

# Presurgical Orthodontic Preparation: A Newer Trend for Orthognathic Surgical Treatment Planning

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**Abstract:** *Pre-surgical orthodontics is mainly aimed at removing the dental compensations of the malocclusion. In short, the main goal for the presurgical orthodontic preparation is to just align and level the teeth, without thinking about the occlusion and also maintain the proper position of incisor to finally achieve the arch compatibility. The objective behind this presurgical orthodontic preparation is to treat the upper and lower dental arches separately/independently then align the teeth, with inclination and angulation correction.*

**Keywords:** Orthognathic Surgery, Treatment Planning, Pre-Surgical Orthodontics

## 1. Introduction

Pre-surgical orthodontics is mainly aimed at removing the dental compensations of the malocclusion. In short, the main goal for the presurgical orthodontic preparation is to just align and level the teeth, without thinking about the occlusion and also maintain the proper position of incisor to finally achieve the arch compatibility. A general guideline is that every patient will need a more or less constant period of post-surgical orthodontics (Between 4-6months) but the presurgical preparation time varies<sup>1</sup>.

If we skip the presurgical orthodontic preparation, the quality of result after the surgery will be lowered and also post-surgical orthodontic treatment time is increase. Beyond a certain amount of presurgical perpetration it can be a waste of time, as the duration of post-surgical orthodontics will not be reduced.

The sequence of the entire treatment can be divided into three distinct phases, each with specific objectives, that need to be met for the optimal attainment of the next stage<sup>2</sup>:

- 1) Presurgical orthodontics
- 2) Surgery
- 3) Postsurgical orthodontic detailing

### Presurgical Orthodontics<sup>2,3</sup>

- Lessens the total treatment time
- Controls the relapse tendencies
- Removes the gross occlusal interferences
- Positions the teeth in an ideal relationship to their respective dental bases
- The dental restrictions imposed for the surgical correction of the jaw discrepancy are eliminated
- Allows maximum surgical correction
- Allows proper intraoperative interdigitation
- Significantly reduces operating time and surgical morbidity
- Allows quick and easy postsurgical efficient orthodontic detailing. The goal, therefore, is to locate the teeth in an optimal and decompensated position, so that the surgical

correction is not hindered by the dentoalveolar component and an optimal skeletal and occlusal change can be produced.

### Objectives<sup>1</sup>

Treat upper and lower dental arches separately/independently. Align the teeth, with inclination and angulation correction:

- To relieve crowding (correct the arch length deficiency).
- To close the spaces (eliminate tooth size discrepancies).
- To correct rotations.
- To eliminate gross dental interference

### Intra-arch Objectives<sup>1</sup>

- Alignment of the incisors in 'ideal' position
- Establishment of correct torque
- Removal of dental compensations
- Increase the severity of vertical and/or horizontal aspects of malocclusion
- Establishment of desired anteroposterior and vertical position of the incisors
- Achievement of arch compatibility on models
- Establishment of class I canine and molar relationships on models
- Create space for segmental osteotomy by root paralleling.

### Time estimation<sup>3</sup>

Presurgical 3 to 12 months, (varies with orthodontics the difficulty in alignment)

Surgery 3-8 days hospitalization

Under surgeon's 3-8 weeks care

Postsurgical 3-6 months (over 6 months due orthodontics to inadequate preparation)

Procedures that need to be done before surgery include –

- Alignment
- Leveling – by intrusion
- Arch compatibility

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Procedures that can be done before and/or after surgery –

- Post. crossbite correction
- Levelling by extrusion

Procedures necessary after surgery –

- Settling and levelling by extrusion
- Root paralleling at osteotomy sites
- Detailed tooth positioning.

Asorthognathic surgery brings about three-dimensional change/improvement, whenever combined surgical orthodontics is planned, the deformity should be considered in three planes of space. Hence, presurgical orthodontic treatment plan also should be drawn keeping all three planes in the mind.

### Objectives for anteroposterior—sagittal plane (AP)<sup>1</sup>

Removal of dental compensations or decompensation phase.

### Objectives for transverse Plane

- Differentiation of skeletal from dental problems
- Identification of relative and absolute discrepancies
- Achieve reasonable arch compatibility on the models
- If not, plan for segmental osteotomy procedures.

