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Title: Role of Facebow transfer in Orthognathic Surgery- An Overview

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Abstract: This overview article aims to outline and emphasize the role of Facebow's during the planning stage of any complicated Orthognathic procedure. They provide and accurate orientation of the jaw bases to the cranium and hence facilitate the fabrication of occlusal splints which are very useful for the maxillofacial surgeons to accurately position the jaws during the surgery.

Introduction

Dentofacial deformity is a condition primarily affecting jaw and dentition. Problems associated with dentofacial deformity include the inability to incise or chew, speech impairment, unacceptable aesthetics, temporomandibular joint disorders, and psychological issues.[1] There are two modalities for the correction of dentofacial deformities, i.e., orthodontic treatment and orthognathic surgery. Orthodontic treatment offers limited scope in severe dentofacial deformity. Orthognathic surgery attempts to establish normal aesthetic and functional anatomy for patients suffering from dentofacial disharmony. The surgeon's task is to first define the original position of the dentofacial skeleton, then estimate the desired final position, and finally develop a three-dimensional (3D) representation of the movements necessary to accomplish the intended goal. [2] The use of dental casts mounted on an articulator is a crucial part of the planning, as is the production of inter-occlusal positioning wafers as templates to guide surgeons perioperatively in positioning the jawbones. Accurate positioning of casts of the upper teeth, indicating the position of the maxilla relative to

the skull, is essential for reliable planning; in current articulators, the casts are mounted using a face bow, producing inaccurate and unreliable relations between the casts and the skull.[3]Recent advancement in the field of orthognathic surgery is the use of computer-aided design/computer-aided manufacturing (CAD/CAM) in development of surgical planning for the treatment of complex craniomaxillofacial deformities.[4]

Facebow transfer

Prediction tracings provide an estimate of the amount and direction of maxillary and mandibular movement. However, model surgery performed on an anatomic (semi-adjustable) articulator provides a more accurate assessment of the surgical movements, as it allows assessment in all three dimensions. Furthermore, the transfer of the maxillary cast to the articulator by using a face-bow gives a reliable estimation of the distance between the dentition and the intercondylar hinge axis. This is important when vertical movements of the maxilla and/or mandible are planned, because autorotation changes the position of the jaws in both vertical and horizontal dimensions. [5]

The more accurately the maxillary model is mounted with respect to the true hinge axis, the more accurate will be the information provided about the horizontal and vertical movements of the jaws during model surgery. The surgical procedures that are performed on the articulator will directly simulate those to be done on the patient. For proper mounting of the

maxillary cast, at least two technical points must be achieved: 1) the radial relationship between the maxillary teeth and the intercondylar hinge axis, and 2) the angular relationship between the maxillary occlusal plane and the skull.[6]

The linear (radial) dimension between the dentition and the intercondylar hinge is simple to obtain by using a face-bow transfer.

Two types of face-bows are available, arbitrary and kinematic. A kinematic face-bow is a device fastened to the mandibular dentition that locates the "true" intercondylar hinge axis, or an axis of mandibular motion where purely rotational movements of the condyles occur. Using this type of face-bow, the arc of closure of the mandibular cast on the articulator will very closely simulate the actual mandibular arc of closure on the patient. An arbitrary face-bow relates the maxillary dentition to an estimation of the location of the mandibular intercondylar hinge axis. Two types of arbitrary face-bows are available. One requires the user to attempt to locate the mandibular condyles by palpation and marking the skin surface prior to taking a face-bow transfer. Using this type of face-bow, the condylar locating devices are adjusted so that they are directly over the skin marks. When this face-bow is connected to the articulator, the adjustable condylar locating pins are attached to the intercondylar hinges of the articulator. With the other type of arbitrary facebow, which is more popularly used in dentistry and oral and maxillofacial surgery, the maxillary dentition is related to the external auditory meatus by ear rods.

