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Orthodontic consideration in Orthognathic surgery-A review

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Abstract: *Skeletal malocclusions are one of the common problem encountered in today's orthodontics. Treatment of such skeletal deformities requires combination of orthodontic and surgical treatment. The treatment does not change only the bony relations of the facial structures, but soft tissues as well, and by doing so, may alter the patient's appearance. However, longer treatment times and transitional detriment to the facial profile has led to a new approach called "surgery-first," which eliminates the presurgical orthodontic phase. After the jaws are repositioned, the orthodontist is then able to properly finish the bite into the best possible relationship. Surgery may also be helpful as an adjunct to orthodontic treatment to enhance the long term results of orthodontic treatment, and to shorten the overall time necessary to complete treatment.*

Keywords- *Orthognathic surgery; Dentofacial deformity;Surgery First Approach*

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I. Introduction:-

Orthognathic surgery includes different variety of surgical procedures which enables a surgeon to consign the teeth, jawbones, and associated hard and soft tissue structures into their respective anatomical places. Surgery performed after braces placement is not a choice in all the cases, but sticks for very severe problems like growth disturbances, congenital abnormalities, or trauma. Correction of these abnormalities generally results in improvement in function such as chewing, speaking, and breathing, and often improves facial aesthetics. The treatment alter the bony relations of the facial structures, soft tissues along with patient's appearance. Concurrent orthognathic techniques can be applied in many fields of surgery: apart from correcting congenital and posttraumatic malocclusions, they can also be help full in the treatment of the obstructive sleep apnea syndrome (Riley *et al.* 1993)[1], to improve phonetics (Vallino 1990)[2] or even in tumor resections (Grime *et al.* 1991, Sailer *et al.* 1999)[3,4].

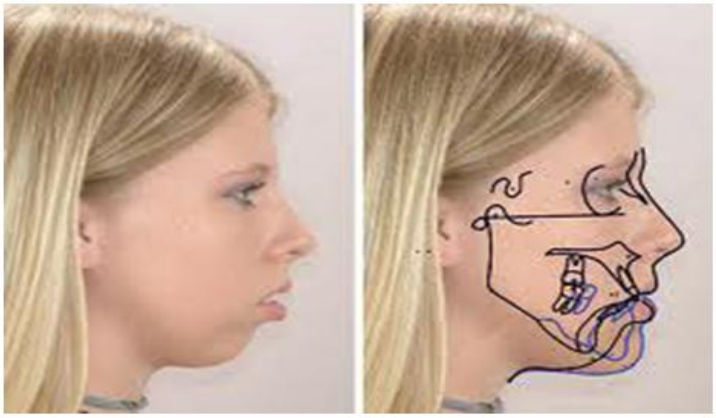
Early communication and coordination between the Orthodontist and surgeon is essential This ensures the success of surgical treatment and patients satisfaction. Orthognathic surgery may also carry a risk of temporomandibular disorders (TMD) or may have no benefit for TMD (Sostman *et al*. 1991, Smith *et al.* 1992, Onizava *et al*. 1995)[5,6].

Prolonged treatment times and intermediary deterioration of facial profile has led to a new approach called "surgery-first," in which the presurgical orthodontic phase has been obsolated.[7] The "surgery-first" approach was first given by Nagasaka et al.[8] in 2009.Over time, this approach has got recognition among orthodontists and surgeons for several reasons. First, the esthetic concern for the patient is concern from the beginning. Second, the total treatment time is significantly reduced due to elimination of presurgical orthodontic phase. Third, a "surgery-first" approach does not seem to spoil the final occlusion.

After the jaws are positioned at their respective position, the orthodontist is then able to properly finish the occlusion into the best possible intercuspation or realation.

II. Need of surgery:-

There are several jaw abnormality which are corrected through orthodontics and surgery.



Fig;-1 Showing jaw discrepancies in Digital Photography

- When orthodontic treatment alone unable to correct a problem – When congenital abnormalities, growth disturbances, or previous trauma have resulted in jaw positions so that orthodontic treatment alone unable to achieve a satisfactory functional and aesthetic result.