### Objectives for vertical Plane

Maximizing presurgical orthodontics in open bite cases  
Minimizing the presurgical mechanics in deep bite cases.  
This is essential for the following:

- Avoidance of adverse dental relapse potential
- Maximizing the speed and efficiency of the treatment

### To relieve arch crowding by Presurgical Orthodontics

If arch length deficiency is greater than 6mm, then carry out extractions of teeth

- First premolar extraction gives 7 mm of space
- Whenever the basal bone limit permits, relieve the crowding by multiloop wires, either 014 or 016 Australian Wilcock premium + grade wire (4 to 5 mm space gain)
- Additional 3 mm space can be gained by interproximal stripping of 0.25 mm from the mesial and distal surfaces of six anterior teeth.

**Table 1:** Various presurgical arch wire used for alignment<sup>3</sup>

Wire Size	Use
.008", .009", 0.10" supreme grade Australian Wilcock wire	Excellent properties for alignment without fabrication of loop
.012", .014", .016" Australian Wilcock wires of premium + grade	Ideal for correction of rotations, alignment and levelling when used in loop form (trap food)
Coaxial wires in six of .016", .018", 0.0175", .0195"	Good properties for correction of rotations and alignment of crowded anterior at a low cost
Nickel titanium wire- .014", .016"x .016", .017x .025", .016"x.022"	Outstanding initial wire for leveling and unravelling crowding gently. Costly wire.

### Selection of the appliance<sup>2</sup>

**Stability** – It is important to stabilize the teeth against stresses encountered at surgery and during IMF. Use of a preadjusted appliance is recommended due to the stability

provided by a rectangular wire in a rectangular slot. Proffit does not recommend using a Begg appliance for surgical patients, as he feels the stability provided by a round wire is much less. But many surgical cases have been done with a Begg appliance using a rectangular wire in the ribbon mode.

**Esthetics** – the most esthetic appliances today are the lingual appliances. But these are not recommended for surgical patients due to the following reasons –

- Impossible to use the appliance for stabilizing the teeth during surgery or IMF.
- Post-operative patients have difficulty in mouth opening for the first few months.

If a lingual appliance is used, at least for some time peri-operatively a labial appliance will have to be bonded to overcome these limitations. Recently, various article reported that the use of a maxillary lingual and mandibular labial appliance in orthognathic patients. But they too mentioned the use of labial appliances just before the surgery and thereafter until the end of the treatment. The advent of bonding has made labial appliances more esthetically acceptable, but it is still advisable to bond posterior teeth form the 2<sup>nd</sup> premolar or 1<sup>st</sup> molar back.

Width of the labial brackets have been reduces to increase esthetics, but some extremely narrow brackets have poor rotational and tip control. Tooth colored brackets are of 2 types:

**Plastic brackets** – Not suited for surgery as they tend to fracture, and bracket slot is not good enough to provide good torque control.

**Ceramic brackets-** are stronger than plastic brackets and provide good torque control. But they are brittle and can fracture. Impacts should be avoided during treatment, especially during surgery. They are satisfactory for surgical treatment, but should be limited to the upper anteriors only, and the surgeon must be prepared to use alternative stabilizing methods (like arch bars) if the brackets fracture in the OT.

**Slot Size** – Either slot size – 18" or 22" – is good enough for surgery, as long as a full sized wire is placed in the slot – 17"x 25" ss for 18" slot, and 21"x25" ss or TMA for 22" slot. But when segmented arch mechanics needs to be employed, 22" slot is preferable, as the individual segments can be well stabilized with 21"x25" ss wires.

**Bonding vs banding** – bond anteriors, and band posteriors. When there are periodontal problems, bands are to be avoided, due to difficulty in keeping the area clean.

### Appliance modifications<sup>2</sup>

Although PAE brackets are recommended for surgery, few things must be kept in mind –

- 1) All prescriptions cannot be used for surgical patients. Extreme prescriptions must be avoided. "Extraction series" brackets tend to have a high amount of tip on the canine and premolar brackets which result in roots converging into the extraction space. This can cause problems in case of segmental osteotomies. Hence roots

should not be converging in the extraction space. On the other hand, the opposite side bracket should not be placed, as it would cause too much root separation, and increase the time required for post-surgical orthodontics.

