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Skeletal Class Lll Malocclusion With Severe Prognathic Mandible And Retrognathic Maxilla Correction Via A Surgical-Orthodontic Technique: Case Report And Review Of Literature

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Abstract:
This case report describes the management of a case of a 19-year-old male patient with extremely severe skeletal Class III malocclusion due to a marked mandibular protrusion accompanied with a small and retruded upper jaw in order to improve the concave profile. The patient had an extreme Skeletal Class III malocclusion beyond the envelope of orthodontic correction, with reverse overjet of 9 mm, ANB of -12 and Wits of 15 mm, hence orthognathic surgery along with pre and post-surgical orthodontics was performed in order to correct the occlusion as well. One year post retention, the occlusion was stable, and no relapse was observed. The patient's complaints and orthodontic problems were completely resolved. Therefore, a combination of orthodontic and orthognathic with Le Fort I maxillary osteotomy may be a viable option in the correction of extremely severe skeletal class III malocclusion with maxillary hypoplasia correction in order to restore facial aesthetics.

Key-words: *mandible prognathism, orthognathic surgery, malocclusion skeletal class III*

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Literature involving maxillary orthognathic surgery has been contributed from several sources. Its inception dates back to when German surgeon von Langenbeck in Berlin performed hemi-maxillary osteotomies to extirpate nasal and nasopharyngeal polyps[1]. The first documented total Le Fort I-type osteotomy in literature was performed in 1868 by an American surgeon David Williams Cheever to surgically excavate a nasopharyngeal polyp. Cheever[2] had previously performed a down-fracture of the right hemi maxilla at the Le Fort I level in 1867 to remove a similar polyp[3].

On the other hand, the evolution and introduction of modern maxillary orthognathic surgery has had contributions from various historical sources.[3] Later, French surgeon Rene Le Fort developed the Le Fort classification of facial fractures in 1901 based on his trials with blunt trauma on cadaveric faces[4]. Wassmund[5] performed a maxillary osteotomy at the Le Fort I level in 1927 without plate disjunction or bone grafting, and Axhausen in Berlin described advancement of the incompletely mobilized maxilla at the same level in 1934[6]. Obwegeser improved the precision of the Le Fort I osteotomy in 1965 by suggesting complete mobilization of the maxilla for repositioning without tension.[7] The technique gained popularity after Bell's 1973 description of the resilient maxillary blood supply, and since then, various modifications of the osteotomy and bone grafting methods have been developed[8].

For over 50 years, Le Fort I advancement has been a dependable method for fixing maxillary retrusion and class III occlusal relationships[8]. However, traditional orthognathic surgery comes with the risk of complications and relapse when extreme movements are involved or with certain patient groups. This issue is compounded by the fact that approximately 25% of patients with maxillary hypoplasia require orthognathic surgery[9].

The conventional Le Fort I maxillary advancement with maxillary hypoplasia is typically limited to a movement of 10 mm due to the risk of instability and relapse with greater movement[10-16]. Adult skeletal Class III malocclusion is generally one of the most difficult maxillofacial deformities to correct since it involves complex, multiple inter-related aspects such as cranial base abnormalities; maxillary and mandibular skeletal and dental components, which necessitate precise orthognathic surgical repositioning of the jaws with extensive pre- and post-surgical orthodontics.

The prevalence of Class III malocclusion in the Indian population is not well-established due to limited data[19]. Some studies have reported varying rates of prevalence ranging from 2.9% to 9.1%, depending on the region and population group studied[20,21]. For instance, a study involving 1,020 Indian patients seeking orthodontic treatment found a prevalence of 2.9%, while another study of 1,000 Indian school children aged 12-15 years

reported a prevalence of 4.8%[21-23]. However, a study of 1,200 Indian school children in the same age group reported a higher prevalence of 9.1%[23-25]. These complex cases require careful and meticulous treatment planning, including predictive Cephalometric tracings, mock model surgeries, an integrated orthodontic-surgical approach and steady, uninterrupted patient compliance, motivation and cooperation.

