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TECHNIQUE

Model Surgery: A Presurgical Procedure for Orthognathic Surgeries – Revisited

[1]Ramesh Chowdhary, [2]Fraser walker, [3]Nivedita Mankani

[1]Clinical Professor, Department of Prosthodontics, Branemark Osseointegration Center, Karnataka, India
[2]Principal, Department of Max Fax Lab, Southern General Hospital, United Kingdom
[3]Senior Lecturer, Department of Prosthodontics, PM Nadegowda Dental College, Karnataka, India

Correspondence: Ramesh Chowdhary, Clinical Professor, Department of Prosthodontics, Branemark Osseointegration Center, Karnataka, India, e-mail: drramc@yahoo.com

ABSTRACT

Over the last three decades orthognathic surgery has become a routine procedure for the correction of facial deformation. People have become aware and more concerned about the maxillofacial deformation. Surgery of the facial skeleton involves complex three-dimensional movements based on a series of nonsurgical procedures. Bimaxillary osteotomies, which change the occlusal level to improve function and enhance physical appearance, requires to be planned preoperatively with the help of model surgery. This paper explains the procedure of model surgery using an semiadjustable articulator, along with fabrication of the wafer.

Keywords: Model surgery, Orthognathic, Wafers.

INTRODUCTION

Over the last three decades orthognathic surgery has become a routine procedure for the correction of facial deformation. People have become aware and more concerned about the maxillofacial deformations.

Surgery of the facial skeleton involves complex three-dimensional movements based on a series of nonsurgical procedures. Bimaxillary osteotomies, which change the occlusal level to improve function and enhance physical appearance, requires to be planned preoperatively with the help of model surgery.

The early pioneers (Hullihen, 1849; Angle 1903; Blair 1907)[1-3] relied mainly upon their clinical and surgical appearance. Kostecka (1931)[4], used unarticulated models to evaluate the pre- and postoperative occlusion. Subsequently, segments of the sectional models were held together with wax and a German silver alloy splint was fabricated for fixation (wassmund 1935).[5] Heggie [6] challenged the accuracy of model surgery and suggested the use of a calibrator (modified vernier caliper) to assess the maxillary position during surgery. The calibrator registers the distance between the nasion, an arbitrary points on the nose and the midline incisor tip. Contrary to established practice, Lindof and Steinhauser (1978)[7] and Cottrell and Wolford (1994),[8] suggested planning and operative procedure. They proposed that in case of a large mandibular advancement, if the thin-walled maxilla is repositioned first, then a maxillary shift may occur while the maxillomandibular fixation is applied. They, therefore, performed the mandibular surgery first using cephalometric tracings to predict the postoperative position. The mandible is then stabilized with rigid fixation before placing the maxilla into an ideal occlusion. However, the use of an anatomical articulator with a face bow transfer for bimaxillary osteotomies is essential to achieve accuracy of the maxillary position in space and its relationship to the optimum functional centric occlusion (Hohl, Bamber and Harris).[9,10]

The diagnostic information gained from preoperative clinical and radiographic assessment and model analysis is integrated to establish a treatment plan. This treatment plan is expressed in the model surgery and the simulated postoperative model relationships are used to fabricate the intermediate and final occlusal wafers. These wafers are essential means of transferring the treatment plan into an accurate surgical procedure.

Here is the descriptive presentation of Eastman anatomically-oriented model surgery technique, which essentially advocates the use of a face bow recording with a supine centric relation record and a semiadjustable articulator.

PROCEDURE OF MODEL SURGERY PERFORMANCE

Model surgery has become an essential procedure for planning surgical outcome for patients requiring the correction of a dentofacial deformity.

Basic Requirements

1. Making a impression
2. Making of models
3. Face bow transfer
4. Articulators
5. Fabrication of splints.

Making of Impressions

The impression technique for orthognathic model surgery is very technique sensitive. A defect may not be noticed on the plaster model but the occlusal relationship may be altered, particularly with segmental procedures. A further complication would be the inaccurate fit of the intraoperative occlusal positioning wafers.