- 2) All teeth should be included in the strap-up. Mandibular second molars can be included before surgery, but it is better to include maxillary molars after surgery, as they have a tendency to extrude. This can interfere with surgical positioning of the jaw bases. If the maxillary second molars are included before surgery, they must be kept depressed using a step bend.
- 3) Auxiliary molar tubes and headgear tubes should be present, and molars should have lingual attachments to aid in use of cross elastics.
- 4) Brackets with adequate mesio-distal and rotational control – twin brackets to be used (should be at least ½ the mesio-distal width of the tooth), or single brackets with rotational wings.
- 5) Integral hooks in the brackets- these help in stabilization during surgery, and for attaching elastics during post-surgical orthodontics. Long hooks should be avoided, as they make oral hygiene maintenance difficult. Some surgeons however feel that the brackets may get dislodged if these hooks are used for stabilization and prefer to use hooks on the archwire instead.

#### Alignment of the arch<sup>2</sup>

- This stage is similar to any orthodontic patient. Principles of alignment remain the same.
- Initial tipping of the teeth into their correct position, using undersize, round and resilient wires. This permits free sliding, freedom to tip mesio-distal and labelling, and light continuous forces, with longer range of action.

#### Levelling of the arch<sup>2</sup>

Unlike non-surgical orthodontics, levelling of the arch in all surgical patients is not necessarily pre-surgically. Often it is advantageous to leave some amount of vertical discrepancy and allow the arch to be levelled surgically. Also, a large amount of levelling is also done post-surgically. When the mandible is moved forward or back surgically, the final vertical height of the face is determined by the position of the lower incisors.

- If it is desired to increase the face height → the lower incisors should not be intruded, and leveling of the arch should be done post-surgically, by extrusion.
- In patients with normal or excessive face height, the lower incisors must be intruded pre-surgically. Basically, the desired final post-surgical position of the incisors should be achieved presurgically
- If segmental procedures are to be done, the teeth should be levelled within the segments, and the final levelling among the segments will be done post-surgically.

Mechanics to be employed for levelling –

Intrusion → Segmented mechanics

Extrusion → Continuous wire mechanics

#### Anterio – posterior positioning of the incisors<sup>2</sup>

Anterio-posterior position of the teeth affect the amount the jaws can be moved sagittaly. In any malocclusion, some amount of dental compensation occurs to partially correct the malocclusion. During presurgical orthodontics dental compensations must be removed.

Hence tooth movement is often in the direction opposite to what they would be moved for camouflage treatment. This has an effect to seemingly worsening the malocclusion, either increasing the overjet, or creating a reverse jet. For the same reason extraction patterns used in presurgical orthodontics are opposite to those used for camouflage treatment.

#### Overtreatment<sup>2</sup>

This is required because in addition to the normal relapse tendency of the teeth, there is also a period of IMF, which tends to augment the forces of relapse.

The type of post-operative tooth movement anticipated is different for different types of fixation being utilized.

- a) **Wire osteosynthesis and IMF** – the teeth are in IMF for 6 weeks following surgery. During this time, due to the elastic recoil of the soft tissues, the mandible tends to slip back. Since the teeth are still tied together, the mandibular incisors tend to procline, and the maxillary incisors tend to retrocline, in order to maintain the occlusal relationships. Factors influencing such tipping of the teeth are:

- Tooth mobility due to ortho treatment
- Play between archwire and bracket slot
- Mobility of bony segments due to wiring.

These changes cease after bony union occurs after about 6 weeks.

In such cases it is helpful to overcorrect the teeth positions pre-surgically, but it is not useful to overcorrect at the time of surgery and place the patient in anterior cross-bite.

- b) **Rigid internal fixation** – jaws are usually immobilized for only 2-3 days post surgery. The mandible tends to move anteriorly in such cases. Hence lower incisors tend to retrocline, and upper incisors tend to flare. Hence overcorrection of the incisors is less desirable in the case of internal fixation.