Although correcting the esthetics is more than often the patient's chief complaint, it is almost invariably accompanied by functional debilitation such as difficulty in mastication, speech impairment, obstructive sleep apnoea, temporomandibular joint disorders, and psychosocial handicaps. However, a major limitation of orthognathic surgery for Class III malocclusions, is the possibility of postsurgical relapse owing to factors such as the amount of mandibular setback, extension of the pterygomasseteric sling, decreased tongue space. The complications associated with excessive maxillary advancement are delayed union or non-union at the osteotomy sites, wound dehiscence at the pterygomaxillary disjunction sites and relapse due to posterior muscle pull[26].

In this case report, we describe a case of Le Fort I osteotomy for maxillary advancement in order to improve aesthetics in Skeletal Class III malocclusion patient.

I. Case report:

A case of a 19-year-old male patient, who presented to our hospital in the Maxillofacial surgery department, with the chief complaint of an unesthetic facial appearance caused by a prominent lower jaw and short upper lip. He had no specific past illness. The patient did not have a history of smoking or drinking alcohol. He had no remarkable family medical history. His temperature was 36.5°C, pulse rate was 75 beats/min, and blood pressure was 129/83 mm Hg with extreme Skeletal Class III malocclusion beyond the envelope of orthodontic correction, with reverse overjet of 12 mm, ANB of -12 and Wits of 15 mm is described, which was effectively and successfully managed by a modified protocol of single staged orthognathic jaw surgery in conjunction with pre- and post-surgical orthodontic treatment.

Fig. 1 pre-operative side profile depicting Severe Prognathic Mandible

Fig. 2

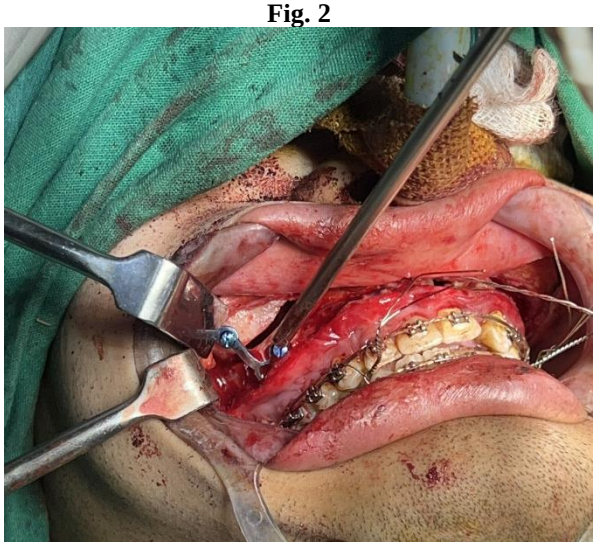

Fig. 3

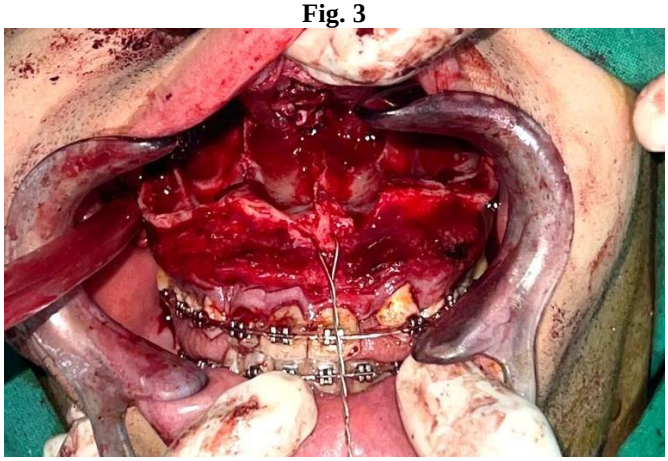

Fig 4.

Fig 5.

Diagnosis & treatment objectives problem list
1. Extreme Skeletal Class III Malocclusion.
2. Compromised smile esthetics.
3. Prognathic mandible. Retrognathic maxilla.
4. Concave profile.
5. Class III canine and molar relationship.
6. Reverse Overjet by 9 mm.
7. Decreased lower facial height.
8. Compromised speech.
9. Compromised functional (masticatory) efficiency.