It is known that the external auditory meatus is approximately 12 to 13 mm behind the center of the mandibular condyle and, therefore, when the face-bow is mounted on the articulator, the ear rods are attached to a point behind the intercondylar hinges (depending on the brand of articulator). Both types of arbitrary face-bow give an estimation of the location of the midpoint of the mandibular condyles. The use of the arbitrary face-bow transfer is thought to be adequate for use in orthognathic surgery because it has been demonstrated that the arbitrary intercondylar hinge axis is within a 5-mm radius of the true hinge axis.[3,7]

When using any type of face-bow, a third point of reference is necessary to relate the angle of the occlusal plane to a horizontal reference plane, usually Frankfort horizontal. The third point of reference is most commonly orbitale, registered by an orbital pointer on the face-bow, or nasion, registered by a nasal rest on the face-bow. Another technique used by some manufacturers is to not incorporate a device for a third point of reference on the face-bow; instead, the face-bow is positioned on the articulator and rotated up or down until the incisor is vertically positioned at a predetermined level in space, usually a line scored into the incisal pin.[8]

When using an articulator for orthognathic surgery, it is imperative that the angle between the occlusal plane and Frankfort horizontal (or true horizontal) in the patient be the same as the angle between the occlusal plane of the maxillary model to the upper (horizontal) member of the

articulator. If incorrect, erroneous information will result from model surgery. This is especially important in two-jaw surgery because the maxilla is repositioned to a new location in space using measurements made parallel and/or perpendicular to the reference planes of the articulator. For instance, if the maxilla is to be positioned 5 mm superiorly and 5 mm anteriorly, this is usually done in relation to the upper member (for superior positioning) and the incisal pin (for anterior positioning). The interim splint then relates this new maxillary position to the unoperated mandible. If the occlusal plane angles differed between the patient and the articulator, following surgical repositioning the location of the maxilla will differ from that planned on the articulator. The more accurately the articulated models are mounted on the articulator, the more accurate will be the information provided about the horizontal and vertical movements of the jaws during model surgery.[3, 9]

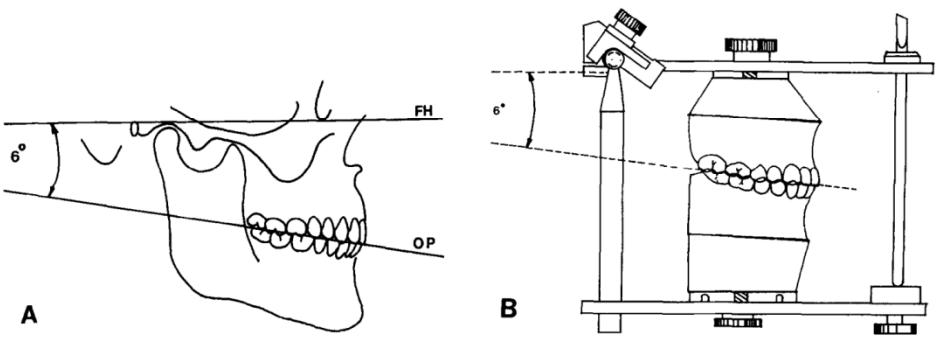

FIGURE 1. The angle between the maxillary occlusal plane and a horizontal reference plane, either the true horizontal or more commonly Frankfort horizontal (*A*), must be transferred to the articulator during the mounting of the maxillary cast (*B*). In the case shown, the angle is 6°. This angle varies considerably among patients. If this angle is different between the patient and the articulator, the maxillary cast will be positioned at a different point in space on the articulator than it is in relation to the patient's skull. This will affect the information obtained during model surgery.

Courtesy-Ellis E 3rd, Tharanon W, Gambrell K. Accuracy of face-bow transfer: effect on surgical prediction and postsurgical result. J Oral Maxillofac Surg. 1992 Jun;50(6):562-7. doi: 10.1016/0278-2391(92)90434-2. PMID: 1593315.

Ellis et al demonstrated a significant difference between the inclination of the occlusal plane on the mounted models and the actual occlusal plane as measured on the cephalograms. Their solution for this problem involved modification of the mounting technique used with the Hanau articulator., This technique cannot be used with the SAM system, because the mounting jigs available for this system do not allow for pin adjustments during mounting.7

With the SAM Anatomical Face-bow, the first step was to adapt the bite fork to the maxillary teeth. This was done with attention to proper alignment in the sagittal plane. After the bite fork was adapted, it was removed. The face-bow was placed in the ears and was locked in place. The nasion adapter was placed, fitted, and secured. The bite fork was placed back in the mouth, and 2 cotton rolls were placed underneath the bite fork. This allowed the patient to stabilize the bite fork when biting down. Finally, the rods that connect the bite fork to the face-bow were placed and tightened. [6,10]

In using the Erickson Face-bow, the bite fork was adapted and removed as in the previous technique. The face-bow was placed in the ears and was locked in place. The tip of the infraorbital pointer was aligned with the most inferior aspect of the infraorbital rim. With the face-bow in this position, the adjustable nasal rest was adapted and locked. Once the bite fork was placed back in the mouth, the rods that connect the bite fork to the face-bow were placed and tightened .[6,7]

