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Management of class III malocclusion: Orthosurgical synergism



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Keywords:
Orthognathic surgery
Le Fort osteotomy
Bilateral sagittal split osteotomy

ABSTRACT

The main objectives of surgical-orthodontic treatment are to normalize the dentoskeletal parameters, facial profile, occlusion, and function. The choice among the various surgical procedures is based on clinical examination and cephalometric evaluation. This article highlights the successful management of patient with skeletal class III malocclusion by combined orthodontic-surgical treatment.

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1. Introduction

The most difficult and interactive malocclusion that can be managed with orthodontics alone is skeletal class III malocclusion. In as early as 1907, Angle recommended combined orthodontic and surgical treatment for mandibular prognathism. Skeletal class III malocclusion can present true mandibular prognathism (20–25%), maxillary deficiency (20–25%) or a combination of both (50–60%).[1] The prevalence of class III malocclusion in Indian population is 1–3%.[2] In pre-adolescent with growth potential presenting with maxillary deficiency and mandibular excess, face mask therapy is a good option. In adolescent and adults presenting with the same, orthodontic-surgical approach by surgically advancing the maxilla and mandibular setback is the ideal solution. In borderline cases single jaw surgery or surgical camouflage can be resorted.[3]

A recent study concluded that surgical patients could be distinguished from nonsurgical ones on the basis of Wits measurement, maxillary/mandibular length ratio, gonial angle, and sella-nasion distance.[4] The main objectives of surgical-orthodontic treatment are to normalize the dentoskeletal parameters, facial profile, occlusion, and function. The choice among the various surgical procedures is based on clinical examination and cephalometric evaluation.

This communication highlights the successful management of 20-year-old male with skeletal class III malocclusion by combined orthodontic-surgical treatment.

2. Case report

A 20-year-old male reported to the Division of Orthodontics with a chief complaint of “forwardly placed lower jaw”. On clinical examination it was found that patient was mesocephalic and mesoprosopic. He had concave facial profile with competent lips, good chin-throat angle, non-consonant smile and an acute nasolabial angle (Fig. 1). Intra orally molar and canine relationship was Class III bilaterally. Anterior teeth showed reverse overbite and reverse overjet. Cephalometric analysis revealed a skeletal Class III relationship with hyper divergent facial pattern. Upper incisors were found to be proclined whereas lower incisors were retroclined (Fig. 2).

Based on this problem list, treatment objectives were formulated which comprised of levelling and alignment,

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http://dx.doi.org/10.1016/j.jpfa.2014.02.009
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Fig. 1 – Pre-treatment extra oral and intra oral characteristics of the patient.

correction of molar and canine relation, correction of skeletal asymmetry and improvement of profile & smile.

The treatment plan included therapeutic extraction of 14 & 24 and fixed mechanotherapy (0.022″ MBT PEA). A combined orthodontic-surgical treatment was formulated comprising of:

(a) Pre-surgical orthodontics.
(b) Surgical phase in which maxillary advancement of 8 mm and mandibular setback of 6 mm was planned.
(c) Finishing and detailing.

Rationale for PM extraction was to decompensate the natures compensation and to correct the inclination of upper incisors- as depicted by a) **1 to NA – 44 °(17 mm)** [N being 24 (4)], b) **max incisor protrusion 12 mm** [N being 4–6 mm]. Had no extractions been carried out and only mandibular setback done then we could have compromised the airway. PM extraction allowed us to correct the teeth on their jaw bases and allowed bijaw surgery thereby addressing both the skeletal correction and also the surgical procedure didn't compromise the airway.

The decision of bijaw surgery was taken keeping in view of the fact that the skeletal class III was due to a combination of small maxilla and large mandible. A mandibular setback alone would result in decreased tongue space, compromised airway, sub-optimal esthetics and higher risk of relapse. In the hierarchy of stability of orthognathic surgery, a combination of mandibular set back and maxillary advancement is relatively more stable than mandibular set back alone.

0.022″ MBT PEA was bonded after the therapeutic extraction of 14 & 24 and levelling and alignment was carried out. Extraction space closure was done using loop mechanics (tear drop loops). On completion of pre-surgical orthodontics stabilizing arch wires of dimension 0.019 × 0.025 were placed (Fig 3).