#### Segmental surgeries<sup>2</sup>

In these cases, the axial inclination of the anterior teeth in the anterior segment must be established pre-surgically. If the axial inclination is corrected surgically, it can cause the canine to be elevated from the occlusal plane, and proper post-surgical poisoning of the canine becomes difficult. If the osteotomy site is at an extraction site, up to half the extraction space should be left open so as to allow for the osteotomy cut.

#### Anchorage consideration<sup>2</sup>

Most times than not, the teeth in the arches have to be moved in opposite directions. Hence intermaxillary elastics are excellent in providing the necessary directions of force, and extraoral anchorage is rarely needed. If extractions are done, all the space should not be closed during presurgical orthodontics. Small amount of space can be left to help in some minor corrections post-surgically.

#### Arch compatibility<sup>2</sup>

The final step is to assure that the maxillary and mandibular archforms are compatible to each other, so that the teeth fit into each other after surgery. This includes shape and width.

Usually, one of the arches has a U shape and the other has a V shape. The narrower regions need to be expanded. This can be done by using co-ordinated arch wires from the beginning, and slowly proceeding to heavier archwires. Sometimes exaggerated arch wire forms may be needed to correct the archform. After archform correction, the roots will have to be torqued, so as to prevent cuspal interferences. But no more than 2-3 mm per side of dental expansion should be done, anything more than that should be done surgically.

All the expansion does not need to be done before surgery. Up to a half cusp cross-bite can be left to be corrected post-surgically, when the occlusal interferences have been relieved. A slight amount of arch incompatibility can be tolerated when splints are used.

Confirming the arch compatibility clinically can be difficult. A Class II patient can protrude his mandible, and this can give some idea as to anterior compatibility. But this is not possible in a class III patient.

Checking the compatibility of a set of study casts taken just before presurgical preparation can help confirm arch compatibility.

At the end of the pre-surgical phase, the patient should be in a full sized rectangular steel wire which will help stabilize the teeth during surgery.

### Stabilization of the arches during surgery<sup>3</sup>

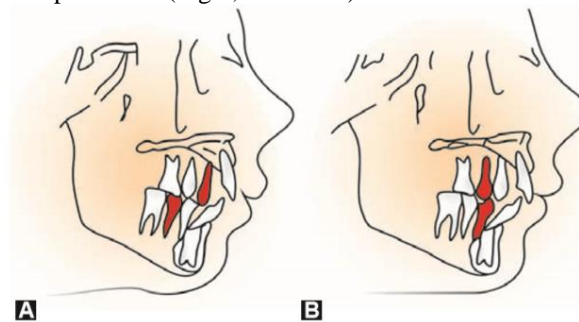
As discussed earlier, the stabilizing archwire should have the following characteristics –

- 1) **Full dimension, filling the slot**– 17”x 25” ss for 18” slot, and 21”x25” ss or TMA for 22” slot. A 19”x25” wire in a 22” slot is acceptable, but it is preferred to place at least a 21”x25” TMA wire.
- 2) **Attachments for IMF** – Even with the advent of rigid internal fixation, the surgeon will require to at least tie the arches together into the splint towards the end of the surgery. Hence some means of attachment should be provided. Even though most brackets have integral hooks, attachment to the archwire is preferred, especially if multiple segments of the dental arch are to be created.
- 3) Kobayashi hooks, though helpful in post surgical orthodontics, are of no use for IMF. Soldered brass spurs to the archwire inter-dentally are most preferred – although they do carry a risk of annealing the wire. Slide-on hooks can be welded. Crimpable hooks can be used, but they must be tack welded for proper stability, and they can sometimes distort the wire.  
The stabilizing wire must be passive – so that no tooth movement occurs after model surgery.