- To improve jaw function – Correcting this bite often helps many people to chew food more normally and eat things that they have been previously incapable to eat.

- To enhance the long term orthodontic result (stability) – In some cases, orthodontic treatment alone can produce a good quality bite relationship during and immediately after the orthodontic treatment. However, when an underlying jaw abnormality is responsible for the bite problem, it will be difficult to maintain the position of the teeth over a period of time after the braces have been removed. Surgery can often improve the long term results in these cases.
- Reduction in overall treatment time – In cases where the combined orthodontic along with surgery is indicated, then here the movement of the jawbone to a better anatomical position may decrease the amount of orthodontic treatment that is necessary.

- Change in facial appearance – Placement of jaws in the proper position may often result in a more pleasant facial appearance.

- Improved breathing – Surgeries involving advancement of mandible, often greatly improves the ability to breathe, for instance- in cases of sleep apnea.

- Improved speech – Correction of inadequately positioned jaws or teeth may have a positive effect on abnormal speech. Jaw surgery combined with speech therapy to correct speech abnormalities.

- Improvement in jaw pain – Patients experience some relief in jaw joint ans muscles pain after jaw surgery. But, the correction of jaw positioning will not be able to totally eliminate or decreased pain.

III. History of Orthognathic surgery:-

III.1 Mandibular osteotomy-

Hullihen (1849)[9]- The first mandibular osteotomy is considered to be Hullihen´s procedure in 1849 which was performed to correct a protrusive malposition of a mandibular alveolar segment caused by a burn (Hullihen 1849)[9]. Osteotomy of the mandible prognathism correction was first carried out in 1897 as so called ´St Louis operation´. The osteotomy was held by Vilray Blair, who later described several ways to correct maxillofacial deformities and was the first to present a classification of jaw deformities mandibular prognathism, alveolar mandibular, mandibular retrognathism , maxillary protrusion and open bite.

Berger (1897)[10]**-** Stated that a condylar osteotomy is used for the correction of prognathism. This technique was explained by others, but the results were not satisfactory due to certain issues of relapse and open bite. Only slight progress took place between the two World Wars (second phase), Trauma surgeries helped in many ways to apply these experiences to the principles of orthognathic surgery.

Caldwell and Letterman (1954)[11]**-** In 1954, Caldwell and Letterman performed first time a vertical ramu osteotomy technique, which had the advantage to the inferior alveolar neurovascular bundle.by minimizing trauma to the nerve site. This method could be used instead of body ostectomy to correct mandibular excess.

Trauner and Obwegeser (1957)[12]**-** developed intraoral bilateral sagittal split ramus osteotomy (BSSO),

Dal Pont (1961), Hunsuck (1968) and Epker (1977)[13]-Gave modification in BSSO. It allowed corrections in the three planes of space without any bone graft.

As told by **(Wyatt 1997**)[14] Now a days sagittal split osteotomy has become the most popular performed mandibular procedure.

Suuronen R et al. 1999[15] Application of the principles of distraction osteogenesis represent the latest innovations in orthognathic surgery.

III.2 Maxillary Osteotomy-
Wassmund initial endeavor to perform maxillary osteotomy. Wassmund did not mobilize the maxilla, but employed orthopedic traction postoperatively to position the maxilla.

(Turvey & White 1991)[16]**.** In 1960 that Obwegeser started to carry out maxillary surgery and described a large series of LeFort I osteotomies in 1969. That marked the beginning of a new era in the correction of maxillofacial deformities: before the mid-1960´s, dentofacial deformities were treated by performing mandibular surgery.

It was summarizes that palatal and maxillary soft tissue pedicle attached to the ostetomized segments is a vital tissue needed to be preserved after the detailed study of maxillary artery.. This allows good healing and minimizes the risk of tissue necrosis. (**Bell et al. 1975, Turvey & Fonseca 1980)**[17,18]**.**
first total two-jaw surgery was done by **Obwegeser in 1970**[19]**.** This technique facilitates the correction of widespread dentofacial deformities in a single operation.

