Treatment Modalities for Skeletal Class III Malocclusion: Early to Late Treatment

Snigdha Pattanaik1, Noorjahan Mohammad2, Sasmita Parida3, Subhrajeet Narayan Sahoo4
1Assistant Professor, Department of Orthodontics, Institute of Dental Sciences, SOA University, Bhubaneswar, Orissa, India, 2Assistant Professor, Department of Pedodontics, Mamata Dental College, Andhra Pradesh, India, 3Associate Professor, Department of Radiodiagnosis, SCB Medical College, Cuttack, Odisha, India, 4Post-graduate Student, Department of Orthodontics, Institute of Dental Sciences, SOA University, Bhubaneswar, Orissa, India

Skeletal Class III malocclusion has always been characterized by an unpredictable growth pattern with doubtful prognosis though treated at a very young age. Treatment protocols may include growth modification, orthodontic camouflage, or orthognathic surgery, depending on the degree of the skeletal discrepancy and the age of the patient. The orthopedic approach for growth modification is limited to the children in a growth phase. In a patient with underdeveloped maxilla, the face mask may be the treatment of choice, whereas in a Class III patient with over developed mandible a chin cap is needed. Camouflage orthodontic treatment is performed in patients with a mild skeletal Class III discrepancy and no remaining growth. However, adult patients with severe skeletal Class III discrepancy might need orthognathic surgery to correct the malocclusion.

Keywords: Angle Class III, Malocclusion, Orthodontics, Orthognathic surgery, Treatment protocol

INTRODUCTION

The Class III malocclusion has a strong genetic background which may express itself at an early age. The problem becomes more apparent during the pubertal growth spurt. In general, a parent or grandparent on the one side of the family shows the same malocclusion. Optimum treatment timing for orthodontic problems continues to be one of the most controversial topics in orthodontics.

Clinicians who might advise not treating the Class II patient until the late mixed or early permanent dentition often advice correcting the Class III malocclusion as soon as it is identified.1

This article includes a review on etiology, diagnosis, and various treatment modalities in an individual with Class III malocclusion.

ETIOLOGY

The skeletal Class III malocclusion may have variable etiology. The main etiology of skeletal Class III malocclusion is genetic inheritance. The classic example is the Habsburg jaw, which is the prognathic mandible of Austrian royal family.2 The cleft lip and palate also results in maxillary deficiency giving rise to a Class III malocclusion. Various environmental factors such as mouth-breathing, mandibular posture, the size of the tongue, and the pharyngeal dimensions could also affect the jaw size as described by Rakosi and Schilli. Constant distraction of the mandibular condyle from the fossa may be a growth stimulus for excessive growth of mandible.3

INCIDENCE OF CLASS III MALOCCLUSION

About 5% of American population shows signs of Class III malocclusion whereas in Asia the malocclusion is seen in 4% to 13% of the population which is mainly due to the midface deficiency of malocclusion. The incidence of Class III malocclusion is slightly higher among the Japanese and Chinese population, but African-Americans population shows a lesser incidence.4-6

DEVELOPING CLASS III MALOCCLUSION

An excessive development of mandible may be noticed in infancy. In the 1st months of life, a sequential development of the Class III condition may be observed as:7-9
1. Eruption of the maxillary central incisors in a lingual relationship
2. Development of an anterior crossbite during the eruption of the lateral incisors

Corresponding Author:
Dr. Snigdha Pattanaik, Department of Orthodontics, Plot No - 939/40, Mahanadi Vihar, Cuttack, Odisha, 753004, India. E-mail: dr.snigdhapattanaik@gmail.com

Access this article online

DOI: 10.17354/cr/2016/182
3. Flattening of the tongue with a forward posture against the lower incisors
4. Forward positioning of the mandible by the child due to various habits.

**PSEUDO-CLASS III MALOCCLUSION**

Moyers proposed the pseudo-Class III relationship as a positional malocclusion with an acquired neuromuscular reflex. Pseudo-Class III malocclusion is characterized by the presence of an anterior cross bite due to a forward functional displacement of the mandible.

In pseudo-Class III malocclusion because of premature occlusal contacts to close the mouth in the most convenient position and to establish occlusion, protrusion of mandible occurs. Maxillary incisors show some degree of retroclination, and the mandibular incisors are proclined in pseudo-Class III malocclusion. According to Turley and Lin, pseudo-Class III malocclusion etiology is some degree of hereditary tendency.