Treatment goals
1. To address the skeletal discrepancy, correct the severe facial deformity and improve facial esthetics by means of ortho-surgical correction.
2. To correct the skeletal maxillo-mandibular relationship by means of single stage le fort 1 (Maxillary advancement by 9 mm)
3. To address decreased lower facial height and achieve an ideal facial balance.
4. To achieve Class I molar and canine relation bilaterally and normal incisors axial inclination by means of dento-alveolar decompensation as the canines were missing (H/O extraction due to decay)
5. To achieve an ideal functional occlusion by pre-surgical decompensation and post-surgical orthodontic settling.
6. To improve his smile esthetics and achieve a pleasing esthetic profile.
7. To Improve functional efficiency in mastication and speech.

Treatment plan
Combined Orthodontic and Surgical line of treatment, involving four phases:
a) *Presurgical Orthodontics phase:*

Pre-surgical orthodontic decompensation of the occlusal relationships, elimination of surgical occlusal interferences by intruding the over erupted teeth, attainment of an ideal dental arch alignment, and establishment of an ideal anteroposterior and vertical positions of the incisors. This procedure assists in producing a predictable and precise final outcome, so that patient's function and facial harmony improve instantly after surgery.

b) Surgical Phase: The surgery of the Maxilla.
1st Surgical phase: Le Fort I osteotomy for forward positioning of the maxilla by 10 mm.

c) Postsurgical Orthodontics phase:

Settling and finishing of occlusal relationships and final retention plan, so as to achieve optimal functional efficiency, esthetic harmony and structural balance.
(d) Prosthetic phase:

To establish canine relation and replace 12,23 by giving an emax zirconia on 22 to 21 and 13 to 11.

Presurgical orthodontics began with bonding of 0.022MBT pre adjusted edgewise prescription appliance. To achieve sufficient decompensation and ideal maxillary and mandibular incisor inclinations, existing spaces within the arches were utilized. Initial levelling and alignment was carried out using 0.016" NiTi, 0.016" x0.022" NiTi and 0.019"x0.025" NiTi arch wire; followed by 0.019"x0.025" Stainless Steel for closure of residual spaces and correction of inclination of U/L incisors; Stainless Steel as final stabilizing wires. At the end of the presurgical orthodontic phase, dental decompensations were eliminated with Class III molar relation. The upper third molars were extracted 6 months prior to the surgical Phase 1. The lateral incisor was moved into the space of the missing canine and an FPD was fabricated from 21 to 22. Presurgical phase records were repeated and compared. Impressions were also taken and models were hand articulated for examining occlusal compatibility. Cephalometric prediction tracing was done.

Computed Tomographic scans were carried out together with a 3-D printed model. After presurgical orthodontics, face bow transfer was done and maxillary relation to cranial base was recorded and transferred to a semi adjustable articulator. A recorded occlusal wax bite was utilized for the mandibular cast articulation. Mock surgery was performed on the articulated models and the individual dental casts were repositioned, simulating the movements of the jaws. An intermediate acrylic occlusal splint was fabricated after the maxillary cast was advanced by 9 mm on the articulator to oppose the mandibular cast, simulating the maxillary advancement surgery.

Phase II: surgical phase

1st Surgical phase: maxillary advancement

Le-Fort I osteotomy was carried out, and the maxilla was repositioned 10 mm anteriorly. The prefabricated intermediate interocclusal wafer splint was placed which guided the positioning of the maxilla relative to the mandible. Semi-rigid internal fixation was carried out using two miniplates at the bilateral pyriform apertures and two at the zygomaticomaxillary crests together with monocortical screws. Postoperative recovery was smooth and uneventful, and the patient was maintained on a soft diet for the first 2 weeks after surgery.

No maxillomandibular fixation was continued in the postoperative period, although the Interocclusal wafer splint was left secured to the maxillary arch for a month to provide stability during the healing and callus formation stage. Class III elastics were placed immediately post-operatively and maintained for the initial 4 weeks post-surgery, and thereafter discontinued when the interocclusal splint was removed. Orthodontic dental levelling and alignment of the arches was continued after removal of the acrylic wafer splint. Radiographic records were taken.