The author's technique modified the hardware of the existing SAM Anatomical Face-bow. The use of the nasion locator was eliminated, and a Boley gauge with sharpened points was added. One-millimeter holes were drilled in the most anterior aspect of the bite fork and in the middle of the anterior edge of facebow. The length of the face-bow (19.5 cm) was measured from its anterior edge to a perpendicular line that passed through the center of both ear rods.[11, 12]

REFERENCES

1. Filho AML, Junior GMFG, Santos ES, JUnior MJB, Neto JVP, Santos JMO. Treatment of Dentofacial Deformity Associated with Temporomandibular Joint Ankylosis Through Vertical and Sagittal Osteotomies of the Mandibular Ramus. J Craniofac Surg. 2022 May 1;33(3):e305-e308. doi: 10.1097/SCS.0000000000008193. Epub 2021 Nov 2. PMID: 34732668.

2. Harrington C, Gallagher JR, Borzabadi-Farahani A. A retrospective analysis of dentofacial deformities and orthognathic surgeries using the index of orthognathic functional treatment need (IOFTN). Int J Pediatr Otorhinolaryngol. 2015 Jul;79(7):1063-6. doi: 10.1016/j.ijporl.2015.04.027. Epub 2015 Apr 27. PMID: 25957779.

3. Fraser Walker, Ashraf F. Ayoub, Khursheed F. Moos, Joseph Barbenel, Face bow and articulator for planning orthognathic surgery: 1 face bow. British Journal of Oral and Maxillofacial Surgery. 2008;46(7):567-572.

4. Oh JH. Recent advances in the reconstruction of cranio-maxillofacial defects using computer-aided design/computer-aided manufacturing. Maxillofac Plast Reconstr Surg. 2018 Feb 5;40(1):2. doi: 10.1186/s40902-018-0141-9. PMID: 29430438; PMCID: PMC5797724.

5. Hammoudeh JA, Howell LK, Boutros S, Scott MA, Urata MM. Current Status of Surgical Planning for Orthognathic Surgery: Traditional Methods versus 3D Surgical Planning. Plast Reconstr Surg Glob Open. 2015 Mar 6;3(2):e307. doi: 10.1097/GOX.0000000000000184. PMID: 25750846; PMCID: PMC4350313.

6. Gateno J, Forrest KK, Camp B. A comparison of 3 methods of face-bow transfer recording: implications for orthognathic surgery. J Oral Maxillofac Surg. 2001 Jun;59(6):635-40; discussion 640-1. doi: 10.1053/joms.2001.23374. PMID: 11381385

7. Ellis III E, Tharanon W, Gambrell K. Accuracy of face-bow transfer:effect on surgical prediction and postsurgical result. J Oral Maxillofac Surg 1992;**50**:562–7.

8. Ramasamy M, Karthigeyan S, Giri TC, Rajendran V, Shetty A, Deivanai M. Evaluation of the inclination of maxillary occlusal plane on mounted casts using a fixed value and customized nasion indicator in artex articulator: Facebow system - An in-vivo comparative study. J Pharm Bioallied Sci. 2013 Jun;5(Suppl 1):S54-9. doi: 10.4103/0975-7406.113297. PMID: 23946578; PMCID: PMC3722707.

9. A. Quast, P. Santander, D. Witt, A. Damm, N. Moser, H. Schliephake, P. Meyer-Marcotty. Traditional face-bow transfer versus three-dimensional virtual reconstruction in orthognathic surgery. International Journal of Oral and Maxillofacial Surgery. 2019; 48 (3): 347-354.

10. Hicks ST, Wood DP. Recording condylar movement with two facebow systems. The Angle Orthodontist. 1996 Aug 1;66(4):293-300.

11. Stokbro K, Aagaard E, Torkov P, Bell RB, Thygesen T. Virtual planning in orthognathic surgery. International journal of oral and maxillofacial surgery. 2014 Aug 1;43(8):957-65.

12. Zinser MJ, Sailer HF, Ritter L, Braumann B, Maegele M, Zöller JE. A paradigm shift in orthognathic surgery? A comparison of navigation, computer-aided designed/computer-aided manufactured splints, and "classic" intermaxillary splints to surgical transfer of virtual orthognathic planning. Journal of oral and maxillofacial surgery. 2013 Dec 1;71(12):2151-e1.