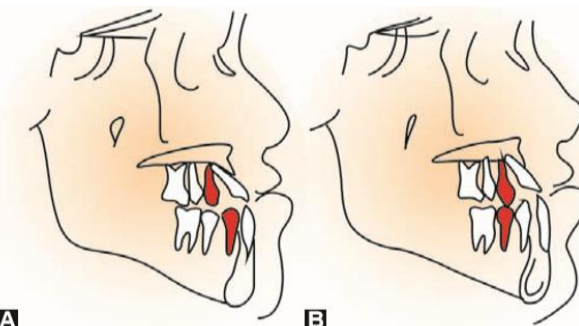
### Extraction pattern for presurgical orthodontics<sup>3</sup>

There is definite difference in extraction patterns chosen for conventional camouflage orthodontics and presurgical orthodontics. For skeletal class I malocclusion (Fig 20 A and B), no maxillary tooth extraction or extraction of upper second premolar should be done (This is to prevent over retraction of the maxillary anterior teeth which would compromise the mandibular advancement) and lower first premolar extraction should be planned to allow leveling of

the arch and to correct the lower anterior proclination. In skeletal class III malocclusion, the extraction pattern chosen will be reverse. In these cases extract upper first and lower second premolars (Fig 1, 2A and B).



**Figure 1a and b:** Extraction pattern for class II malocclusion. (A) For routine orthodontics, (B) For surgical orthodontics.



**Figure 2 a and b:** Extraction pattern for class III malocclusion. (A) For routine orthodontics, (B) For surgical orthodontics.

### Selection of Orthodontic appliance<sup>3</sup>

#### Fixed Orthodontic Appliance System

Fixed orthodontic appliance system is chosen. This appliance is used not only to move the teeth, but also to stabilize them against the stresses encountered at surgery and during maxillomandibular fixation. Modern preadjusted edge wise .022” slot appliance with its myriad of variations can be used. In this appliance round or rectangular wire is tied into a bracket slot. It is well adapted for tooth movement as well as for stabilization of teeth.

Conventional Begg appliance is not suitable for stabilization. Clear or tooth colored plastic brackets or ceramic brackets are not suitable for surgical orthodontics. They are susceptible for breakage and tend to discolor. Bracket placement on the teeth is typical for the usual orthodontic patient, except in the area of a planned osteotomy site, it is advisable to tip the brackets on two adjacent teeth, so that a straight wire will cause root divergence during the presurgical orthodontic phase or to use arch wire bends to produce the desired tooth movements. Sometimes to make the roots divergent at osteotomy site, the right and left canine and premolar brackets are deliberately switched during presurgical treatment phase, it is recommended that all the molars be banded.

Integral hooks—built in hooks in the bracket of molar teeth can be helpful, (or crimpable hooks on the wires) for surgical stabilization and postsurgical finishing, for intra-arch elastic attachments.

### Anteroposterior sagittal (AP-sagittal) Plane Presurgical Orthodontic Objectives<sup>3</sup>

To remove nature's compensation by correcting the axial inclination of the incisors (achieve ideal axial relationship) In skeletal class II malocclusion, the maxillary teeth are often retroclined and the mandibular incisors are proclined to compensate for the skeletal discrepancy and to reduce the incisor overjet and to have functional occlusion (nature's compensation). In these cases, orthodontic decompensation is achieved by uprighting the proclined mandibular incisors and proclining of the maxillary incisors and thereby increasing the amount of overjet to maximum. This will allow surgeon to carry out maximum mandibular advancement. In skeletal class III malocclusion, the maxillary incisors are often proclined and the mandibular incisors retroclined to minimize the reverse overjet of the incisors and to have functional occlusion (nature's compensation). In these cases, orthodontic decompensation is achieved by making the maxillary and mandibular incisors upright on their respective dental bases and thereby increasing the reverse overjet to maximum. This will allow the surgeon to achieve maximum set back of the mandible with stable occlusion and pleasing esthetics. The ultimate goal in AP plane, orthodontic decompensation is to produce sufficient overjet/ reverse overjet to allow for the establishment of class I canine relationship on model prior to surgery as well as in the patient intraoperatively. An ideal incisor overjet/overbite produces better chin-lip balance (Use of class III elastics in class II patients to upright or retract the mandibular incisors and help to procline the maxillary incisors or left in their original position Reverse is done in class III cases with class II elastics).

### Presurgical Orthodontics Objectives for transverse Plane<sup>3</sup>

The dentofacial deformities in this plane have commonly defects in the arch width, usually of the maxilla, i.e. posterior cross bites—unilateral or bilateral. They are often combined with AP and vertical problems and also can be associated with deviation of the mandible in centric occlusion. Transverse plane discrepancies are usually treated either by buccal tipping or bodily movement of posterior teeth. In surgical orthodontics it is important to know (i) whether the problem is skeletal or dental and (ii) whether the problem is relative or absolute.