Procedure:

The patient was positioned in a supine position, with a shoulder roll used to ensure a natural alignment of the head. We performed nasotracheal intubation as it is the preferred method as it allows for easy checking of airway and occlusion. To secure the North bent ET tube in place during surgery and prevent displacement, a 2-0 silk suture was used to attach it to the lower part of the nasal septum. We established external facial landmarks before proceeding with the procedure to accurately measure the movement of the maxilla in relation to the cranial skeleton by creating a small tattoo using a skin marker around the medial canthus and nasofrontal junction. Once these landmarks were set, preoperative measurements of the maxilla were obtained from the teeth or orthodontic brackets on both sides. To aid in controlling bleeding, local anesthesia with adrenaline was administered into the gingivobuccal sulcus of the upper lip.

An incision was performed to preserve a healthy section of movable gum tissue. Most surgeons recommend a 5-mm cuff, based on our experience, adding a few extra millimeters to the incision allowed for an appropriate amount of tissue for a secure and leak- proof closure. The incision was created using a #15 blade. Once the mucosa was penetrated, the dissection progressed directly towards the bone, avoiding deviation into the facial muscles. The incision extended from the first molar to the opposite first molar, exposing both the lateral and medial buttresses of the maxilla.

Subperiosteal dissection was performed with an elevator to expose the front surface of the maxilla. The dissection extended back to the posterior palate, ensuring that the floor of the nose and nasal septum were exposed, allowing for visualization of the superior surface of the palate.

Superiorly, the dissection stopped at the level of the infraorbital nerves. Laterally, the dissection was carried around the lateral maxillary buttress while maintaining a subperiosteal plane and avoiding soft tissue dissection. The lateral dissection terminated upon reaching the pterygomaxillary junction. After exposing the maxilla, we established reference points on the bone to guide the achievement of the preoperative plan. The patient's aesthetic goals determined the locations for the medial and lateral osteotomies. These osteotomies were marked on the maxilla using a Romson skin marker pen or a high-speed bur. Care was taken to avoid the tooth roots when designing the osteotomy.

The lateral maxillary buttress was osteotomized using a piezo surgery unit, directing it towards the ipsilateral piriform rim. The same osteotomy was performed on the contralateral side. A thin osteotome was then used to complete the posterior osteotomies of the lateral and medial maxillary buttresses. A nasal septum osteotome was employed to separate the nasal septum from the maxilla. The posterior wall of the maxilla was fractured using a 12mm chisel and mallet, while being mindful not to penetrate too deeply to avoid the internal maxillary blood vessels. During the corticotomies of the medial maxillary buttresses, care was taken to avoid the nasotracheal tube and unnecessary delays in the procedure. Lastly, the pterygomaxillary junction was separated using curved pterygoid chisel. By placing a finger inside the mouth and palpating the hamulus, the medial extent of the osteotomy could be confirmed for proper positioning.

Once the osteotomies were completed, the down fracture was performed by applying digital pressure. After completing the down fracture and mobilization, the new position of the maxilla was determined based on the patient's aesthetic goals and preoperative planning. The desired movements were executed in relation to the preoperatively measured external reference points. Once in the desired position, the maxilla was secured using titanium plates and screws. L- shaped plates, with a thickness of 2 mm, employed on each maxillary buttress to enhance stability. The patient was then released from MMF, and the occlusion was carefully evaluated. The maxillary midline was assessed in relation to the external reference points, and the position of the central incisors was checked in relation to the mandibular incisors. Centric relation and occlusion were evaluated by manipulating the mandible relative to the new maxillary position.

After confirming proper occlusion, the incision was closed using absorbable sutures. A 3.0 Vicryl suture

in a alar-cinch stitch pattern to achieve a watertight closure was used. Additionally, a V-Y advancement of the mucosal tissue was performed to prevent a flattened upper lip and restore the upper lip pout, especially following significant horizontal movements.

