MANAGEMENT OF CLASS III MALOCCLUSION - A REVIEW WITH REPORT OF FOUR CASES

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Abstract

Background: Class III malocclusion with multifactorial etiology manifests with dental or skeletal discrepancies, if severe could lead to compromised facial esthetics and function, thereby decreasing the self-esteem in an individual especially during growing period.

Case report: The present article describes four cases of management of class III malocclusion in 10 years, 11 years, 27 years and 24 years old individuals. Different approaches such as bonded acrylic splint RME, rail-style face mask and fixed orthodontic treatment have been applied. The treatment planning, progress and results of each case has been discussed.

The treatment follow up suggested the improvement in profile of the patient in all four cases.

Conclusion: Although there are controversies regarding the timing of instituting the treatment for class III malocclusion, it cannot be overemphasized that early treatment increases the options available and reduces the time needed for correction.

Introduction

Class III malocclusion is best described by discrepancies of dental or skeletal components in antero-posterior or vertical directions. Retrognathic and narrow maxilla, prognathic and wider mandible, and/ or a combination of both are the common clinical presentations of skeletal class III malocclusion. The magnitude of the discrepancy may compromise facial esthetics variably and motivates individuals to seek orthodontic correction.[1]

The Class III malocclusion may be hereditary in occurrence further affected by environmental factors such as mouth breathing habit.[2] Its prevalence varies among different ethnic groups ranging between 1% and 4% in Caucasians,[3] 4% and 5% among the Japanese[4] and 4% and 14% among the Chinese.[5] However its frequency is higher among Asians as large percentage of patients exhibit maxillary deficiency. In European royal families, the mandibular prognathism is commonly inherited. The heritability of mandibular prognathism among Brazilian families was estimated to be 0.316. Since it is an autosomal dominant inheritance with incomplete penetration, the expression of mandibular prognathism is influenced by a major gene.[6]

The classification of class III malocclusion has evolved since a century ago being regularly revised with focus on occlusal relationship and treatment planning.[7] The classification based on skeletal and dental is given in Table-1.

Types	*Skeletal Classification*	*Dental Classification (Dewey)*
A	Short or Retrognathic Maxilla	Molar is in class III with Antirior Edge to edge relationship
B	Long or prognathic mandible	Molar is in class III with crowed mandibular incisors
C	Combination of retrognatic maxilla and prognathic mandible	Molar is in class III with anterior crossbit

Table 1: Classification of class III malocclusion

Cephalometric, facial and occlusal analysis is a reliable tool in determining the structural etiology of Class III malocclusion. Description of the craniofacial morphology may require an analysis of antero-posterior (A-P) measurements as suggested by Ricketts,[8] Harvold,[9] and Steiner analyses.[10]

The following criteria helps to differentiates a dental crossbite from a skeletal one:

I. Dental assessment: Examine the incisal overjet. If the mandibular incisors are retroclined with positive overjet or edge to edge incisal relationship, then a compensated Class III malocclusion should be suspected (i.e., the skeletal discrepancy is compensated by proclined upper incisors and retroclined lower incisor). However when a negative overjet is seen, functional assessment needs to be done.

II. Functional assessment: The relationship of the maxilla to mandible is assessed to determine the presence of centric relation/ centric occlusion (CR-CO) discrepancy. An abnormal tooth contact leads to anterior positioning of mandible which forces the mandible forward. Such individuals presenting with a forward mandibular shift on closure may present with a normal facial profile, Class I skeletal pattern and Class I molar relation in centric relation, but in centric occlusion they may present with Class III skeletal and dental pattern (pseudo Class III malocclusion). To differentiate simple Class I malocclusion from a compensated Class III malocclusion, CR-CO shift should be eliminated. No shift on closure suggests a true Class III malocclusion.

III. Profile analysis: The evaluation of chin position, midface profile and overall facial proportions is recommended.[11] The overall profile may be convex, straight, or concave, the maxilla may be retruded or

mandible may be protruded. The chin position relative to the nose and upper face is evaluated by blocking out the upper and lower lips. With this the chin retrusion or protrusion is determined. Similarly the midface is evaluated by blocking out the lower lip and chin. An imaginary line that passes from the inferior border of the orbit through the alar base of the nose down to the corner of the mouth should be convex. Whereas if the tissue contour is straight or concave, it suggests a midface deficiency.

