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CLASS III MALOCCLUSION

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بسم الله

الرحمن

الرحيم

اشَهِدَ ّالله أنَّهُ لَا إِلٰهَ إِلَّا
هُوَ وَالْمَلَائِكَةُ وَأُولُو
الْعِلْمِ قَائِمًا بِالْقِسْطِ
لَا إِلٰهَ إِلَّا هُوَ الْعَزِيزُ
الْحَكِيمُ

دق الله العظيم

سورة ال عمران، الاية 18

Declaration

This is to certify that the organization and preparation of this thesis have been made by graduate student **Ahmed Raad Emnati** under my supervision in the College of Dentistry, University of Baghdad in partial fulfillment of the requirement for the 5th Grade.

Signature:

Dr. Jinan Eliewy Saloom

The supervisor

Dedication

This thesis is dedicated to my parents .

For their endless love, support and encouragement.

Acknowledgment

Thanks Allah (ﷻ) for everything, for providing me with power and patience to perform this study.

I would like to express grateful thanks to dean of college of dentistry, University of Baghdad ***Prof. Dr. Hussain Al-Huwaizi****.*

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List of Contents

List of Contents

List of figure

Introduction

Class III malocclusion is a subject of interest and concern to the orthodontist in both research and clinical practice in addition to that, class III malocclusion has long been viewed as one of the most severe facial deformities. The appearance of protruding mandible with reverse overlap of the anterior teeth is easy to identify **(Graber, 1988).**

Hunter (1788) addressing mandibular prognathism stated that "It is not un common to find the lower jaw projecting too far forward, so that its fore teeth pass before those of the upper jaw, when the mouth is shut; which is attended with inconvenience and disfigure the face".

In our face-conscious society it seem that any departure from the usual are the "normal" attracts attention; especially for children this often means derision and ridicule because the child want to be like this playmates and because facial disharmony is predisposing to psychological aberrations **(Graber, 1988).**

Studies conducted to identify the etiological features of class III malocclusion show that the deformity is not constricted to the jaws but involves the entire the craniofacial **complex (Chang et al., 1992; Mackay et al., 1992; Battagel, 1993).**

The prevalence of class III malocclusion varies among different races and population. The highest prevalence is among Asians of the Far East and the lowest is in Caucasians **(Bukhary, 2005)**. In Iraq it ranges from 2.4% to 6.3% **(Agha et al., 2002; Khamarco et al., 2002).**

In orthodontic diagnosis and treatment planning, great importance has been attached to evaluate the sagittal apical base relationship. Both angular and liner measurement have been incorporated into various cephalometric analysis to help the clinician diagnosis anteroposterior dysplasia and establish the most appropriate treatment plan. Any cephalometric analysis based on either angular or liner measurements has obvious shortcomings, which have been discussed in detail by **Moyers et al (1979).**

Freeman (1988) stated that, even before Angle introduced his Classification of malocclusion to profession in the early 1900s, the anteroposterior relationship of mandible to maxilla was the most important diagnostic criterion. It is important to identify whether the etiology of class III malocclusion is dental, functional or skeletal. If the problem is skeletal, it

must be determined whether the cause is overdeveloped mandible, underdeveloped maxilla or combination of both **(Baik et al., 2004).**

So, when treating class III patients orthodontically whether they are growing children or mature adults, anteroposterior and vertical position of facial components as well as dental relationship must be considered so that the excess or deficiency may be treated where it actually exists **(Guyer et al,. 1986).**

1.1 Definition

According to Angle's classification, the lower arch is at least one-half cusp width too far forward in relation to the upper arch, judged by the first permanent molar relationship.

According to the canine classification, in class III the upper permanent canine will occlude backwards to the embrasure between the lower canine and first premolar.

According to the British standard definition, class III incisor relationship includes that malocclusion where the lower incisor edge occludes anterior to the cingulum plateau of upper incisors. Class III malocclusion affects around 3 percent of Caucasians **(Jones and Oliver, 2000).**

Fig. 1: Class III malocclusion according to the molars, canines and incisors relationship

1.2 Etiology of class III malocclusion

1. **Skeletal factors**

Osseous class III is the problem of skeletal morphology and osseous growth that leads to the skeletal imbalance. It also called True Class III malocclusion **(Graber, 1972)**, True prognathism **(Jacobosn et al., 1974),** Skeletal Class III malocclusion **(Foster, 1982)** and True Mesi-occlusion **(Nakasima et al., 1986).**

Jacson et al. (1974) stated that class III skeletal imbalance is usually attributed to one or more of the following components variable:

1. The mandible may be too large relative to maxilla (lengthened ramus, lengthened mandibular body or large total length).
2. The maxilla may be too small relative to the mandible.
3. The maxilla may be retro-positioned relative to the mandible.
4. The mandible may be positioned too far forward relative to the maxilla.
5. A forward rotation of the mandible relative to cranium will cause the chin point to move into a horizontally more protrusive position; a prognathic mandible may thereby result together with a reduction in lower anterior facial height.