There sets of impression are to be made. Wherein out set is used for the fabrication of occlusal wafers, one is a diagnostic cast and the anatomical markings and model surgery.

Making of Models

After the impressions are poured in dental stone, the base of the cast is trimmed with the flat plane placed across the occlusal surface of the mandibular teeth. The base is trimmed until it is parallel with the flat plane. Accordingly the maxillary cast is also trimmed square with the sides being parallel to the base of the mandible (Fig. 1).

Selection of Articulators

Plain simple hinge articulators can be used during

1. Maxillary advancement with no height change of the maxilla, i.e. no impaction per number down graft.
2. Mandibular advancement as a single jaw procedure.

However, planning orthognathic surgery by model surgery on semiadjustable articulators offers advantages over simple instruments. The use of a semiadjustable anatomical articulator with a face bow transfer for maxillary osteotomies is essential to achieve accuracy of the maxillary position I space and its relationship to the optimum functional centric occlusion and also in cases of:

1. Maxillary osteotomics with height changes, i.e. impaction or down graft
2. Bimaxillary procedures
3. Segmental or multipart maxillary osteotomies.

After the rnaxillary cast is mounted, the mandibular cast is mounted using the centric wax record, which is taken at the same clinical appointment as the efface bow registration.

References Lines: Markings on the Models

Vertical reference lines are placed on the sides for the maxillary cast and are useful in quantifying the amount of anteroposterior movement at surgery. Similar lines made on the anterior and posterior surfaces of the maxillary cast describe the amount of arch rotation and help prevent or correct a transverse discrepancy. A third set of reference marks are horizontally placed at 10 and 20 mm from the articulator mounting ring. Dental landmarks are utilized to make a series of measurements in order to document the preoperative anatomic position of the maxilla (Figs 2 and 3). A measurement is taken from the incisal pin on the articulator to the upper incisors and similarly to the lower incisors. A simple device was made consisting of square tube which was attached to the incisal pin of the articulator and secured by a screw. The pin is a sliding fit and can be adjusted to touch the teeth, a measurement can then be taken and used to evaluate the change in position of the maxilla. This measurement can also be taken using a vernier calliper and measuring the distance between the teeth and the pin. These measurements are recorded on the cast for future reference (Fig. 4).