The prediction of the progression of Class III malocclusions has been investigated.[12] The various morphological features of Class III malocclusion have been compared with the norms like molar relationship, ramus positions cranial deflection and porion location.[13] The sum of the deviations greater than four determined by using Rocky Mountain Data System (Sherman Oaks, CA), suggests excessive mandibular with an accuracy of 70% to 80%.[14]

The success or failure of early treatment could depend on inclination of the condylar head, the maxilla-mandibular vertical relationship together with the width of the mandibular arch. Successful outcomes with 95% degree of accuracy were predicted using ramal and corpus length, mandibular position, and gonial angle.[9] However, the prediction formula using single cephalogram can be reserved for diagnosing unsuccessful cases with 70% accuracy rate.

Treatment strategies in class III: The class III malocclusion can be treated at various stages during the dental and skeletal development or after the cessation of jaw growth [Table 2].

Growth modification

Antero-posterior and Vertical Maxillary Deficiency: Both of these contribute to Class III malocclusion. The effect is direct in cases where maxilla is small or in posterior position. If the maxilla does not grow vertically, the effect on the mandible is indirect, which then rotates upward and forward during normal growth, thereby leading to mandibular prognathism. This appearance is more related to position rather than size of the mandible.[9]

Since maxillary deficiency is commonly a component of skeletal Class III malocclusion, the recent treatment strategy is aimed at promoting maxillary growth, for which the data from randomized clinical trials are not available.[9] However In children, inhibiting mandibular growth or stimulating maxillary growth tends to modify the growth in skeletal Class III malocclusion.[15]

There are three approaches to manage maxillary deficiency: Frankel's FR-III functional appliance is the most effective method followed by reverse-pull headgear (facemask) and Class III elastics to skeletal anchors is the least effective.[9]

During the construction of FR-III appliance, mandible should be positioned posteriorly and rotated open and stretch the upper lip stretched forward using pads. These lip pads stimulate forward growth of the maxilla by causing periosteal stretching. Levin and colleages[16] reported that patients who wore this appliance all the time for 2.5 years followed by part time retention of 3 year period, maxillary size and position as well as mandibular position significantly improved along with more lingual positioning of lower incisors and increasing the overjet. This position was maintained for a follow up period of 6 years.

Protraction forces are applied to the peri-maxillary sutures using Facemask which encourages the forward growth of maxilla. The facemask and rapid palatal expander (RPE) are often used together.[17] The ideal time to reposition the maxilla forward is before the age of 8 years as orthodontic tooth movement can overwhelm skeletal change, and more recent studies comparing untreated Class III children to those treated with maxillary protrusion have confirmed greater skeletal change at earlier ages. Long-term studies confirm greater success, treatment was initiated by age 10 because the probability of forward positioning reduces to zero when sexual maturity is attained.[18]

A child with short-face Class III is more successfully treated using functional appliance than a long-face class III because growth modification in short face patients involves simple rotation of mandible down and back, not giving rise to antero-posterior mandibular deficiency. The growth pattern in long-face class III patients is difficult to modify and can only be camouflaged by elongating the anterior teeth to close the anterior open bite which in turn worsens the facial esthetics.[19] In the recent past, Orthognathic surgery was the most preferred option to manage these cases.

In clinical practice, treatment focused to change the deficient maxillary position can be enhanced in either of two ways. In the first approach, the facemask is applied to miniplates at the zygomatic arch (base) or in the maxilla anteriorly. Sar and associates[20] applied anchors above the maxillary incisors with 400 gm of force each side, and used facemask for about 16 hours per day and reported anterior maxillary movement without its rotation to be 0.45 mm per month as compared to 0.24 mm using conventional facemask. This approach is most promising in adolescent patients. In the second approach, bone-supported miniplates are place in the upper and lower jaw bilaterally to deliver interarch forces using Class III elastics. This approach is more effective and skeletal change achieved is remarkable compared to the use of Facemask with anterior mini plates. Also the full time force application can be achieved by this approach without the need to wear an extra-oral appliance.