IV. Orthodontist and surgeon interactions

Since 1960s, surgeons and orthodontists tended to work independently to correct dentofacial deformities. It soon became apparent that problems will remain constant if surgery would be done prior to orthodontic treatment. Neither the orthodontist nor the surgeon could have proper understanding of therapy. These hindrances were largely eliminated by a treatment performa that is initiated with interactive treatment planning . continued with a pretreatment agreement on a sequence that involved orthodontic This procedures continued with preparation for surgery, surgery with archwires used for stabilization, and a relatively short period of postsurgical orthodontic finishing. It is more beneficial to keep post surgical procedure as short as possible.

IV.1.Interactive diagnosis and treatment planning-
Dentofacial proportions in patients underwent surgery should be evaluated thoroughly, with a proposal for orthognathic surgery or orthodontics alone based on the evaluation.
Two-dimensional computer image predictions of profile changes from repositioning the jaws or the teeth are now practically accurate in non growing patients, who constitute most potential surgical patients.
The surgical planning for patients with intricate problems also aid by three-dimensional radiographs and may be indicated at that stage
All photographs and radiographs should be taken in the natural head position. Additional records that could provide more specific details are 3D photographic images,(Figure-2) CBCT,and videoimages of the patient.[20,21]

Fig;-2. Mandibular surgical simulation movement using Morpheus3DCT software.

V. Presurgical orthodontic treatment-

The objective of presurgical treatment is to prepare the patient for surgery, placing the teeth relative to their own supporting bone without concern for the dental occlusion at that stage. The amount of presurgical orthodontics can be inconsistent, ranging from only appliance placement in a few patients to 12 months more so of treatment in others with severe crowding or protrusion. The presurgical phase should almost never require more than a year, unless it is delayed by waiting for growth to be completed.[22]

Another way to express the goal of presurgical orthodontics is that it should prepare the patient so that postsurgical treatment can be completed within 6 months[22.]

-Steps in Orthodontic Preparation for Surgery

The important steps in presurgical orthodontics are to align the teeth in the arches and to establish the correct antero-posterior and vertical position of the incisors. Both are essential so that the teeth will not obstructed in placing the jaws in the preferred position.

The leveling of the dental arches is predominantly important. The guideline is that extrusion is generally done more easily postsurgically, whereas intrusion must be accomplished presurgically or handled surgically. Two common problems require special consideration: how to level an increased curve of Spee in the lower arch of a patient with deep bite and how to level the upper arch in an open-bite patient who has a large vertical divergence between anterior and posterior teeth.

V.1.Leveling the Mandibular Arch

Whenever there is an increased curve of spee is present, the decision to stable either by intrusion of incisors or extrusion of premolars must be based on the desired final face height. If there is short face and less distance from the lower incisor edge to the chin is normal, then leveling by extrusion of posterior teeth is indicated, so the chin will move automatically downward at surgery. If the lower incisors are elongated and face height is normal or excessive, intrusion should be carried out so that normal face height can be achieved after surgery.

In short-face, deep-bite patients who need additional face height, it is always advantageous to level the lower arch after surgery. Prior to surgery, the teeth are aligned and the antero-posterior position of the incisors is established, but the lower arch is not leveled, and steps are needed in all rectangular archwires, including the surgical stabilizing wire. This means the surgical splint will be thicker in the premolar region than anteriorly or posteriorly. At surgery, normal overjet and overbite are created, and the space between the premolar teeth is corrected postsurgically by extruding these teeth with working archwires with a reverse curve of spee. The leveling occurs rapidly, typically within the first 8 weeks after orthodontic treatment stops because there are no occlusal contacts to oppose the tooth movement[22].