**Early Treatment of Class III Malocclusion**

The early treatment of Class III malocclusion is always into two schools of thought. Some authors believed that skeletal alteration was impossible and that the dominance of genetic inheritance cannot be altered. They also suggested that any treatment on the deciduous dentition would be temporary and will not have any effect on the permanent dentition.

However, researchers have found out many favorable outcomes for early treatment. The treatment of Class III malocclusion should be started as soon as we see the anterior cross bite. Tweed suggested treatment timings can be as early as 4 years of age.

According to Rickets, the main objectives of early treatment lying in five concepts:  
1. Obtaining a skeletal correction
2. Providing the opportunity for a functional change in the environment
3. Utilization of the individual growth toward the correction
4. Elimination of the detrimental habits such as breathing.
5. Using the forces of developing occlusion for treatment of malocclusion.

Turpin also developed a list of positive and negative factors to aid in deciding when to interrupt a developing Class III malocclusion.

**Positive Factors**
1. Good facial esthetics
2. Mild skeletal disharmony
3. No familial prognathism
4. Antero-posterior functional shift
5. Convergent facial type
6. Symmetric condylar growth
7. Growing patients with expected good cooperation.

If the above factors are not present in the patient, they are listed as negative, and treatment can be delayed until growth is completed.

**TREATMENT ALTERNATIVES FOR SKELETAL CLASS III MALOCCLUSION (FIGURE 1)**

a. Early treatment
   i. Type A (retrognathic maxilla)
      1. Face mask
      2. Frankel - 3
   ii. Type B (prognathic mandible)
      1. Chin cup
   iii. Type C (combination of both)
      1. Class III activator
      2. Class III bionator

b. Orthodontic camouflage
   i. Selective tooth extraction
   ii. Distalization of mandibular dentition using mini-implants

c. Surgical treatment
   i. Maxillary advancement
   ii. Mandibular setback
   iii. Genioplasty

---

**Figure 1:** Treatment alternatives for skeletal Class III malocclusion
TREATMENT FOR TYPE A CLASS III MALOCCLUSION

The etiology of Type A Class III malocclusion may be contributed to an underdeveloped/retrognathic maxilla that gives rise to a concave facial appearance. The development of mandible is apparently normal. In these patients, treatment should be started as early as possible. The treatment options vary from using a facemask to give extraoral traction to pull the maxilla out to using a Frankel’s appliance to guide the maxilla to a more favorable position.

FACE MASK

The face mask can be used as the first line of treatment in case of Class III malocclusion due to the retrognathic maxilla. Facemask provides a downward and forward growth of the maxilla at an early age. Around 300 g of extraoral force is given per side. The traction of the facemask can cause significant changes in the circum-maxillary sutures and in the maxillary tuberosity.

Using head gear maxilla can be forward by 2-4 mm within 12-15 months. The facemask can be used most efficiently in the early mixed dentition stage before the eruption of the permanent incisors.

DESIGN

The most commonly used is a petit type of face mask that is made of two acrylic pads lined with soft closed-cell foam that in contact with forehead and chin regions. These pads are interconnected by a round, contoured length of 0.25ʺ stainless steel rod with acorn nuts on each end, the positions of the pads are adjustable through the loosening and tightening of a set screw and the midline frame can be modified according to the patient face outline. To the center of this midline, frame cross bar is attached by screws to adjust it vertically for patient safety.

The second component of this appliance system is the maxillary splint, which should be attached to posterior dentition. Maxillary splints can be divided into two types: A bonded maxillary splint and a Banded maxillary splint.

Banded palatal expansion appliance is most commonly used in the mixed dentition. Molar bands are contoured on the maxillary primary second, and permanent first molars are joined by soldering to the palatal plate and hyrax screw in the midline, and it is activated by twice daily (0.025 mm per turn) for 1 week in case of narrow maxilla activation is for 2 weeks depends on correction of malocclusion.

Bonded maxillary splint consist of a hyrax screw into a wire framework that extends around the buccal and lingual surfaces of the dentition and acrylic covering the primary second molars and permanent first molars with another wire are bent to cross the occlusion in between molars and ends with a hook for protraction with elastics.

The splint is activated once per day until the desired result is achieved. The patient in whom no change is required in the transverse direction, the appliance is only activated for 8-10 days to loosen the circum-maxillary sutures and to promote maxillary protraction.

BIOMECHANICS

Maxillary protraction below the center of resistance produces anticlockwise rotation of the maxilla. Protraction elastics attached near the maxillary canine with a downward and forward pull of 30° to the occlusal plane minimize bite opening. In the late 1970’s, Delaire and coworkers used reverse headgear for forward positioning of the skeletal maxilla only in young patients (below age 10). The forward movement of the maxilla is essentially zero by the time of maturity.