Prediction tracing simulating 8 mm maxillary advancement and 6 mm mandibular setback with commensurate soft tissue changes were traced (see Fig. 4). This was used as a communication tool to explain to the patient, relatives and interaction with surgeon (Fig. 3).

Impressions were recorded following accomplishing of presurgical orthodontic goals. Facebow transfer to orient the maxilla to cranial base was done and transferred to semi



Fig. 2 – Pre-treatment OPG and lateral cephalogram



Fig. 3 – Pre-surgical extra oral and intra oral characteristics of the patient



Fig. 4 – Pre-surgical OPG and lateral cephalogram

adjustable articulator (Fig. 5). Model surgery was carried out on these mounted casts. Reference lines were drawn on mounted casts and maxillary cast was advanced by 8 mm and mandibular cast was set back by 6 mm. In view of the bi-jaw surgery planned for the patient, two surgical splints were fabricated. Once maxillary cast was advanced by 8 mm then a 2 mm thick surgical splint was fabricated with cold cure acrylic on the mandibular cast as mandible was the stable

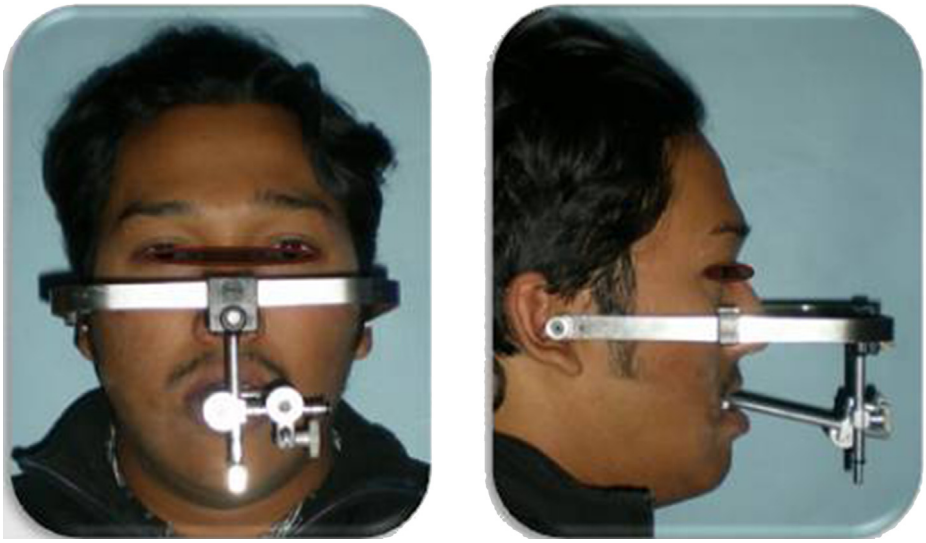


Fig. 5 – Facebow transfer.

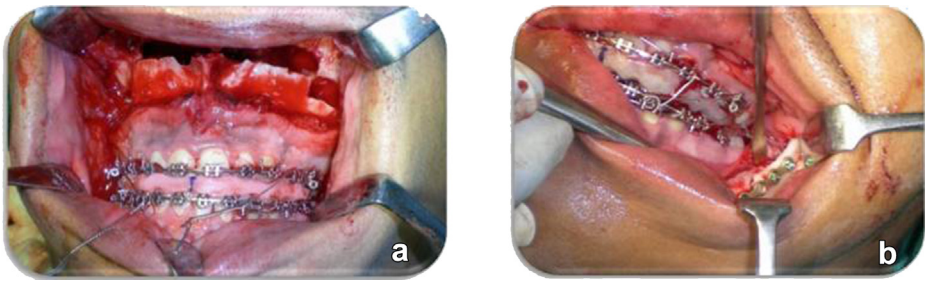


Fig. 6 – Le Fort I osteotomy, BSSO, placement of surgical splint and ORIF

guide to the occlusion. This was called the intermediate splint. Now with the maxillae as a stable reference point 'mandibular cast was setback by 6 mm and the final splint was fabricated.

A Le Fort 1 osteotomy of maxilla was carried out and maxilla was mobilized and advanced as per guidance vide intermediate splint (Fig. 6a). The maxilla was fixed by 2 × 4 whole titanium mini bone plates with screws bilaterally. Thus maxilla was stabilized in the desired position. BSSO was done in which mandible was setback (Fig. 6b) (see Figs. 7 and 8).