Briefly, lateral and oblique views exhibited anteroposterior deficiency of the maxilla and severe prognathic mandible with concave facial profile. Intraorally, the molar relationship was class III with complete anterior crossbite [Fig. 1 and 2]. A final diagnosis of class-III molar malocclusion with anterior crossbite was made. Orthognathic surgery was decided as a treatment plan after consultation with orthodontists and taking informed consent from the patient. Le fort 1 osteotomy with presurgical and postsurgical orthodontics was planned to achieve aesthetically acceptable and functionally optimum occlusion, with straight facial profile and minimum traumatic surgical exposure to the patient. The patient underwent presurgical orthodontic treatment for 1 year for leveling and alignment, following which decompensation was performed [Fig. 3]. The patient was reevaluated in the orthognathic combined clinic before surgical treatment. LeFort I osteotomy maxillary advancement of 10 mm, with 4-mm downward movement, was performed, where Osteotomy cuts were made using piezosurgery unit saw tips and chisel mallet was further used to down fracture the bone. Autograft harvested from the chin was used to perform augmentation and to close all bony gaps to support the large amount of maxillary advancement and prevent relapse. An upper vestibular incision was made from molar to molar. V-Y plasty done during closure for lip lengthening along with alar sinching done. 3-0 vicryl suture was used for closure. All the osteotomies were stabilized with rigid fixation by using 2-mm miniplates and screws. The patient was admitted in the hospital for 5 days after surgery and then discharged in a stable condition. [Fig. 4].

II. Discussion

Orthognathic surgery is a specialized procedure aimed at improving the alignment of the upper and lower Jaws, as well as enhancing the overall facial profile. It is employed when conventional orthodontic treatment alone cannot address skeletal malocclusion. The procedure involves collaboration with an orthodontist both before and after the surgery. Orthognathic surgery is capable of addressing various abnormalities, including: (1) Class II and Class III skeletal malocclusions accompanied by anterior open bite and facial asymmetry, (2) TMJ abnormalities, (3) obstructive sleep apnea syndrome, (4) hemifacial microsomia, and (6) deformities or malocclusions resulting from trauma.

Class III malocclusions, characterized by a protruding lower jaw, often lead to facial asymmetry.This asymmetry arises from deviations in the positioning of the maxilla, mandible, or both. While a prognathic mandible can cause skeletal class III malocclusion, a retruded maxilla or a combination of a prognathic mandible and a retrusive maxilla can also contribute to this condition. In such cases, orthognathic surgery is necessary to correct both functional occlusion and aesthetic abnormalities. Mandibular prognathism, classified as a class III by Angle, occurs when the mandible is positioned more forward than the cranial base. This condition is primarily influenced by genetics and environmental factors, with genetics playing a larger role. Mandibular prognathism, also known as the Habsburg jaw, is a genetic disorder characterized by an overdeveloped mandible or a hypoplastic maxilla. In class III malocclusion, the anterior oral seal of the upper and lower lip compensates for dentoalveolar issues. This compensation is not observed in individuals with an increased vertical skeletal proportion, where lip incompetence is present. The anterior oral seal is achieved through tongue positioning to lower the lip seal. To diagnose mandibular prognathism, a comprehensive evaluation consisting of clinical examination, lateral cephalometric analysis, and panoramic radiography is conducted. The diagnosis requires the presence of at least two criteria: a straight or concave facial profile, overjet less than 0 mm or edge-to-edge bite, a class III molar and canine relationship, and an ANB angle equal to or less than 0 degrees.

During orthognathic surgery, alignment of the maxilla and mandible is performed to establish proper dental posture and correct facial and maxillomandibular irregularities. The surgical treatment effectively balances the relationship between the maxilla and mandible and aligns the teeth. The commonly utilized techniques in orthognathic surgery include sagittal split ramus osteotomy. Orthognathic surgery is frequently employed to address underlying conditions that impact chewing, facial pain, and aesthetics. In the case of the patient being discussed, he exhibited significant class III skeletal and maxillary hypoplasia, which affected his appearance, mastication, and speech. Given the nature of this case, conventional orthodontic treatment alone was unable to resolve the issues, necessitating orthognathic surgery. Cephalometric analysis and a three-dimensional planning program confirmed the need for orthognathic surgery to correct the skeletal class III condition with maxillary hypoplasia. Achieving proper occlusion during orthognathic surgery presented challenges, necessitating the use of a splint to determine occlusion when the maxilla was moved forward.