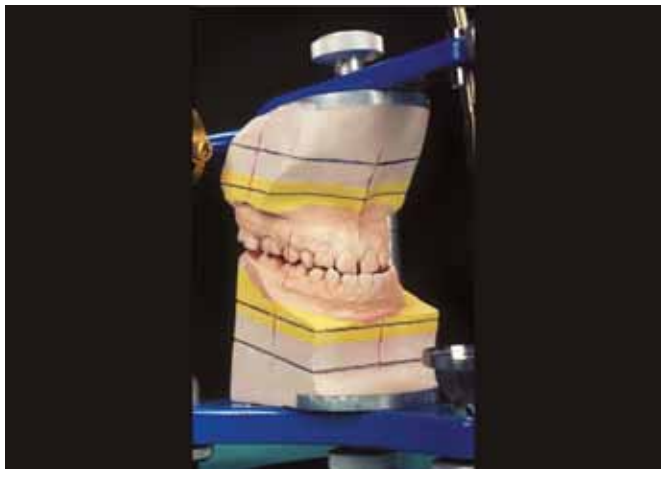


Fig. 2: Dental landmarks are utilized to make a series of measurements in order

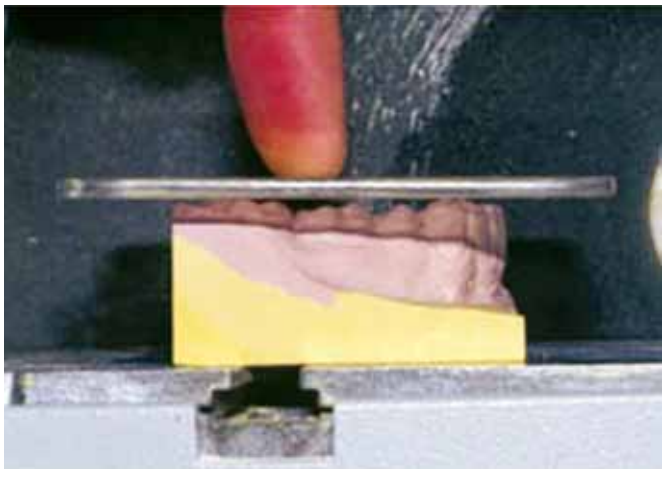


Fig. 1: Maxillary cast is trimmed square with the sides being parallel to the base of the mandible

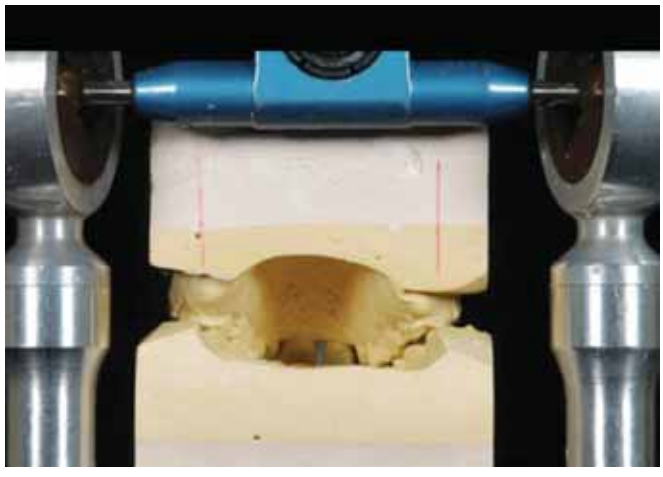


Fig. 3: Measurement taken using a vernier calliper measuring the distance between the teeth and the pin

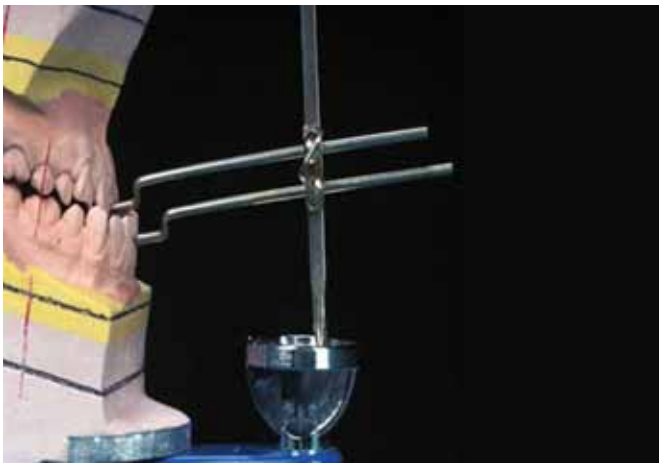


Fig. 4: The segments of the maxillary cast are repositioned in optimum occlusion using the lower cast and are sealed together using sticky wax

Model Surgery Procedure

- The maxillary cast is separated from the mounting plaster. This can be done by placing a plaster knife at the joint of the mounting plaster and the maxillary cast, with a sharp blow to the knife the cast and mounting base will separate.
- The cast is now segmentalized to duplicate the cuts made in the preliminary plan. The segments of the maxillary cast are repositioned in optimum occlusion using the lower cast and are sealed together using sticky wax (Fig. 5).
- The maxillary cast is then attached to the upper mounting plaster and is repositioned using the prescribed movements obtained from the cephalometric planning.
- The mandibular cast is separated from the mounting plaster in the same way as described for the maxillary cast. The mandible is repositioned to the prescribed final occlusion The final position intraoperative wafer is now constructed.