The disadvantage while using reverse headgear even in young patients is forward movement of maxillary teeth relative to maxilla; downward and backward rotation of the mandible. Normally positioned or retroclined maxillary teeth with normal or short anterior vertical facial dimensions is ideal case for this appliance.

THE FUNCTIONAL REGULATOR (FR-3) OF FRANKEL

A method of functional jaw orthopedics that has gained increased popularity in the United States was predicated on the system of FR appliances developed by Professor Rolf Frankel of the German Democratic Republic.

This Frankel’s appliance should be used in patients with Class III malocclusion characterized by retrognathic maxilla. The appliance can be most efficiently used during the deciduous, mixed, and early permanent dentition stages. According to Frankel’s philosophy, the perioral musculature has a potential restraining influence on the outward development of the dental arches. To screen these undesired muscular forces on the dental arch, Frankel has used the vestibular shields and upper labial pads in the Frankel III appliance. These acrylic pads counteract the forces of the surrounding muscles that restrict forward maxillary skeletal development and helps in a favorable maxillary growth. However, the vestibular shields fit
closely in the mandible, thus restricting mandibular alveolar development.\textsuperscript{20,21}

Frankel reported a study of 74 severe Class III cases treated with the Frankel-3 appliance. The results showed that greater forward movement of maxillary landmarks is obtained in the patients treated with Frankel 3 appliance.\textsuperscript{22}

**TREATMENT FOR TYPE B CLASS III MALOCCLUSION**

Type B Class III malocclusion characterized by the overdevelopment of the mandible and concave profile. The treatment includes redirect the growth of the mandible.

**CHIN CUP**

In patients with an overdeveloped mandible, chin caps have been used to inhibit mandibular growth. However, there are limitations in its use since the mandibular condyle is a growth site rather than a growth center. Chin cup produces an inhibitory effect on the mandibular condyle thus redirecting mandibular growth. According to reports by Sugawara \textit{et al.},\textsuperscript{23} chin cap therapy on children with overdeveloped mandibles was effective during the period of treatment but lacked long-term stability due to relapse from catch-up growth.

Various studies have shown that chin cup treatment significantly changes in the craniofacial complex as a result of:

1. A decrease in the mandibular plane angle
2. A low gonial angle
3. A reduced SNB angle
4. A redirection in the downward vertical growth of the midface.\textsuperscript{24}

**TREATMENT OF TYPE C**

Type C malocclusion is a combination of a retrognathic maxilla or a prognathic mandible or both. This malocclusion requires a combination therapy to produce anterior movement of the maxilla with posterior mandibular movement.

**CLASS III ACTIVATOR**

For the correction of skeletal Class II malocclusion, Andresen introduced activator. Rakosi modified original activator by adding wire and acrylic components to treat Class III malocclusion. The activator includes four stop-loops located mesial to all first molars to prevent mesial tipping of the molars and to stabilize the appliance. The lower labial pads are used to remove the force of the upper lip, create a periosteal pull to induce bone formation and to protract the maxilla. The construction bite is taken by retruding the lower jaw helps in posterior positioning of the mandible with maxillary protraction.\textsuperscript{25}

**CLASS III BIONATOR**

Balters Bionator III can be used in Angle Class III molar relationship with edge-to-edge incisor position or anterior cross bite and a concave profile. This appliance encourages the growth of the maxilla; the mandible is positioned in the most retruded position while taking the construction bite and skeletal changes occurs through neuromuscular modifications.\textsuperscript{24} The low and forward tongue position can also be corrected.

Studies have shown that with the help of the Class III bionator there is an increase in the upper jaw length with the advancement of point A. Palatal and mandibular plane angles are also widened. There is an increase in the anterior facial height. Bionator III redirects the antero-posterior mandibular growth, and it is useful in Class III malocclusion correction in growing patients with midfacial deficiency, hypodivergent growth pattern, and reduced facial height.

**ORTHODONTIC CAMOUFLAGE TREATMENT**

Orthodontic camouflage treatment can be performed in Class III malocclusion patients with the mild skeletal discrepancy in patients with no growth potential. Selective tooth extraction (premolars, lower incisors, or lower second molars) is done to correct only the dental malocclusion. Orthodontic mini-implants can also be used to distalize the entire mandibular dentition.