Class III Camouflage

Dental compensation or camouflage of simple class III malocclusions can be done in adult patients whereas severe cases require Orthodontics and/or Orthognathic Surgery.[1] Moderately severe Class III malocclusions can be corrected by retracting the mandibular incisors into the available extraction space and proclining the maxillary incisors.

Skeletal anchorage can be additionally used to distalize the entire mandibular dentition.[9]

These types of cases can be managed by various approaches[2] including extraction usually premolars in the lower or both arches,[1,3] horizontal or vertical extra-oral tractions and distalization of lower molars.[21] For non-growing class III patients, midline maxillary osteotomy followed by expansion device is recommended for treatment of crossbite.

Orthognathic surgical procedures

When the facial esthetics is compromised by skeletal problem, the surgical orthodontic treatment is the preferred choice for patients severe facial asymmetry and do not present any potential for facial growth. The class III dental and skeletal relationships are treated by orthodontic surgical treatment which promotes advancement of maxilla and retrusion of mandible.[22] The success of orthognathic surgery relies on the Pre-surgical orthodontic preparation which dictates the skeletal movements at the time of surgery. The complete correction of skeletal discrepancies can be achieved by recognizing and correcting the prevailing dental compensations.[21]

Three-dimensional (3D) imaging technology such as cone-beam computed tomography (CBCT) can be a boon to aid in better diagnosis, surgical simulation, and splint construction and is exceptionally useful for patients with facial asymmetries.[23] Once the surgical planning is done, the presurgical phase begins with alignment and leveling of both the arches and decompensating the teeth to an ideal position within the arches and coordinating the arches. Any required expansion should be performed only surgically whenever segmental Le Fort I osteotomy is planned.[24]

Orthognathic patients respond well to the combination of Le Fort I. The nasomaxillary soft tissue profile can be improved by Lefort I advancement. Rotating the maxilla-mandibular complex can modify occlusal plane and incisal axis. Maxillary retrusion is often noticed in prognathic mandible patients, and rotation of the maxillo-mandibular complex clockwise allows for more mandibular setback and may improve the depressed paranasal contour.[25]

Timing of treatment

Early Treatment of Class III Malocclusion:

In class III patients, orthodontists do not prefer early orthopedic treatment because it is not possible to predict mandibular growth. Those patients who have undergone early orthopedic treatment could further need surgical treatment once the growth is completed. There are limitations regarding the prediction of mandibular growth while using a single cephalometric radiograph. Long term early treatment results have been analyzed and have found various several cephalometric variables like mandibular position, corpus length, gonial angle, and height of the ramus to have predictive values. Unfortunately such formulae can only predict successful outcomes.[26]

Creating a favorable environment for dentofacial development should be the objective of early orthodontic treatment. The early Class III treatment goals are:

1. Prevention of progressive soft tissue or bony changes that are irreversible: Very often Class III malocclusion is seen along with anterior crossbite. If the anterior crossbite is not corrected, it may cause abnormal wearing and dental compensation of the lower incisors, further leading to gingival recession or making the labial alveolar plate thin.
2. Improvement of skeletal discrepancies to promote future growth: Excessive mandibular growth is seen along with dental compensation of the lower incisors. Early orthopedic treatment using facemask or chin cup therapy improves the skeletal relationships, which in turn minimizes excessive dental compensation such as overclosure of the mandible and retroclination of the mandibular incisors.
3. Improvement of occlusal function: Functional shift occurs quite often with Class III malocclusion and an anterior crossbite. Any discrepancies in centric occlusion/centric relation (CO/ CR) and adverse growth potential can be eliminated by early orthopedic treatment.
4. Simplifying phase II comprehensive treatment: The need for orthognathic surgery can be in mild and moderate Class III patients, who have undergone early orthodontic or orthopedic treatment. Even though surgery may be required at a later stage, its extent can be minimized by correction of transverse dimension at an early age and maximizing the maxillary growth potential. To improve facial esthetics, that further influences psychosocial development of a child.[27] Treatment with facemask and/or chin cap has found to improve lip posture and facial esthetics.