Post surgical orthodontics was initiated 6 weeks following surgery. Settling, finishing and detailing of occlusion were achieved in 4 months. Fixed spiral bonded lingual retainer were placed follo7 & 8. Comparisons of pre and post-treatment cephalometric values are presented vide Fig 9 and Table 1.

3. Discussion

A Class III malocclusion may result from retrognathic maxilla or prognathic mandible or a combination of both (see Table 2). The incisal overjet, L1-MP angle (antero-posterior dental relationships), Wits appraisal, Mx/Mn ratio (antero-posterior jaw relationships), gonial angle (vertical jaw dimension), and incisal overbite (vertical dental relationship) are the diagnostic parameters for making diagnosis and for determining treatment modalities for class III malocclusion patients.[5]

Numerous treatment modalities are available for correction of class III malocclusion ranging from growth modification, orthodontic camouflage and combined orthodontic-surgical treatment. Modality most appropriate for the patient depends upon age of the patient and severity of malocclusion.

Surgical treatment of class III malocclusion is carried out in multiple phases which includes presurgical orthodontics (Phase I), Orthognathic surgery (Phase II) and Post-surgical orthodontics (Phase III) followed by retention phase.

3.1. *Pre-surgical orthodontics*

A main aim of the presurgical orthodontic phase is levelling and alignment of dentition to allow maximum surgical correction.[6] Incomplete presurgical decompensation of the mandibular incisors has several possible causes including inadequate labial bone to allow sufficient advancement, previous mandibular arch extractions and lower lip muscle resistance to incisor advancement. Other factor associated with incomplete mandibular incisor decompensation includes the severity of the pretreatment retroclination of the mandibular incisors and the severity of reverse overjet. Despite the observed problems with achieving adequate decompensation, the results nevertheless show that surgical treatment almost always fully corrected the overjet. Furthermore, when surgery does not fully correct the overjet, the postsurgical orthodontic phase is a further opportunity to fully correct it.

During sagittal correction it is important to give due consideration to transverse relationship. It should be noted

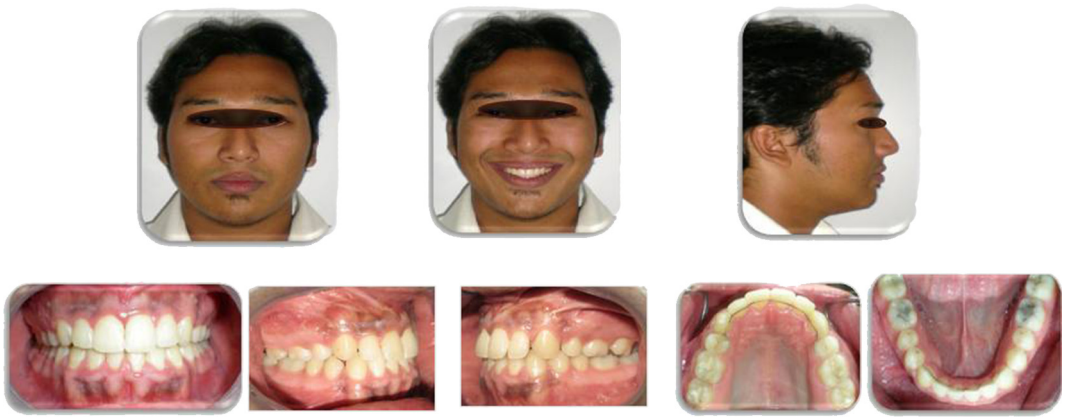


Fig. 7 – Post-treatment extra oral and intra oral changes.



Fig. 8 – Post-treatment OPG and lateral cephalogram.

that if mandible is set back it occludes against wider maxilla and if maxilla is advanced. It occludes against wider portion of the mandible. So there is a need to increase the transverse dimension which is achieved by either slow dento-alveolar, orthopaedic or surgical expansion. The method to be used depends upon skeletal maturity of a patient, magnitude of transverse discrepancy, presence of fenestration or dehiscence etc. It has been seen that orthopaedic expansion is most effective in mixed dentition cases where as in adults surgical method is the preferred option.