However, in patients with severe skeletal discrepancies and an overdeveloped mandible, orthognathic surgery should be considered to improve function and esthetics. Recently, some limitations of orthodontic camouflage treatment have been overcome using mini-implants for skeletal anchorage.\textsuperscript{26}

**SURGICAL TREATMENT**

Surgical correction of Class III cases must always be postponed until growth is completed and thus, in general terms, not before 18 years of age for women and 19 or 20 for men. Surgical correction that is done too early can easily lead to a relapse due to residual mandibular growth.

From the sagittal standpoint, the parameters that indicate advancement of the maxilla with Le Fort I osteotomy are: Flattening of the paranasal areas, accentuated naso-genial fold, moderate flattening of the cheek-bones, obtuse
nasolabial angle, maxillary prolabium little in evidence, prominent nose with some degree of the hump and tip-tilted downward.

Where a larger increase at the middle third is necessary, Bell’s high osteotomy may be taken into consideration because this provides greater filling at the cheek-bones. In cases of severe hypoplasia of the middle third of the face, with flattening of the inferior orbital rim and scleral exposure, a maxillo-malar osteotomy may be employed. In this type of osteotomy, only vertical or transverse movement possible and it can be done to correct anomaly of antero-posterior, normal or decreased vertical dimension, maxillary dental midline coinciding with the median axis of symmetry or at most deviated by 2 mm. In other cases, where this type of osteotomy cannot be adopted, the best alternative is the classic Le Fort I osteotomy associated with implantation of alloplastic material or lipo filling in the sub-oralbital area.

In few selected cases, a true anterior position of the mandible and chin requires a mandibular set back alone. In this case, it is necessary that cheek, nose, and superior lip have a good balance. However, correction of Class III cases with mandibular osteotomy alone should be limited to clinical situations with negative over-jet not above 3-4 mm. Marked mandibular setback may cause excess soft tissue beneath the chin leads to unesthetic appearance, and there is decreased posterior airway space, with development of an OSAS in the future.

Patients with increase amount of initial over-jet, double jaw osteotomy preferred because in these cases there is greater skeletal and muscular stability, a less stretching of the pterygomasseteric sling, and excessive bi-protrusion. The fundamental parameters which are considered for vertical dimensions are the ratio between middle and lower thirds of the face, relationship between lips and teeth, gummy smile if present and the labial competence or incompetence. A vertical excess of the maxilla with labial incompetence, gummy smile, and excessive tooth exposure tends to indicate repositioning the maxilla superiorly. On the contrary, in a small percentage of cases characterized by little vertical development and insufficient tooth exposure (short face) repositioning the maxilla downward is indicated. If on the contrary, the vertical excess is exclusively in the lower third; genioplasty with vertical reduction will be required. With regard to transverse dimensions, these concern both the occlusal relationship and esthetic parameters. From the occlusal standpoint, transverse discrepancy should be corrected, as we have already seen, during pre-operative orthodontic treatment. Only in some particular cases may segmental maxillary osteotomy, in two or more pieces, be taken into consideration. Transverse change can be possible only 4-5 mm using this type of osteotomy because the palatine fibro-mucosa is not elastic. The ratio between the bi-zygomatic and the bi-gonial widths is the fundamental esthetic parameter in transverse dimension. In Class III cases, there is usually a reduced bi-zygomatic width, and various methods exist to achieve an increase in this measurement, as lipofilling or biomaterial implants. With regard to correction of the mandibular angles, this may quite easily be done endorally by remodeling with a pear-shaped bur, or through osteotomy and resection with an angled saw.

**CONCLUSION**

The management of skeletal Class III malocclusion is always a challenge to orthodontists because of the tendency to relapse due to the catch-up growth of the mandible. However, the treatment should always begin as soon as we diagnose the malocclusion. The orthopedic approach for growth modification may achieve successful results in children who have an underdeveloped maxilla and a fairly normal mandible. The orthopedic appliances also reduce the severity of the malocclusion thereby eliminating the chances of orthognathic surgery. A camouflage orthodontic treatment may be used for patients with a mild to moderate skeletal Class III discrepancy and a hypodivergent skeletal pattern. However, adult patients with a severe skeletal discrepancy and completed growth are candidates for surgical treatment.

**REFERENCES**


How to cite this article: Pattanaik S, Mohammad N, Pandia S, Sahoo SN. Treatment Modalities for Skeletal Class III Malocclusion: Early to Late Treatment. IJSS Case Reports & Reviews 2016;2(8):28-33.

Source of Support: Nil, Conflict of Interest: None declared.