Turpin proposed a list of factors, both positive (good facial esthetics, mild skeletal disharmony, no familial prognathism, presence of antero-posterior functional shift, convergent facial type, symmetric condylar growth, and growing patients with expected good cooperation) and negative (poor facial esthetics, severe skeletal disharmony, familial pattern established, no antero-posterior shift, divergent facial type, asymmetric condylar growth, growth complete, and poor cooperation) which help the clinician to decide the time of interception for a developing Class III malocclusion.[12] Early treatment is suggested for those patients who present with positive characteristics and that treatment can be postponed till the completion of the growth for patients with negative characteristics.

Late treatment of Class III Malocclusion:

Orthodontic Camouflage: Indicated for adolescent patients or adults with mild skeletal discrepancies. Strategies for Camouflage treatment include selective tooth extraction (premolars, lower incisors, or lower second molars), use of

the multiple edgewise arch wire (MEAW) technique for distal tipping of the mandibular posterior segment, or distalizing the entire mandibular dentition using mini-plates.[9]

However, orthognathic surgery should be considered as a treatment option for patients with severe skeletal deformities and overdeveloped mandible to improve function and esthetics.[9]

Late orthodontic treatment prognosis

The selection of treatment modality dictates the orthodontic mechanics and the tooth/teeth to be extracted. Hence, in the borderline skeletal class III cases, the decision of performing orthodontic camouflage treatment or surgery should be made early. The important variables that should be considered during treatment selection are severity of the skeletal discrepancy, facial pattern, angulation of incisor, nasolabial angle, anterior facial proportion, periodontal condition, post-treatment change in occlusion and esthetic appearance, and the possibility of remaining mandibular growth.[10]

Case 1 [Figure 1]

A 10-year-old male child presented with palatally erupting both maxillary central incisors as well as maxillary right lateral incisor and canine due to late extraction of their over-retained deciduous predecessor. Extarorally, the profile was slightly concave with reverse overjet of 4mm. Cephalometric analysis revealed that SNA and SNB were 79 and 80 respectively. The skeletal age of the child was determined and he was in CVMI stage 2 which suggested that at least 25 to 65% growth was expected. Considering this active growth period, treatment plan was formulated which constituted rapid maxillary expansion for a 3 weeks period and retention therapy for 3 months to correct reverse overjet.

Treatment progress

During the first phase, rapid maxillary expansion was performed by bonded acrylic splint RME for 3 week period during which daily quarter turn (90 degree) activation was performed by patient. The appliance covered the maxillary posterior occlusal and buccal segments, thereby disoccluding posterior teeth and enabling crossbite correction. It was then cemented and kept in position for 3 month period so that it facilitates calcification and stabilization of midpalatal suture. Following this period, a Hawley's retainer was delivered to be used for 6 months.

Treatment results

Positive overjet was achieved which improved the profile of the child. Cehalometric evaluation revealed that SNA improved from 79 to 81 degrees. The follow-up was done after 3 years as seen in the post-operative pictures [Figure 1: 10, 1.11, 1.12].

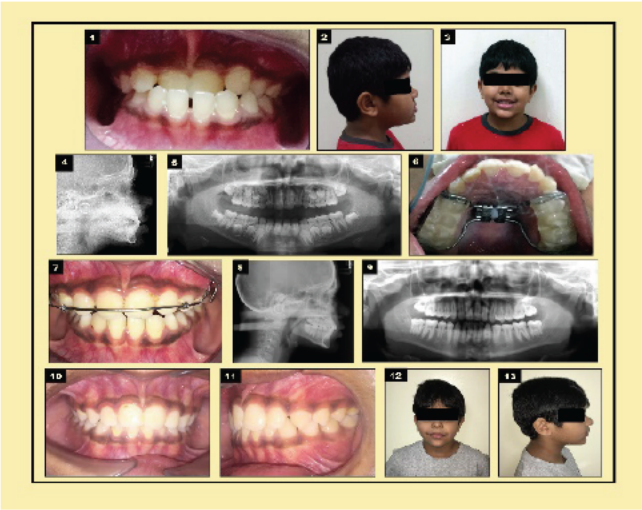

Figure 1: Management of class III malocclusion using bonded acrylic splint RME

Case 2 [Figure 2]