OCCLUSAL WAFERS

Analytic model surgery allows the transfer of prescribed three-dimensional movements to the patient by using specific measurements, reference points and custom made surgical splint. For either maxillary or mandibular procedures you need to make only one splint (final splint), after reproduction of the arch movement on the arch model.

For double jaw procedure you will be required to make intermediate splint (wafer) to relate the osteotomised maxilla to the stable mandible and final splint to relate osteotomized mandible to fixated maxilla.

The mandibular cast is separated from the articulated mounting base and repositioned to the presurgical position, this is the intermediate position (maxillary surgery completed, no mandibular surgery). An acrylic wafer is constructed using the previously described method. It is good practise to use different colors of acrylic for wafer construction, this allows easy identification in theater. The system employed for this purpose is the final position wafers are always clear and the intermediate wafers are always ivory, this prevents confusion of wafer selection during surgery. Once completed, the casts are returned to the final position for reference in the operating theater.

Basic Requirements

1. Dimensionally stable
2. Nonirritable
3. Easy fabrication and less time consuming
4. Good stabilization
5. Should not be bulky
6. Occlusal accuracy
7. Color coding.

Occlusal wafers are usually made of self-cure acrylic, silicone or light cured acrylic. The basic disadvantages of self cure being the leaching of monomer and with silicone the flexibility which causes difficulty in accurate positioning and stabilization. Competitively, light-cured acrylic is dimensionally stable and has good occlusal accuracy. To this orthodontic power chain may also incorporate to stabilize intraoperatively.

Fig. 5: Segmented maxillary cast repositioned in optimum occlusion using the lower cast and are sealed together using sticky wax

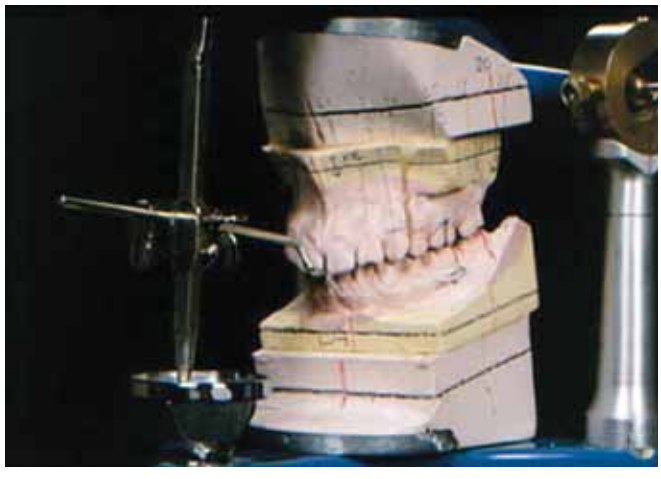


Fig. 6: Maxillary impaction is measured between the horizontal lines scribed on the cast and the mounting plaster

The upper and lower casts had a coat of separating medium applied (Cold mould seal). The acrylic was rolled into a cylindrical shape at the dough stage and adaptable to the lower teeth. The upper cast was then rotated into occlusion, the excess acrylic was trimmed with scissors and the acrylic wafer was left to cure. This intermediate wafer is color coded which determine the new position of maxilla and help surgeon foreary identification during surgery.

In the same manner, the mandibular final splint (wafer) is fabricated after repositioning of the mandible.

These occlusal wafers are of prime significance since they help assemble the segments of ostotomized maxillary or mandibular components and stabilize these segments into the proposed final positions anticipated by the oral surgeons.

Assessing the Results of Cast Movements

Maxillary advancement is calculated by measuring the alternation in length of the pin resting on the labial surface of the upper central incisor (Figs 6 and 7).

Example

Anteroposterior incisal pin measured 50 mm in the starting position.

Anteorposterior incisal pin measured 53 mm in the final position (maxillary cast moved to prescribed position). Maxillary advancement = 3 mm.