This is determined by taking upper and lower impressions and making study cast. The hand held models are brought into class I canine occlusion to know whether the problem is relative or absolute. A relative problem can be tackled by presurgical orthodontics, but absolute skeletal problem should be solved by planning segmental osteotomies of the maxilla to correct the arch width and arch form. As a rule, orthodontic expansion should be limited to 2 to 3 mm per side (4 to 6 mm total), i.e. not more than half-cusp cross bite. Excessive buccal tipping will cause elongation of lingual cusp, which will interfere with the postoperative result, plus there will be great relapse tendency. In an isolated skeletal transverse discrepancy, where no other maxillary surgery is anticipated, surgically assisted rapid palatal expansion is a procedure of choice. Where a skeletal maxillary discrepancy is combined with other maxillary problems, multiple segment maxillary osteotomy is

indicated (Surgical movement of 5 to 8mm laterally is possible). Cases with minor dental discrepancies are dealt as routinely. Many times orthodontic minor expansion can be done in the postoperative orthodontic phase, as there will be no more occlusal interferences present.

### Presurgical Orthodontics consideration for vertical Plane<sup>3</sup>

Vertical maxillary excess (VME) or vertical maxillary deficiency (VMD), i.e. long face and short face cases demand consideration for presurgical orthodontics in vertical plane. VME with anterior open bite will exhibit typical step behind maxillary canine (a rainbow curve). The level of anterior teeth occlusal plane will be higher than the posterior teeth occlusal plane in the maxilla

- 1) No attempt should be done to close the anterior open bite pre-surgically.
- 2) Avoid intrusive mechanics in the posterior teeth and concurrently avoid any extrusive mechanics in the anterior region (potential adverse relapse tendencies).
- 3) Severe accentuated or reversed curve of Spee should be treated with segmental orthodontics.
- 4) Only dental alignment should be carried out separately in the anterior segment and two posterior segments (level each segment separately).

Skeletal open bites are best treated by segmental maxillary osteotomies, which allow differential vertical movement of anterior and posterior segments. VME without anterior open bite will exhibit nature's dental compensation, i.e. overerupted extruded anterior teeth. In these cases, pre-surgical decompensation with alignment as well as orthodontic intrusion of the anterior teeth will be needed.

### Skeletal deep anterior overbite pattern<sup>1,2</sup>

Skeletal deep anterior overbite pattern will have three types:

- Short face
- Averageface
- Long face.

In short face or VMD with skeletal deep anterior overbite, there is a need to increase the lower facial height for better esthetic results. No leveling of curve of Spee in the mandibular arch should be done presurgically. Level only the maxillary arch. After surgical advancement of mandible is carried out, lateral open bites will be created in the posterior region. This can be corrected in postsurgical orthodontic phase by tripodding and extrusion of posterior teeth. In average face and long face with skeletal deep anterior overbite, to prevent increase in the lower facial height, the curve of Spee is leveled by intrusion of anterior teeth prior to surgery.

### Root positioning at the planned osteotomy sites and retaining the extraction spaces<sup>2</sup>

Whenever premolar extractions are carried out for relieving the crowding, the total extraction space should not be utilized. At least 3 to 4 mm space should be left for making the segmental osteotomy cuts, without jeopardizing the periodontal status of the adjacent teeth. Judicious interproximal stripping can be carried out wherever possible, so that the entire premolar space can be utilized for set back of the anterior segment. Periapical X-rays of the planned

osteotomy region should be taken and if roots are convergent, they are made divergent. The equal amount of space should be created between the crowns as well as roots of the teeth adjacent to the osteotomy sites.

### Completion of presurgical orthodontic phase<sup>1</sup>

Fresh records should be taken at the completion of presurgical orthodontic phase. The models should be duplicated. One set is kept for the record and another one handed over to the surgeon for mock surgery or model surgery and preparation of the occlusal wafer splint. Impressions for models should be taken before fixing the stabilizing arch wire. Interocclusal wafer splints should not be more than 2 to 3 mm thick. (Prior to splint making, the models should be checked whether class I canine and molar relationship can be achieved post surgically).