3.2. *Surgical phase*

Le Fort I osteotomy and BSSO are most frequent operations performed in combination. Before doing surgery prediction tracings and model surgery are carried out. During surgery usually Le Fort I is performed first. This results in auto rotation of mandible. Even reverse of this technique can also be performed if difficulty in stabilizing the maxilla is anticipated.

3.3. *Significance of bimaxillary surgery over single jaw surgery*

Bi maxillary surgeries are preferred over single jaw surgery because:

- Bimaxillary surgeries produce more stable results than single-jaw mandibular procedures in class III correction.[7]
- It has found by studies that the odds of bimaxillary surgery achieving an ideal post-treatment ANB angle is 3.4 times greater than for single-jaw surgery.

3.4. *Effect of mandibular set back on airway, hyoid and tongue position*

Mandibular setback surgery not only improves the occlusion, function, and esthetics by changing the position of the mandible, but it can also cause narrowing of the pharyngeal airway space (PAS) and changes in the position of the hyoid bone and the tongue.[8,9]

The hyoid bone moves downward for physiologic adaptation to the soft tissues after setback surgery.[8] The hyoid bone progressively returns to its original position, whereas the postsurgical decrease in hypopharyngeal airway space is maintained during the follow-up period.[10]

3.5. *Soft tissue changes*

After orthognathic surgery soft tissues gets altered in 3 dimensions. Generally, facial esthetics are improved after surgery, but these changes are judged mainly by the changes in the soft tissues.[11]

Studies have indicated more soft-tissue movement in the central parts than in the lateral parts with maxillary advancement and mandibular setback,[12,13] because of the semicircular shapes of the maxilla and the mandible, advancement in the soft tissues decreases gradually toward the posterior part. This corresponds to the fewer changes in

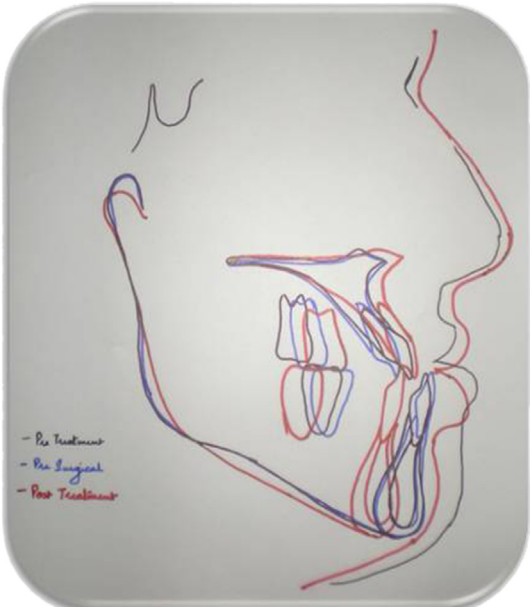


Fig. 9 – Pre- and post-treatment lateral cephalogram superimposition.

Table 1 – Comparison of pre and post-treatment cephalometric values.

	Pre-treatment	Post-treatment
SNA	76°	83°
SNB	88°	84°
ANB	−12°	−1°
U1 NA	44° (17 mm)	30° (8 mm)
U1 NB	16° (5 mm)	15° (4 mm)
GoGn – SN	29°	28°
Occl-SN	10°	9°
FMA	28°	29°
IMPA	78°	80°
A to N perpendicular	−13 mm	−7 mm
Co-A	84 mm	89 mm
Co-Gn	142 mm	133 mm
LAFH	85 mm	85 mm

Table 2 – Comparison of pre and post-treatment soft tissue cephalometric values.

	Pre-treatment	Post-treatment
Soft tissue facial angle	88°	88°
Nose prominence	21 mm	14 mm
Superior sulcus depth	4 mm	5 mm
Soft tissue subnasal to H line	4 mm	7 mm
Skeletal profile convexity	−13 mm	−3 mm
Basic upper lip thickness	23 mm	17 mm
Upper lip strain	19°	16°
H angle	6°	13°
Lower lip to H line	5 mm	2 mm
Inferior sulcus to H line	0 mm	4 mm
Soft tissue chin thickness	11 mm	11 mm
Nasolabial angle	98°	101°
E Line		
Upper Lip	−9 mm	−4 mm
Lower Lip	0 mm	0 mm

the subcommissural region, a lateral part, than in the labiomental or chin region, a central part.