An eleven year old female child having a history of genetic predisposition presented with lack of development of the middle third of the face and concave profile. A reverse overjet of 3 mm with a marked mesial molar relationship due to forwardly placed mandible and a crossbite of four permanent incisors were observed. On cephalometric analysis, a retrognathic maxilla, prognathic mandible and an anterior divergent face was evident. The skeletal age of the child was determined as CVMI stage 2 which suggested that at least 25 to 65% growth was still expected. Considering that the child's skeletal age, rapid maxillary expansion for a 3 week period was planned followed by retention therapy for 3 months to correct reverse overjet.

Treatment was planned to perform rapid maxillary expansion for 3 weeks followed by using the functional appliance reverse pull head gear to promote maxillary growth and control mandibular growth till the end of growth period.

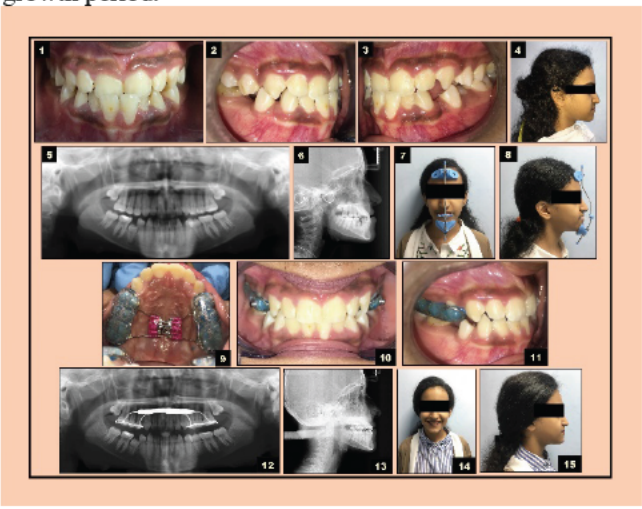

Figure 2: Management of class III malocclusion using bonded acrylic splint RME.

Treatment progress

The reverse overjet was corrected using bonded acrylic splint RME for 3 week period during which daily activation of quarter turn (90 degree) was performed by patient. The appliance covered the maxillary posterior occlusal and buccal segments thereby disoccluding posterior teeth enabling crossbite correction. The rail-style face mask was given to promote maxillary growth and prevent mandibular growth and was advised to continue till the cessation of growth.

Treatment results

Positive overjet and overbite was attained and the maxillary position improved. Patient profile shows marked improvement with an increase in SNA value from 78 to 81 degrees. A lateral head film was taken immediately after removal of the bonded appliance and superimposed; the initial film showed no inferior movement of the maxilla and an extrusive and uprighting of the maxillary incisors.

Case 3 [Figure 3]

A 27 year old female patient reported with a history of orthodontic treatment being done priorly. The extra-oral examination revealed a dolicocephalic head form, leptoprosopic facial form, concave prolife, anterior divergence, and protruded lower lips. The intra-oral examination revealed an anterior crossbite in relation to all incisors, Class III molar and canine relationship. The maxillary incisors were slightly retroclined whereas the mandibular incisors were proclined. Forward path of closure, reverse overjet of 4 mm and overbite of 4 mm was observed. The cephalometric analysis revealed a class III skeletal base, an orthognathic maxilla (SNA=82) and a prognathic mandible (SNB=84). Considering the normal skeletal and dental maxillary structures, treatment was planned to perform orthodontic camouflage, extraction of mandibular first premolars, raise the bite in posterior region, retract the mandibular anterior teeth to correct the reverse overjet and slight procline the maxillary anterior teeth.