Prior to the surgery, tooth alignment and leveling were performed, and the utilization of a splint provided a solution to address this issue. The primary objective of orthognathic surgery is to correct maxillary retrusion, malocclusion, temporomandibular disorders, and sleep apnea. Cephalometric tracing and wafer production were conducted as part of the pre-surgical planning. The wafer splint serves as a device to transfer the planned occlusion from pre-surgical stages to the post-surgical phase. Cephalometric planning guides the manipulation of dental

models in the surgical wafer, allowing for the precise transmission of Jaw movements. These acrylic interocclusal splints assist in physically aligning the upper and lower teeth when the osteotomy segments are surgically repositioned and stabilized. Two types of interocclusal wafers are utilized: a final wafer to achieve the desired postoperative occlusion and an intermediate wafer to guide maxillary osteotomy motions using the mandibular position as a reference baseline. The latter is commonly used for mandibular-only and bimaxillary osteotomies. The Le Fort I osteotomy is a frequently employed technique to address maxillomandibular abnormalities and malocclusions, with class III malocclusion being a common indication for this procedure. Horizontal advancement achieved through Le Fort I osteotomy provides correction for the majority of patients with malocclusion. During the orthognathic surgery, the maxilla was advanced by 10 mm as planned, followed by the placement of wafer splint and intermaxillary fixation. L-shaped plates were installed in the anterior and posterior maxilla to ensure stability.

In Le Fort I procedures, manipulating the maxilla can lead to deviation of the nasal septum. Postoperative complications may include intraoperative bleeding, edema lasting for a week or two, postoperative pain, nasal obstruction, and bilateral infraorbital nerve paresthesia. According to a study by Freihofer in 1977, it was recommended to delay maxillary advancement until permanent dentition to avoid the occurrence of "pseudorelapse" caused by mandibular growth in adolescent patients[27]. This finding was later supported by Ross. However, in our current series, we performed Le Fort I advancement in adult patient who was in the permanent dentition stage. In a study conducted by Araujo et al.[28], they performed maxillary advancement and utilized Stienmann pins to stabilize the fragments. Additionally, they performed bone grafting in 5 out of 8 patients[29]. They observed a significant decrease in relapse, particularly when the grafting was performed between the maxillary tuberosity and pterygoid plates, as also suggested by Obwegeser[30].

In contrast, in our study, we employed miniplates for bone fixation using autograft from chin. These variations in surgical techniques highlight the different approaches and strategies employed in maxillary advancement procedures. In line with previous studies, Willmar[31] reported that all statistically significant relapses occurred within the first year after the surgery. This finding was later confirmed by Posnick and Ewing[32]. It is widely agreed upon by most authors that vertical relapse is more common than horizontal relapse and tends to occur predominantly during the period of intermaxillary fixation (IMF). Willmar proposed several factors that contribute to the higher tendency for vertical relapse. These factors include the forces exerted by the muscles of mastication, the influence of the position of the lower jaw, the effects of IMF, and the pull exerted by suspension wires if they were used in the procedure. Houston and James, as well as Posnick and Ewing, observed that the magnitude of surgical advancement in either the horizontal or vertical dimension did not correlate with the occurrence of relapse[33,34,35].

These findings highlight the complex nature of relapse in orthognathic surgery, with multiple factors influencing its occurrence. It emphasizes the need for careful patient selection and individualized treatment planning to achieve optimal outcomes and minimize the risk of relapse. In 2001, Heliovaara et al.[34] conducted a study on patients with cleft lip and palate (CLCP) who underwent Le Fort I advancement with miniplate fixation. They reported a mean horizontal relapse of 20.5% and a mean vertical relapse of 22.2% within the first year post-surgery. However, a subsequent study by the same authors, one year later, showed a decrease in relapse rates in both dimensions when autogenous bone grafts were used in the pterygoid region. The mean relapse was 8.5% (0.4 mm) horizontally and 16.7% (0.6 mm) vertically in that study. The use of autogenous bone grafts in the pterygoid region has been suggested by several authors as an alternative to overcorrection but carries the risk of bone resorption and donor site morbidity[35,36].