Fig. 7: Segmental maxillary procedures or palatal midline splits are measured. The measurement is compared with the study cast and the difference in measurement indicates the amount of expansion or closing of the maxillary arch

On completion of the correction of the maxillary center line, the two lines on the posterior surface of the maxillary cast must be coincidental with the lines on the mounting plaster. This ensures the maxilla has not been rotated at the center of the palate. If the maxilla rotates in its center there will be posterior shift of one side of the maxilla this will then indicate a posterior shift which is not surgically possible as it will hit the pterygoid plate. It is desirable to advance the maxilla (Fig. 8).

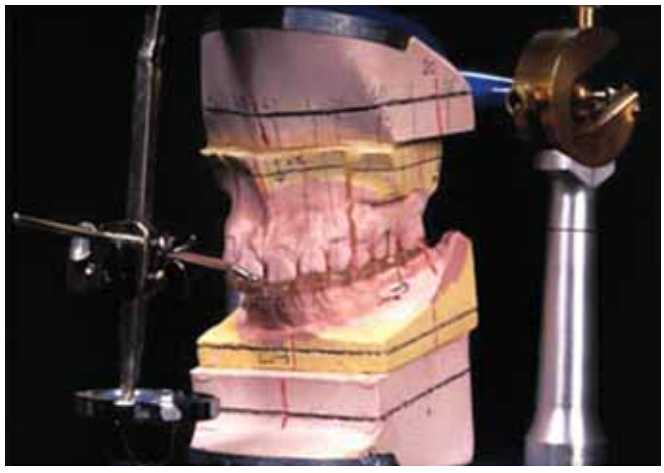


Fig. 8: Advancement of the maxilla

Maxillary impaction is measured between the horizontal lines scribed on the cast and the mounting plaster (Fig. 9).

Segmental maxillary procedures or palatal midline splits are measured as indicated by the arrows. The measurement is compared with the study cast and the difference in measurement indicates the amount of expansion or closing of the maxillary arch (Fig. 10).

In assement of the mandibular movement, maxillary advancement is measured in the same way as the maxilla using the anteroposterior pin. This procedure was described in the maxillary advancement section.

If the mandible is occluded with the maxilla and the anterior section of the cast has lifted from the plaster mounting base, there is an indication of the possibility of an unstable procedure. This situation indicates a downward movement of the ramus placing an unacceptable stress on the ptreomaseteric sling, in addition there will be a downward pull of the hyoid muscles indicating an almost certain relapse of the predicted mandibular position (Figs 11A and B).

The trimming of the casts section explained the procedure for trimming the mandibular cast, ensuring the base of cast was parallel with the mandibular occlusal plane. This, once

