a: Preoperative axial and coronal CT sections showing coronoid processus and zygomatic arc. b: Postoperative axial and coronal CT sections showing coronoid processus and zygomatic arc. Notice the arrows in both preoperative and postoperative sections.



Evaluation and surgical planning with computerized tomographic images preoperatively taken and 3D reconstructed models were described for maxillomandibular distraction in the literature (4, 5). However unilateral mandibular distraction lengthening's effect on the contralateral coronoid process and arcus zygomaticus relation did not take attention of the authors or there was not any risk for interference between coronoid and arcus in their presented cases. The symphyseal mandibular widening and its effects on different part of the mandible was studied by Basciftci et al and no significant displacement was found on coronoid process for 5 mm lengthening on symphysis area of the mandible (6). On the other hand we found that there is a risk of interference between the coronoid process and arcus zygomaticus if we distract contralateral hemi mandible horizontally about 18 mm to get full symmetry. This amount was higher than the Basciftci et al's study and corpus lengthening has more effect on contralateral condylar rotation than symphyseal widening. Mandibular distraction and its effects on the contralateral condylar rotation were described in the literature within various biomechanics studies (7-9). But they have not focused on the coronoid processes and arcus zygomaticus relation. We discussed the CT of the patient with radiologist and orthodontics to predict the effect of the rotation of the mandible on the contralateral condyle, calculated possible rotation on the vertical axis of the left condyle with unilateral lengthening of the hemi mandible. The evaluation showed that 18 mm lengthening of the mandible may have a risk for contact between coronoid process and

the zygomatic arc. Fifteen mm lengthening was planned to the mandibular corpus with distraction to leave maximal secure distance between coronoid process and zygomatic arcus to allow painless bite after the distraction. The coronoid process was evaluated for any possibility to touch to zygomatic arcus after elongation of corpus on contralateral hemi mandible. Based on axial views of patient CT images, left condyle and right ramus centered rotation angle calculated as degree according to predicted right corpus distraction amount and movement of the coronoid process on left side was also estimated. Maximum 15 mm distraction was planned due to prevent interference between zygomatic arc and coronoid process even if full symmetry of face is not achieved (Supp. data 1e, f). Similar calculations were made on models as well. After 15 mm distraction coronal sections in computerized tomography taken postoperatively showed approximation of coronoid process and zygomatic arc as expected (Supp. data 2c, d, e, f). However no sign or symptom of contact between coronoid processus of the mandible and arcus zygomaticus during chewing was seen clinically in our patient in postoperative period.

Using stereo lithographic models and bending the plates with correct vector of distractor on the models lets the surgeon to have precise surgical planning preoperatively as described in the literature (4, 10). We used 3D models to determine optimal vectors for the distractor and to use for bending the plates before the surgery as in the literature. Besides, 3D models helped the orthodontist and the surgeon to predict the possible rotation movement on the contralateral condyle with 2D axial CT study.

Laterognathia causes transmission of chewing force by only small part of the chin. Therefore alveolar tissue is overloaded and alveolar resorption may result. Even though our patient tried to overcome edentulism problem with total denture, he didn't only have aesthetic problem due to serious asymmetry, but he also had some functional problems such as pain and ulceration on one side of the alveolus. Mandibular corpus distraction may seem easy in edentulous patient since no pre-surgical or post-surgical orthodontic treatment will be required. On the other hand collaboration with orthodontic and radiology departments and detailed evaluation with 2D CT and 3D modeling, not only give information for the vector direction and the amount of distraction, but also may prevent unexpected problems such as contralateral contact of coronoid processus with arcus zygomaticus and pain during chewing.

Conclusion

Even in the total edentulous patient with total denture, laterognathia is a serious problem and solving this problem with orthognathic surgery doesn't necessitate prolonged orthodontic treatments. Cooperation, collaboration and multidisciplinary approach are essential with orthodontics and radiologist in order to prevent unexpected problems such as coronoid process arcus zygomaticus contact. These patients may achieve fast and reliable functional and aesthetic result with correctly planned orthognathic surgery.

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