If intrusion is required, a segmented arch approach is indicated in the presurgical orthodontics. For the lower arch, surgical leveling rarely is indicated, although a subapical osteotomy to depress the incisor segment is possible(Figure-3)

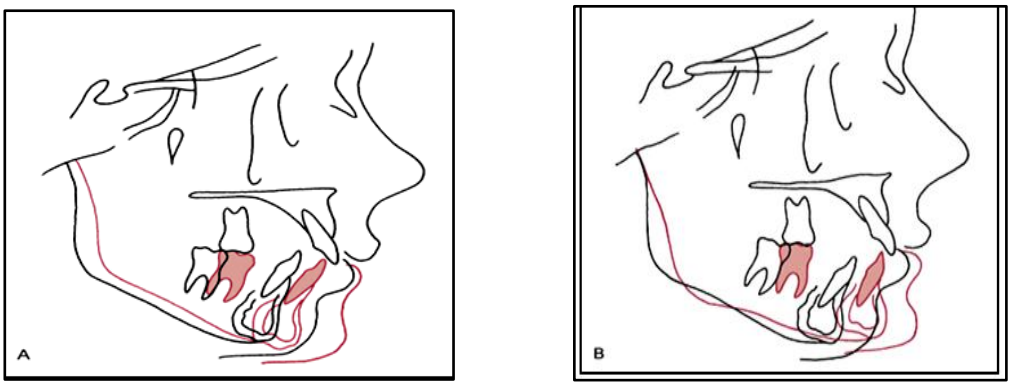


Fig-3;- *Effects of orthodontic leveling on the position of the mandible at surgery.* ***A,*** *Prediction of mandibular advancement with no change in the presurgical position of the mandibular incisors (i.e., postsurgical leveling of the lower arch by premolar extrusion). The lower incisors and the chin move downward and forward, increasing anterior face height.* ***B,*** *In the same patient, prediction of mandibular advancement after presurgical leveling by intrusion of the lower incisors. This allows rotation of the mandible so when the teeth are brought into occlusion at surgery, the chin moves more forward and slightly upward. The result is a decrease in anterior face height and better correction of the mandibular deficiency.*

V.2.Leveling the Maxillary Arch

In a patient with open bite who will have vertical repositioning of the maxilla, serious vertical disparities inside the maxillary arch are a sign for multiple segment surgery. At the point when this is planned, the upper arch ought not be leveled conventionally. Presurgical leveling ought to be done just inside each fragment

V.3.Establishment of Incisor Position and Space Closure

The anteroposterior position of the incisors figures out where the mandible will be set with respect to the maxilla at surgery and in this way is a basic component in planning treatment. This is frequently the real thought in planning the closure of extraction sites(Figure-4).

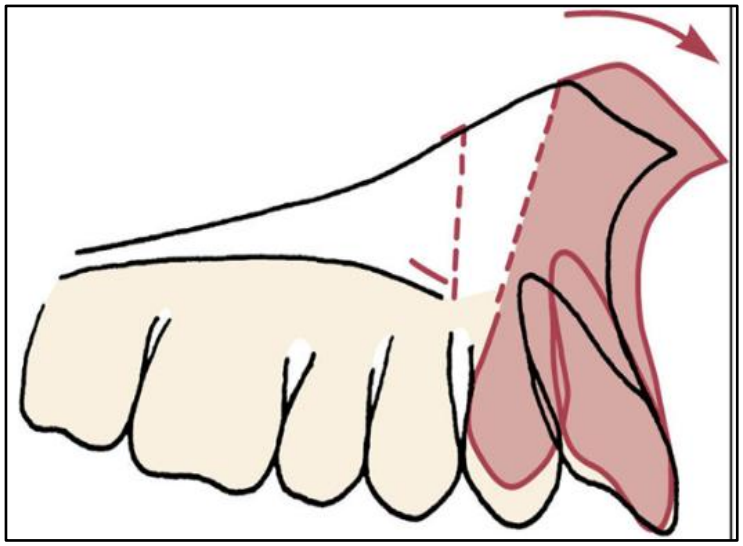


Fig-4; *In segmental maxillary surgery, it is important to establish the correct inclination of the incisors presurgically. Otherwise, it will be necessary to rotate the anterior segment at surgery to maintain the vertical position of the maxillary incisor while its inclination is changed. This tends to elevate the canine off the occlusal plane and diverge the roots at the osteotomy site.*

V.4.Stabilizing Archwires

As the patient is moving toward the finish of orthodontic planning for surgery, it is useful to take impressions and analyze the hand-articulated models for occlusal compatiblity. Minor obstructions that can be redressed effectively with archwire alterations can essentially restrain surgical movement.