2. **Soft tissues factor**

Where the anterior intermaxillary height is large the lips are frequently incompetent. Such cases often have a skeletal anterior open bite, and during swallowing there will be an adaptive variation of swallowing behavior with the tongue coming forwards into the gap between the incisors. where the intermaxillary height is reduced sometimes the upper lip may also be shorter and hypotonic **(Jones and Oliver, 2000).**

3. **Dental factors**

Class III malocclusion are often associated with a narrow upper arch and a broad lower arch, With the result that crowding is seen more commonly, and two greater degree, in the upper arch than in the lower. Frequently, the lower arch is well aligned for even spaced **(Jones and Oliver, 2000).**

1.2.1 Another classification for the etiology of class III malocclusion

The permanent interaction between genetic and environmental factors guides and controls the process of growth and development and determines the morphologic and physiologic traits of the individual **(Van Der Linden, 1969).** The poly genic or multifactorial theory is responsible in the development of class III malocclusion **(Litton et al., 1970).** So, they are complex inter actions of genetic and environmental factors, which may act synergistically or in isolation or may cancel each other out **(Battagel, 1993).**

Graber (1972) classified the etiologic factors into general and local factors; this system was used to describe the etiology of class III malocclusion;

1. **General factors**
   A. **Genetic:** familial studies of mandibular prognothism are suggestive of heredity in the etiology of this condition **(Casto, 1928; Downs).** The best known example of the transmission of distinctive abnormal condition is certainly the mandibular prognathism of the Hapsburg family **(Rubbrecht, 1939).** Heredity determines both tooth size and the pattern of jaw growth **(Gresham, 1975).** Some genetic syndromes are associated with mandibular prognothism such as basal cell nevus, osteogenesis imperfect, Marfan syndrome and Klinefelter syndrome **(Cohen, 1980).** The correlation between parents and offspring with class III malocclusion were strong especially for skeletal measurement, indicating that skeletal pattern was more directly related to genetic factor, also both parents and offspring had concave profile **(Nakasima e al., 1982).** Ethnic is also a part of genetics and different morphology of class III malocclusion can be seen in different ethnic groups, **Masaki (1980)** reported that maxillary skeletal retrusion occurred more often in Asians face, whereas mandibular prognathism often observed as a component of class III malocclusion in individuals of European American ancestry. **Singh (1999)** reported that some Asian ethnic groups demonstrate an increase prevalence of class III malocclusion; It is likely that the skeletal component and soft tissue matrices are

genetically determined. Presumably, the co-morphologies of craino-maxillary and mandibular complex are likely dependent upon candidates genes that undergone gene-environment interaction to yield class III malocclusion.

B. Congenital anatomical defect

Cleft palate cause extreme vertical and anterposterior growth deficiency of the maxilla leading to maxillary retrognathism **(Graber, 1972).** About 72.7% of cleft cases are associated with class III malocclusion while 18% associated with class I and 8.8% with class II **(Baek et al., 2002).**

Chemicals and drugs are capable of producing embryological defect if given at critical time; agents like Valium, Aspirin, cigarette and alcohols affected the dento-facial development and may result in cleft palate which in turn leads to deficient maxilla **(Proffit et al., 2007).**

C. Predisposing metabolic climate and disease

Patient with acromegaly, which is cause by anterior pituitary tumor where there is excessive secretion of growth hormone, has excessive growth of the mandible which will create class III malocclusion in adult life **(Strang & Thompson, 1958; Pascoe et al., 1960; Graber, 1972; Proffit et al., 2007).**

D. Abnormal pressure habit and functional aberration

I. **Tongue habit:** tongue habit may result from size, posture or function. Large tongue will cause the mandible to be protruded at all time **(Graber, 1972; Proffit 2000)** and may lead to abnormal growth pattern of the mandible and flaring of the incisors **(McDonald & Avery, 2000).** True macroglosia may be either congenital or acquired; congenital cause likes muscular Hypertrophy, Glandular hyperplasia, hemangioma and Lymphangioma. Macroglosia also occur in conditions like Down's syndrome, while acquired causes may include acromegaly, tertiary syphilis, cyst or tumor involving the tongue and neurologic injury **(Wolford & Cottrell, 1996)** and also thyroid deficiency **(Graber, 1972; Proffit, 2000).**

Regarding tongue posture, flat and anteriorly positioned tongue is responsible for the anterior position of the mandible with resultant increase in its length and flaring of the lower labial segment **(McCallin et al., 1985; Rakosi & Schilli, 1981).** There is a controversy whether tongue posture is a compensatory, adaptive phenomenon or a primary etiologic factor **(Graber et al., 1985).**