In our study, we aimed to address these limitations by utilizing functionally stable fixation with 2 mm thickness titanium miniplates and incorporating overcorrection of 60-80% to achieve satisfactory results and stable occlusion intraoperatively.

Additionally, we acknowledge the significant role of postoperative orthodontics in optimizing outcomes. Cephalometric and geometric morphometric studies have provided insights into the etiology of skeletal Class III malocclusions. It has been observed that approximately 63-73% of these malocclusions are a result of developmental shortening and reduction in anteroposterior dimensions of the palatomaxillary complex, accompanied by anterior vertical shortening of midfacial height. This is often associated with anteroposterior elongation of the mandible, resulting in a retrognathic midface and prognathic mandibular profile, which are characteristic features of these malocclusions.

This case report presents the treatment of an adult male patient with a severe skeletal and dental Class III relationship. A modified Surgical-Orthodontic approach was utilized, pushing the limits of the discrepancy. The treatment involved jaw surgery. In the surgery, the retrusive maxilla was advanced by 10 mm. This sequential approach allowed for the achievement of aesthetically pleasing results, optimal skeletal and dental relationships, and a stable, functional Class 1 occlusion. Prior to the surgical interventions, pre-surgical orthodontic treatment was conducted to eliminate any dental compensations and accurately assess the location and extent of the skeletal discrepancies in both Jaws. By addressing the dental compensations, a clear understanding of the underlying

skeletal issues was obtained. This approach allowed for the step-by-step achievement of a normal skeletal base relationship.

Following the surgeries, postsurgical orthodontic treatment was initiated to refine the occlusion. This involved correcting any emerging dental discrepancies and settling the occlusion into its final stable position. Overall, this modified Surgical-Orthodontic treatment approach, with sequential maxillary advancement, along with pre- and postsurgical orthodontics and prosthodontic rehabilitation, successfully addressed the extreme Skeletal and Dental Class III relationship. The treatment resulted in satisfying aesthetic outcomes, ideal skeletal and dental relations, and a stable, functional Class 1 occlusion. This progressive adaptation helps to establish a stable long-term result with reduced likelihood of relapse.

In addition, the prolonged surgical procedure can contribute to operator fatigue, which can impact the overall quality of the surgery. Postoperative complications such as nausea and vomiting have also been associated with longer orthognathic surgical procedures It should be noted that the prevention of obstructive sleep apnea and maintenance of a normal pharyngeal airway space are important considerations in orthognathic surgery, particularly in cases involving large mandibular setbacks. Each patient's airway anatomy and functional status should be carefully assessed during treatment planning, and appropriate surgical techniques and modifications should be employed to minimize the risk of postoperative complications related to the airway.

III. Conclusion

An effective and stable correction of an extreme Class III skeletal deformity and malocclusion was successfully achieved in this patient, leading to a significant improvement in facial balance, symmetry, and proportion. The patient underwent a modified ortho-surgical management protocol, which involved a staged approach known as "single jaw surgery" Orthognathic surgery. This protocol, combined with conventional pre- and post-surgical orthodontics, allowed for the correction of a considerable skeletal discrepancy through substantial jaw movements. The results obtained were not only functionally and aesthetically ideal but also demonstrated the efficacy and superiority of this approach over the previously used single stage Bi-Jaw procedures for managing severe skeletal discrepancies.

Research involving human participants and /or animals

All procedures performed on the patients (human participants) involved were in accordance with the ethical standards of the institution and/or national research committee, as well as with the 1964 Helsinki declaration and its later amendments and comparable ethical standards.

Declaration of Competing Interest

The authors of this article have not received any research grant, remuneration, or speaker honorarium from any company or committee whatsoever, and neither owns any stock in any company. The authors declare that they do not have any conflict of interest.

Ethical approval

This article does not contain any new studies with human participants or animals performed by the author.

Informed Consent

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