Fig. 9: Maxilla and mandible are lifted

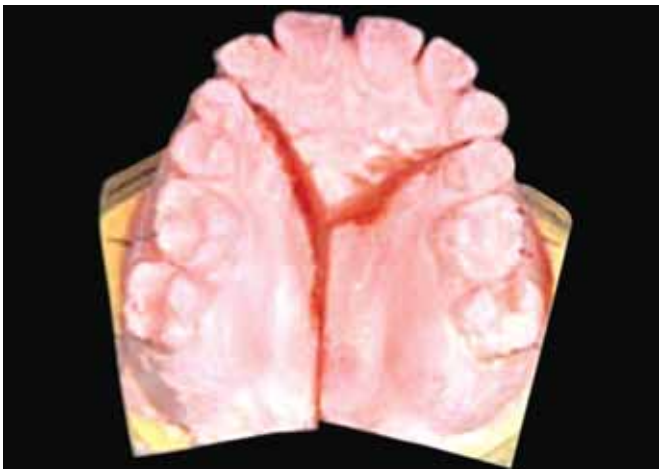
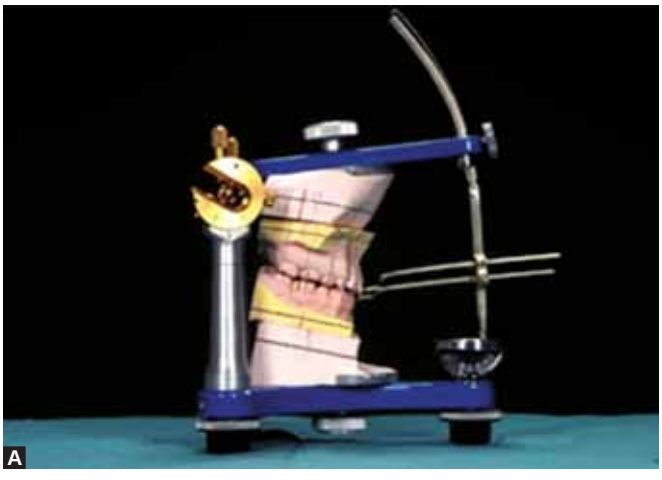
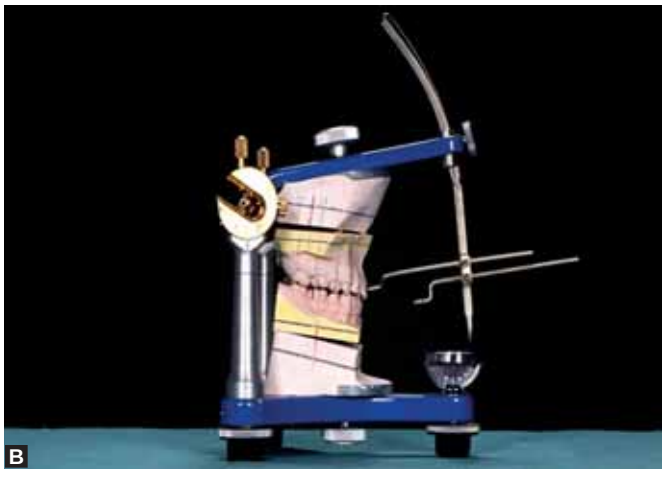


Fig. 10: Measurement is compared with the study cast and the difference in measurement indicates the amount of expansion or closing of the maxillary arch

Fig. 12: Any anterior lift of the cast warns of an unstable surgical outcome





Figs 11A and B: The situation indicates a downward movement of the ramus placing an unacceptable stress on the pterygomasseteric sling

the mandibular cast is mounted, transfers the mandibular occlusal plane angle to the mounting plaster. This then allows the lower cast to be moved anteriorly or posteriorly on the mandibular occlusal plane, therefore, any anterior lift of the cast warns of an unstable surgical outcome (Fig. 12).

Areas of Error

- There are some simple precautions which can be taken to ensure errors are not incorporated into the technique.
- Impressions should be taken in perforated impression trays.
- The impression must be attached to the tray at all points. No tearing of the impression or separation from the tray should be accepted.
- The impressions should not be rested on their heels either in the surgery or the laboratory.
- The wax jaw registration must be taken with extreme care. This is the most common area of error in the model surgery procedure. The model surgery and the cephalometric assessment must start from the same jaw position.
- Face bow registrations must be carefully treated both in the surgery and laboratory. Face bows are easily moved rendering them useless. Should a face bow recording be knocked or rested on the bite fork it should be repeated.
- When mounting the maxillary cast, the bite fork on the face bow should be supported to ensure the weight of plaster does not distort its position.

CONCLUSION

Today's evidence-based dentistry presurgical orthognathic planning is an essential prerequisite of reconstructive orthognathic jaw surgery. Here, the oral and maxillofacial surgeon is very important. The diagnostic information gained from preoperative clinical and radiological assessment and model analysis are integrated to establish a treatment plan. This treatment plan is expressed in the model surgery, the model surgery help aid the oral and maxillofacial surgeon to have a preview of the surgical outcome and determine the exact surgical movements that are necessary to obtain the desired occlusion and esthetics.

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