At the point when any last orthodontic changes have been made, settling archwires ought to be set no less than a month prior to surgery with the goal that they are passive when the impressions are taken for the surgical splint,

to relate the madibular and maxillary dentitions in the position where the surgical splint will be made a. (as a rule 1 to 2 weeks before medical procedure). The settling wires are full-measurement edgewise wires (i.e., 17 × 25 steel in the 18-slot apparatus, 21 × 25 TMA or steel in the 22-slot machine). Hooks as connections to tie the jaws together while rigid fixation are required. These can be included at the time of the splint impressions. 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.

They can be brass wires soldered to a steel settling wire or pre-assembled ball-hooks that are bound or precisely creased set up on the archwire. Sliding the ball-hooks over the wire without securing them is inconvenient in light of the fact that they can slip or rotate when they are utilized to tie the jaws together during surgery. Tight intermaxillary fixation is fundamental at any rate sufficiently long to put rigid fixation[22].

VI. Surgery-

An agreement with regards to the rules ought to be made between the specialist and the orthodontist keeping in mind the end goal to take the proper radiographs at the ideal circumstances. The informational index rules from the British Association of Oral and Maxillofacial Surgeons (BAOMS)and British Orthodontic Society (BOS)prescribe lateral cephalograms preoperatively, toward the finish of pre-surgical orthodontics, post-operatively 1– 3 weeks after medical procedure, the pre-debonding stage, and two years post-maintenance. All encompassing radiographs are required before the underlying orthodontic treatment, and promptly postoperatively[23].

Surgery can control the greater part of the dental and skeletal segments supporting the facial profile; along these lines, any major discrepancy ought to be rectified by surgery. With the headway of surgical skills, different careful alternatives are accessible for the patients. Orthodontists ought to likewise know the conceivable surgical options accessible for their patients and be actively associated with surgical planning. Having comprehended surgical options, orthodontists can complete presurgical orthodontics more proficiently on the grounds that anticipated outcomes can be empowered in advance.

VII. Post-surgical orthodontic treatment-

Once an attractive scope of movement is accomplished and the specialist is happy with the initial healing, the finishing phase of orthodontics can be begun. With rigid fixation, this presently is at 2week to a month post-surgery.

It is critically important that when the splint is removed, the settling arch-wires are likewise expelled and supplanted by working wires to bring the teeth to their final position. This implies ordinarily the orthodontist, not the specialist, should expel the splint. Light vertical elastics are required at first with these working arch-wires, less for tooth development—the archwires ought to do that—however to abrogate proprioceptive driving forces from the teeth that generally would make the patient look for another situation of most extreme intercuspation. Until the balancing out archwires are evacuated, the teeth are held firmly in the presurgical position. Expelling the splint without enabling the teeth to subside into better interdigitation can bring about the patient receiving an unfortunate comfort bite, which in turn complicates orthodontic finishing and could stress recent surgery sites.[101]

The decision of arch-wires during the postsurgical orthodontics is dictated by the sort and measure of movement required. The regular settling of teeth into full occlusion can be accomplished quickly utilizing light round wires (normally 16 mil steel) and posterior box elastics with a anterior vector that supports the sagittal adjustment. A flexible rectangular wire in the upper arch to keep up torque control of the maxillary incisors (in 18-slot, 17 × 25 beta-Ti [TMA]; in 22-slot, 21 × 25 M-NiTi [Nitinol or equivalent]) regularly is a decent decision, with a round wire in the lower arch.