Figure 3: Management of class III malocclusion using orthodontic camouflage, extraction of mandibular first premolars

Treatment progress

After the extraction of both mandibular first premolars, ceramic brackets [0.022" slot MBT] were bonded onto teeth in the lower arch. Bite was raised using GIC bite blocks placed on mandibular posterior teeth. Leveling and aligning was done with 0.014", 0.016", 0.020", 0.016" x 0.022", 0.0 19" x 0.025" Ni-Ti wires. Space closure was done using sliding mechanics with 0.019" x 0.025" stainless steel wire and crimpable hooks. After the over jet was improved, the glass ionomer cement blocks were removed from the molar teeth, the upper arch was bonded and remaining extraction space was closed using similar mechanics . Finishing and detailing was done with 0.0 17" x 0.025" TMA wire.

Treatment results

The crossbite of anterior teeth was corrected within 6 months and the profile of the patient had esthetically improved.

Case 4 [Figure 4]

A 24-year-old male presented for orthodontic treatment with the concern of an unesthetic smile. He had a concave facial profile. The intra-oral examination and analysis of dental casts revealed Angle's Class III molar & canine relationship on left side and maxillary incisor crowding and single tooth crossbite in relation to tooth 33. Cephalometric analysis revealed skeletal Class III (ANB = −3°) malocclusion, a hypodivergent facial pattern (SN-GoGn = 42°), increased lower anterior facial height, maxillary incisor proclination, and uprighted mandibular incisors.

Figure 4: Management of class III malocclusion using Fixed orthodontic appliance in lower arch

Treatment Plan

After correcting molar relation and crossbite, vertical reduction genioplasty is indicated.

Treatment progress

Fixed orthodontic appliance in lower arch was initiated to correct the crossbite in relation to tooth 33. 0.022" slot MBT ceramic brackets were bonded to teeth in the mandibular arch. Bite was raised using glass ionomer

cement bite blocks placed on mandibular posterior teeth. Leveling and aligning was done with 0.014", 0.016", 0.020", 0.016" x 0.022", 0.0 19" x 0.025" Ni-Ti wires. After the overjet was improved, the glass ionomer cement blocks were removed from the molar teeth. After crossbite correction, fixed appliance was placed in maxillary arch and Class III elastics were given to correct molar relation. Finishing and detailing was done with 0.0 17" x 0.025" TMA wire.

As the patient was not willing for the surgical procedure, vertical reduction genioplasty was not performed.

Treatment results

The crossbite of anterior teeth was corrected within 6 months and the profile of the patient had esthetically improved.

Discussion

When growth modification is the goal, treatment most suitable for children with minor-to-moderate skeletal problems, so that when the teeth have correct axial inclination, they are within few millimeters to each other. Tooth movement occurs along with skeletal change when forces are applied to the teeth for transmission to the sutures. In children having true maxillary problems, this type of treatment is most suited. However some evidence suggests that the effects of treatment on mandibular growth may exceed the changes caused by clockwise mandibular rotation.[28]

In our case report, Rail-style facemask was used because it provides more comfort while sleeping and is easy to adjust. It can also be adjusted to accommodate some vertical mandibular movement when compared to the more bulky Delaire type and can cause problems with sleeping and wearing eyeglasses.[9] Bonded RME was used to relieve the maxillary sutures.

For a narrow maxilla, palatal expansion should be done with maxillary protraction for which, the expansion device is an effective splint; however, maxilla should not be expanded just to improve the protraction (as in case 2). Whatever the method of attachment, the appliance must be attached to the facemask using hooks in the canine–primary molar area above the occlusal plane. This places the force vector closer to the purported center of resistance of the maxilla thereby limiting rotation of the maxilla. The force applied should be in the range of 350 to 450 gm. per side for 12 to 14 hours per day. It is better to postpone protraction of the maxilla until the permanent incisors and first molars have erupted. The molars can be a part of the anchorage unit and the overjet can be affected by controlling the inclination of incisors.[9] This was followed in cases 1 and 2.

Spontaneous crossbite correction of permanent incisors can be induced by RPE anchored on deciduous teeth in the early mixed dentition (87,15% of central incisors and 97,15% of lateral incisors).[29] In our first case, bonded RME was used to correct anterior crossbite as well as slightly retrognathic maxilla without the use of face mask.