Tongue thrust was found in 17% of patient with class III malocclusion **(Subtelny & Subtelny, 1972).**

II. **Lip pressure:** some muscle functions may be changed to adapt for already existent mal-relationship between the maxilla and the mandible. In class III malocclusion, the lower lip is impotent and hypofunctional while the upper lip is quite active in addition to low tongue posture. All these may be an adaptive activity; however, they may accentuate the deformation **(Thompson, 1949; Graber, 1972).** Soft tissue matrices, especially labial pressure from circomoral musculature, may influence the final outcome of the craniofacial growth of a child skeletally predispose to class III condition **(Singh, 1999).**

E. Habitual occlusion

The habit of protruding the mandible may accelerate mandibular growth leading to class III malocclusion **(Rakosi and Schilli, 1981).**

2. Local factor

A. Premature tooth loss and irregular eruption path:

Premature bilateral losses of maxillary six years molars (1st molar) may result in a foreshortening of the maxillary arch, which is turn, produce mandibular prognathism **(Gold, 1949).**

When over eruption of molars occur, several unfavorable change take place. If the patient's growth is low, the mandible may rotate backward. Consequently an anterior open bite may be created. However, if the patient has enough growth potential, vertical growth of condyle is stimulated, then the mandible rotates forward creating skeletal class III malocclusion (Sato, 1994).

B. Teeth wear and bruxism

The flat plane of occlusion of deciduous teeth makes it simple to reposition his mandible anteriorly; this may result from relative softness of the deciduous enamel which permits rapid wear and in a rather short period of time, this forward position becomes the new position of mandible **(Gold, 1949).**

C. Teeth number

Patients with more sever hypodontia in maxilla demonstrated tendencies to a class III skeletal relationship **(Chung et al., 2000).**

1.3 Classification of class III malocclusion

1.3.1 Classification of skeletal class III malocclusion according to the location of the problem

One of the old classifications of class III malocclusion was describe by **Sanborn (1955),** who divided class III cases according to anteroposterior position of the maxilla and mandible as determined by SNA and SNB into four subgroups:

1. **Group A:** Those presenting a maxilla within the normal range of prognathism and mandible beyond normal range of prognathism.
2. **Group B:** Those presenting a maxilla below normal range of prognathism and a mandible within the normal range of prognathism.
3. **Group C:** Those presenting a maxilla and a mandible within the normal range of prognathism.
4. **Group D:** Those presenting a maxilla below normal range of prognathism and a mandible beyond the normal range of prognathism.

Pascoe et al. (1960), using vertical height and antero-posterior dimension, classified their class III malocclusion patients into:

1. **Type A:** In which both the maxilla and mandible were within the range of prognathism.
2. **Type B:** The maxilla of normal length, where mandibular length is within the range of prognathism.
3. **Type C:** An underdeveloped, shortened maxilla (retrognathic), where the mandibular is within normal.
4. **Type D:** Maxilla within normal range, occlusion and alveolar process in normal relationship and the mandible is prognathic because of basal prognathism.
5. **Type E:** The maxilla within normal range, where the mandible is prognathic with lengthening of lower third of face and open bite anteriorly.

Tweed (1966) classified skeletal class III into 2 categories:

1. Pseudo class III malocclusion: with small maxilla and conventional shape mandible.
2. True class III malocclusion: with overdeveloped mandible.

Ellis and McNamara (1984) divided the measurements of craniofacial structure of adult class III surgical patient into 4 horizontal components;

maxillary skeletal position, maxillary dental position, mandibular dental position, and mandibular skeletal position and one of vertical component. When each of these five component is divided into 3 classes: protruded, normal and retruded, permits 243 possible subgroup; actually 69 subgroup where found.

Rakosi in **1982** mentioned that six types of class III relationships may be distinguished.

1. **Normal extent of maxillary and mandibular bases:** The upper incisor show lingual, the lower incisors labial inclination. The cause of the anomaly can usually be localized in the dento-alvcolar region. This type is often difficult to distinguish from trans-located closure with marked mandibular prognathism.
2. **Large mandibular base and ascending ramus:** The gonial angle is large, the articular angle is small. The upper incisors show labial, the lower incisors lingual inclination. Edge to edge or open bite is usually seen frontally and cross bite laterally prognathism with fault in the mandible).
3. **Underdeveloped maxilla:** This present with crowding in the upper front region, with the mandibular base prominent. Two variations of the type may be distinguished:
    a) Vertical growth tendency. The ascending ramus and posterior cranial base are short, the gonial angle large and the upper gonial angle (GO1) greater than 65 degree.
    b) Horizontal growth tendency: The ascending ramus and posterior cranial base are large, the gonial angle small and the upper gonial angle (GO1) 40-55 degree.