3.6. *Stability*

With forward movement of moderate distances (8 mm), there is an 80% chance of less than 2 mm change, a 20% chance of 2–4 mm relapse, and almost no chance of more than 4 mm change. If the maxilla is moved both forward and down, the vertical component is likely to relapse, although the horizontal component has a good chance of being retained.

When compared with advancement mandibular setback surgery are more stable because it is easier to place the condyles in their fossa in mandibular setback than in advancement patients, where the posterior tension of the musculature and soft tissue plays an important role.[14]

3.7. *Post-surgical orthodontics*

It is usually started 6 weeks post surgery. During this phase settling, finishing and detailing of occlusion is achieved.

4. Summary & conclusion

Numerous contemporary orthodontic treatment options are available for patients with class III malocclusions. The treatment most suitable for the patient depends on the patient's growth status, the severity of the malocclusion, and facial esthetics. For growing patients with minor to moderate skeletal malocclusions, growth modification appears to be a reasonable solution. For non-growing patients with acceptable esthetics camouflage treatment is acceptable. When facial esthetics is a concern or there are severe skeletal discrepancies, orthognathic surgery combined with orthodontic treatment is the best option. With collaborative interdisciplinary approach, it is possible to treat patient's problems in all planes of space. It is the correct diagnosis and understanding of treatment variables which contribute to success.

Conflicts of interest

All authors have none to declare.

REFERENCES

1. Proffit WR, Phillips C, Dann C. Who seeks surgical orthodontic treatment? *Int J Adult Orthodon Orthognath Surg.* 1990;5:153–160.
2. Kharbanda OP, Sidhu SS, Sundaram KR, Shukla DK. Prevalence of malocclusion and its traits in Delhi children. *J Indian Orthod Soc.* 1995;26:98–103.
3. Proffit RW, Fields HW. *Contemporary Orthodontics.* St Louis: Mosby; 2000.
4. Stellzig-Eisenhauer A, Lux CJ, Schuster G. Treatment decision in adult patients with class III malocclusion: orthodontic therapy or orthognathic surgery. *Am J Orthod Dentofacial Orthop.* 2002;122:27–37.
5. Tseng, et al. Treatment of adult Class III malocclusions with orthodontic therapy or orthognathic surgery: Receiver operating characteristic analysis. *Am J Orthod Dentofacial Orthop.* 2011;139:485–493.
6. Tompach PC, Wheeler JJ, Fridrich KL. Orthodontic considerations in orthognathic surgery. *Int J Adult Orthodon Orthognath Surg.* 1995;10:97–107.
7. Busby BR, Bailey LJ, Proffit WR, Phillips C, White Jr RP. Long-term stability of surgical class III treatment: a study of 5-year postsurgical results. *Int J Adult Orthodon Orthognath Surg.* 2002;17:159–170.
8. Kawakami M, Yamamoto K, Fujimoto M, Ohgi K, Inoue M, Kirita T. Changes in tongue and hyoid positions and posterior airway space following mandibular setback surgery. *J Craniomaxillofac Surg.* 2005;33:107–110.
9. Tselnik M, Pogrel MA. Assessment of the pharyngeal airway space after mandibular setback surgery. *J Oral Maxillofac Surg.* 2000;58:282–285.
10. Lew KK. Changes in tongue and hyoid bone positions following anterior mandibular subapical osteotomy in patients with class III malocclusion. *Int J Adult Orthodon Orthognath Surg.* 1993;8:123–128.
11. Hajeer MY, Ayoub AF, Millett DT. Three-dimensional assessment of facial soft-tissue asymmetry before and after orthognathic surgery. *Br J Oral Maxillofac Surg.* 2004;42:396–404.

12. Kim NK, Lee C, Kang SH, Park JW, Kim MJ, Chang YI. A three dimensional analysis of soft and hard tissue changes after a mandibular setback surgery. *Comput Methods Programs Biomed.* 2006;83:178–187.
13. Soncul M, Bamber MA. Evaluation of facial soft tissue changes with optical surface scan after surgical correction of class III deformities. *J Oral Maxillofac Surg.* 2004;62: 1331–1340.
14. Joss CU, Thüer UW. Stability of hard and soft tissue profile after mandibular advancement in sagittal split osteotomies: a longitudinal and long-term follow-up study. *Eur J Orthod.* 2008;30:16–23.

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