Before handing over the patient to the oral and maxillofacial surgeon, a stabilizing passive rectangular wire with multiple lugs soldered or incorporated onto the arch wire (a lug between every two teeth). These should be placed at least three weeks prior to surgery. This will ensure that no further teeth movement will occur, and occlusal splint fit will not change at the time of surgery

## Conclusion

### Final surgical planning and preparation<sup>3</sup>

After the patient is ready for surgery the following set of records are taken, usually about 2 weeks before surgery, after the final rectangular wires have been in place for 3 weeks or more so that they are passive –

- 1) OPG
- 2) Lat. ceph
- 3) Casts
- 4) Photos – intra and extra-oral
- 5) PA ceph – if there is facial asymmetry
- 6) IOPAs and occlusal view if needed.
- 7) Face bow transfer onto an articulator if needed

OPG is used to verify that root positions will not interfere in osteotomy cuts. The roots should be slightly divergent or parallel, but not converging. The ceph is to be used for cephalometric predictions, to guide the model surgery. Casts are to be used for the model surgery itself.

### Cephalometric predictions and model surgery<sup>4,5</sup>

Ceph prediction should be done either manually or on the computer, and must be done before the model surgery, so that it forms a guideline for the latter.

**Need for a facebow transfer** – This depends on the type of surgery.

- 1) If the relation of the condyles and the mandibular dentition will be maintained during the surgery, and the mandible is required to auto-rotate to a new position, face bow transfer is needed. Accuracy of the rotation is important in this case.
- 2) In case of 2 jaw surgeries, the mandibular position and rotation is important for positioning the maxilla. Hence facebow transfer is needed.

If the relation between the condyle and the mandibular dentition is to be changed during surgery, a facebow transfer is not needed. Mounting on a simple articulator will do. Facebow transfer needed in –

- Reposition of the posterior or entire maxilla
- Segmental subapical procedures of the mandible.
- 2 jaw surgeries.

### Purpose of model surgery

- 1) To verify that the planned movements are possible
- 2) To relate the mandibular and maxillary dentitions in the position where the surgical splint will be made.

### Model Surgery -2 jaw surgery<sup>3</sup>

The patient's impressions are taken after the final rectangular wire is in place for at least 3 weeks so that it is passive and no further tooth movement will occur. This is important to ensure proper fit of the splint during surgery.

Once the impressions are taken, a wax bite is taken to record the occlusion of the patient. Then, the facebow record is taken, and the maxillary cast is mounted on the articulator. The mandibular cast is mounted using the wax bite. During the mounting of the casts, a 5 mm acrylic spacer is used. The maxillary and mandibular models are mounted onto the mounting rings with the spacer interposed. The spacer is then removed. Grooves are created in the plaster. The grooves are coated with petroleum jelly, and another layer of blue coloured plaster is poured. This can be easily removed subsequently. First the maxillary procedure is done. The vertical distance of each crown's cusp tip to the mounting ring is marked and measured. This will later aid in determining the amount of movement carried out. The plate of the jig is then oriented to the maxillary occlusal plane and the maxillary cast is stabilized with putty consistency rubber-base material. The blue coloured plaster is then easily removed. This leaves a space above the maxillary cast to allow for impaction. The jig has anterior and posterior screws which help in impacting the anterior and posterior limits of the maxilla to the predetermined amount. Once the impaction is done, the vertical distance of the teeth to the mounting ring is again measured, to confirm the amount of impaction done. With the maxilla and the jig still in this position, a layer of pink plaster is poured to stabilize the maxilla. After the plaster sets, the incisal pin loosened, and the maxillary cast drops till it touches the mandibular cast. This simulates auto-rotation. In this position of the maxilla and the mandibular casts, the intermediate splint is made. If transverse stability of the arch is required after surgery, a TPA in the upper arch or a lingual arch in the lower can be fabricated just before fabrication of the splint. Also, a 40 mil (19gauge) wire can be fabricated to run from one headgear tube to the other. These are to be inserted after the expansion has been done. After the intermediate splint is ready, the blue plaster spacer is removed from the mandibular mounting, and the mandible is repositioned to the desired position. The final splint is then made. The splints are made with e links incorporated in them, so as to aid in intermaxillary fixation.