Camouflaging for Class III cases would be successful if malocclusion was corrected without affecting the facial appearance and involves a combination of lower incisor retraction and forward movement of maxillary incisors. When the lower incisors are retracted, the chin generally appears prominent. In case-3, axial inclinations of upper and lower arches were corrected during the previous orthodontic treatment. So a decision was made to correct reverse overjet by extracting only mandibular first premolars. In case number 4, class III elastics were used to correct the molar relation and simultaneously correct the mandibular left canine crossbite. Because the reduction genioplasty as an adjunctive procedure to improve the soft tissue contour is losing its popularity due to its unesthetic results, the patient was not advised this treatment option.

Conclusion

Class III patients with maxillary deficiency can be treated using appliances such as the protraction facemask to eliminate anterior crossbite, CO/CR discrepancy, and maximize the growth potential of the nasomaxillary complex. Ideally, treatment using protraction facemask is done during 6-8 years. After treatment completion (2 to 3 years) using protraction facemask, a follow-up lateral cephalogram can be taken to assess the horizontal growth of the maxilla and the mandible as well as the growth vector or direction. During the early permanent dentition period, the Growth Treatment Response Vector (GTRV) ratio is calculated and patients are informed if camouflaging with orthodontic treatment is sufficient to correct the malocclusion or if surgical treatment may be necessary at a later age.

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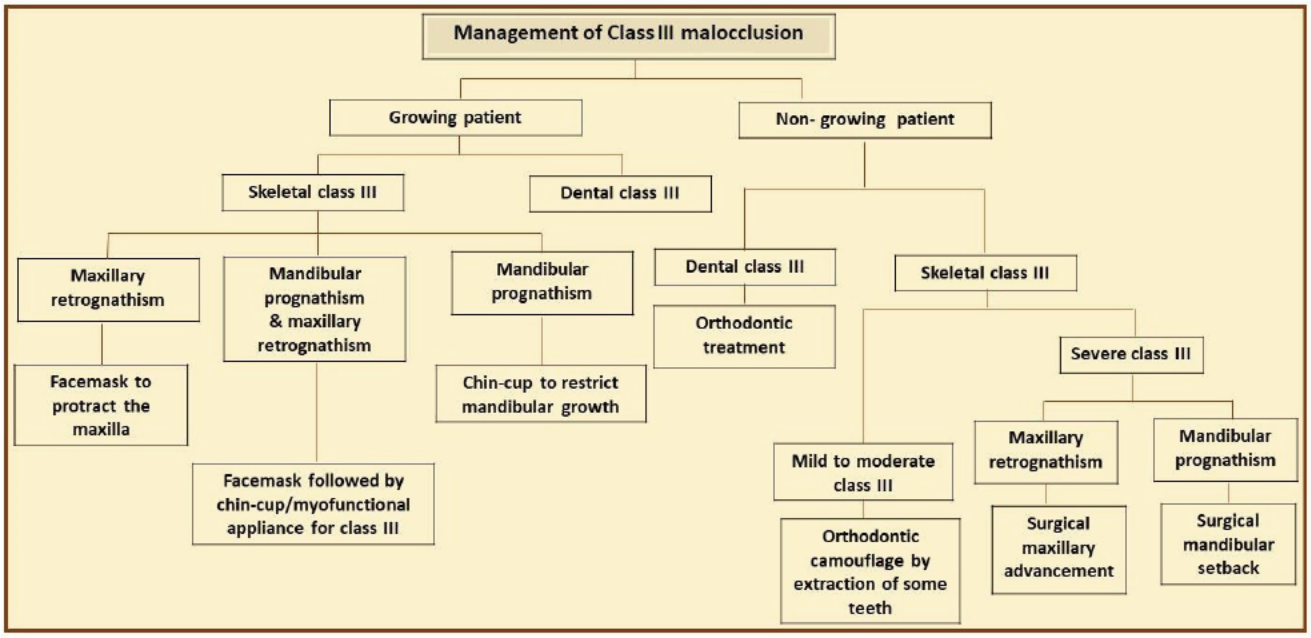

Table 2: Management strategies in class III malocclusion