Elastics ought not be ceased until the point that a solid occlusion is built up. Commonly, patients wear the light elastics full time, including while they are eating, for the first 4 weeks; full time with the exception of eating for an additional a month; and exactly during the evening for a third 4-week term. Elastics can be suspended during any further detailing of occlusion. Patients are progressively intolerant of proceeded with treatment after around a half year, so it is critical to complete the postsurgical orthodontics inside that time if possible.

Maintenance after surgical orthodontics is the same than for other grown-up patients, with one imperative special case: if the maxilla was extended transversely, it is basically vital not exclusively to keep up the expansion during the finishing orthodontics, yet additionally to have full-time retainer wear in the maxilla for no less than a half year. On the off chance that a transpalatal lingual arch was put following surgery, it ought not be evacuated during the first postsurgical year[24].

VIII. Risks and Complications associated with Surgery[25]

Certain risks must be associated with any type of surgical treatment, and these should be weighed against the potential benefits. Though it is important for you to be aware of the risks and side effects associated with orthognathic surgery. In which some are mentioned below:

- Postoperative pain and discomfort as a result of surgery itself.
- Swelling
- Bleeding –As most jaw surgery is performed through incisions inside the mouth, and it is unfeasible to put a dressing over this area. So, some bleeding occurs after surgery.
- Infections with jaw surgery are rare usually resolved quickly, and generally easy to treat. Sometime, infection may lead to improper healing and the need for further surgery.
- Surgery may lead harm to normal structures such as gum tissue, bone, or teeth, though this is extremely rare.
- Numbness or decreased sensation after surgery – As jaw surgery is performed to the face, physical violence of nerves of this area may sometimes lead decrease sensation in particular parts of the face. In lower jaw surgery loss of sensation occur around the lower lip and chin, and around the nose and upper lip occurs during upper jaw surgery. This decreased sensation is usually temporary. Although this numbness also helps to decrease the amount postsurgical pain. But, in a few patients there may be some permanent loss of feeling.
- Risks allied with anesthesia – General anesthesia is very safe particularly in not obligatory surgery cases such as orthognathic surgery. Prior to your surgery, the anesthesiologist will confer all aspects of your anesthetic care

IX. Recovery after Surgery-

The speed of surgical recovery depends on several factors including age and the extent of surgery. After the surgical procedure you can expect the following during your recovery:

IX.1.Jaw Movement

All patients will not have their jaws wired together after orthognathic surgery. So, that jaw function can be performed soon after surgery, for assisting jaw function into new occlusal relationship light elastics (rubber bands) will be used. Considerable improvement in jaw movement will be observed within first two or three weeks. As the jaws are not fixed together with wire this makes it convenient for patients to perform routine functions like talking, drinking, chewing, and maintenance of oral hygiene.

IX.2.Diet

Very soft or liquid diet will be advisable for the first few days immediately after surgery, Approximately 1-2 weeks after surgery foods which requires light chewing force are advice such as finely chopped or mesh chapatti, meshed eggs, or other soft foods. At 2-6 weeks after surgery patients diet will progress to foods such as boiled rice, small pieces of very soft meat such as flaky fish, and other foods which require some chewing. In most cases diet will be near normal after six weeks.

IX.3.Physical Activity

For four to five days limited activity will be performed. This means complete bed rest at home will be adviced. At about one week after surgery patient may be able to return to some limited activity such as slightly restricted work activity, some school activity, and easy relaxation activity. But it also depends on the type of surgery and how quickly you recover after surgery.

X.Conclusion-

The surgical team members should know their involvement in a surgical case and there should be abiding communication with the orthodontist and surgeon. For successful surgery and a desirable outcome. An admirable coordination and communication between the orthodontist, the surgeon, and the rest of surgical team will be necessary.

Performing orthognathic surgery before orthodontic treatment has multiple advantages like shortened treatment time, increased patient acceptance, and prolonged the stability of treatment. So,surgery along with orthodontic treatment has become boon for cases which cannot be corrected by orthodontist alone.

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