### Requirements of the splint<sup>2</sup>

- 1) It should fit the teeth accurately, and there should be no distortion of the resin.

- 2) Should be of minimum thickness required for adequate strength. i.e. – thickness should not be more than 2 mm.
- 3) Excess acrylic should be trimmed off the buccal aspect, to allow for proper visual verification during surgery and oral hygiene maintenance.
- 4) Should allow for ease in IMF
- 5) If rigid internal fixation is to be used, the patient will have to function into the splint soon after the surgery. They must be trimmed so that only the occlusal indentations of the teeth are present in it, so as to permit lateral movements, and yet provide as stable occlusal relationship.

### Making of a 'piggy-back' splint, used in segmented procedures<sup>3</sup>

The first few steps are the same. After the casts have been mounted on the semi-adjustable articulator, and the reference lines are marked on the cast. The above-mentioned jig cannot be used in procedures involving differential movement of multiple segments of the maxilla.

- 1) The maxillary cast is sectioned, and the segments are placed in the appropriate occlusion, as determined by the cephal prediction. Once the segments are positioned as planned, in all 3 planes of space, they are secured to each other in wax.
- 2) The upper cast is then duplicated using alginate. 2 casts are needed – one for making the final splint, and one for the intermediate splint.
- 3) Making the final splint. During this procedure, the final splint is made first, and the intermediate splint is made later. The duplicated max. model and mand. Model are mounted on a *hinge* articulator, in the desired occlusion, and the final splint is made in this position. If transverse stability of the arch is required after surgery, a TPA in the upper arch or a lingual arch in the lower can be fabricated just before fabrication of the splint. Also, a 40 mil (19gauge) wire can be fabricated to run from one molar tube to the other. These are to be inserted after the expansion has been done.
- 4) The splint should have only the indentations of the mandibular teeth in it, so as to allow for lateral movements during functioning. There should be holes in the lateral margins of the splint (or e-links) to aid in IMF.
- 5) To make the intermediate splint, the segmented max. cast is placed back on the semi-adjustable articulator. Any mandibular auto-rotation is simulated. The final splint is fixed onto the max. cast. Separating media is placed over the splint, and the final stage splint is prepared in this position.
- 6) After the splints have been made, they are polished, and they should easily fit in and out of each other. It is preferable to have a colour code, so that it is easy for the surgeon to identify the intermediate and final splint is the OT.

### Problems encountered during model surgery

Rarely, a dental interference may be encountered which will warrant further presurgical orthodontics. Most common – Interference in second molar region, usually caused due to *not* bonding lower 2<sup>nd</sup> molar and bonding upper 2<sup>nd</sup> molar.

The lower 2<sup>nd</sup> molar should be aligned, and the upper second molar should either not be banded or stepped up. Extruded

upper second molar can cause the condyle to be distracted from the glenoid fossa – a major cause of instability. The problem can be tackled by either trimming the 2<sup>nd</sup> molar cusps or going back to a lighter wire to align the second molar.

Second – Incompatibility of canine widths. This is less common in a class II patient where the mandible can be brought forward to check the compatibility, than it is in class III patients. If the Canine widths are not co-ordinated an anterior open bite can result. It is usually wise to resume orthodontics to widen the canine width in the upper arch (usually).

Third – Lack of space between roots to place osteotomy cuts, in case of segmental procedures. This will also require increased orthodontic treatment. If the surgery is not delayed sorting these problems out, it will usually result in compromised treatment and prolonged post-surgical orthodontics.

The splint is used during surgery to help attain the planned occlusion and to stabilize the teeth during surgery. Without a splint however, the surgeon has to decide the most stable position for the jaws, not being able to judge symmetry and midlines, etc. The splint should not be too thick, as this would increase the chances of error as the mandible rotates into occlusion after the splint is removed. At times, there may be some teeth contacting through the splint, but this is acceptable as long as the thickness between these areas is adequate to provide good strength. Otherwise, the splint should not be more than 1-2 mm thick. The splint should be in place until the start of post-surgical orthodontics. If rigid internal fixation is used, IMF is relieved earlier, but the splint should remain tied into one of the arches, and the patient should continue to function into it, guided by elastics.

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