The crowding in the maxilla complicates treatment with these two types, so that fixed appliance is usually required (mandibular prognathism with fault in the maxilla).

4. **Maxilla underdeveloped, mandible normal:** This type occur with mal-development of the maxilla, e.g. in subject with cleft palate and certain syndromes where mid-face underdeveloped is characteristic (mandibular prognathism with the fault in the maxilla).
5. **Maxilla normal overdeveloped mandible:** This group includes “genuine” mandibular prognathism, with poor prognosis for effective treatment (prognathism with the fault in the mandible).
6. **Pseudo translocation closure:** A fully developed skeletal prognathism may be partly compensated by lingual inclination of lower incisor and

labial inclination of the upper incisors. On clinical examination, the anomaly gives the impression of being Trans-located closure, but cephalometric radiography and "mental repositioning " of incisors angulation will reveal a genuine mandibular prognathism.

1.3.2 Classification of class III malocclusion according to morphology

Jacobson et al. (1974) suggested two basic morphologic types of Class III malocclusion:

1. **Divergent Class III pattern:** In which palatal, occlusal and mandibular planes tend to diverge, an obtuse gonial angle and anterior open bite in extreme cases.
2. **Convergent Class III pattern:** Palatal, occlusal and mandibular planes tend toward parallelism, an acute gonial angle and deep overbite.

1.3.3 Classification of skeletal class III according to Head form types

Marton et al, (1992) reported that three groups exist within Class III relating to differences configuration related to head form types:

1. **The brachycephalic Class III:** It has a relatively wider and flatter face, a vertically shorter and less protrusive nasal region and more forward rotated mandible when compared with brachycephalic Class I type.
2. **The dolichocephalic Class III:** It is a less common variant of the long and narrow head form, has a more elongated and protrusive nasomaxilla and a more downward and backward mandibular alignment.
3. **Dinaric or Mesocephalic Class III:** Vertical nasal length tends to be shortened, producing a more forward mandibular alignment associated with average head form.

1.4 Clinical Features of skeletal Class III Malocclusion

Carlotti and George (1981) describe the clinical features of maxillary retrognathism and mandibular prognathism as follows:

Maxillary retrognathism

A. Facial features:

1- Tendency of upper lip to be thin and retruded relative to lower lip.
2- Normal to deficient upper anterior teeth to upper lip relation.
3- Nasolabial line-subnasale: subnasale-tip of nose, usually not 1:1 ratio.
4- Obtuse nasolabial angle.
5- Less incisor appearance during smiling and the teeth seem to be under the upper lip.
6- Nearly normal chin projection.
7- Normal to decrease lower facial height.
8- Concave profile.

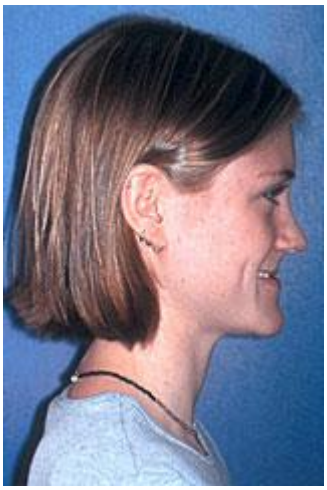

Fig. 2: Profile of a patient with maxillary retrognathism

B. Intraoral features:

1. Class III malocclusion (molars, canines and incisors).
2. Tendency toward crowding and mission or impacted teeth.
3. Transverse deficiencies noticeable in maxillary arch.
4. More nearly normal inclination of mandibular anterior teeth.

Mandibular prognathism

A. Facial features:

1- Normal upper lip form.
2- Normal relation of upper anterior teeth to upper lip.
3- Normal 1:1 ratio between nasolabial line-subnasale: subnasale-tip of nose.
4- Normal to acute nasolabial angle.
5- Good incisor / lip relationship.
6- The lower lip is protruded.
7- Prominent chin.
8- Normal to increase lower facial height.
9- Concave profile.

Fig. 3: Profile of a patient with mandibular prognathism

B. Intraoral features:

1- Class III malocclusion (molars, canines and incisors).
2- Normal maxillary arch.
3- Broad mandibular arch form.
4- Tendency toward lingo-version of lower anterior teeth.

Fig. 4: Intraoral feature of mandibular prognathism

Combined maxillary retrognathism and mandibular prognathism will have the prominent features of both.

Fig. 5: Combined maxillary retrognathism and mandibular prognathism

1.5 Treatment of class III malocclusion

This earlier intervention in class III patients obviously results in a longer period between the start of the initial phase of treatment and the end of the comprehensive treatment phase after the permanent dentition has erupted. The early treatment of Class III malocclusion may be characterized by more than one period of intervention during the mixed dentition **(Graber and Vanarsdall, 1994).**

1.5.1 Treatment aims

The principal treatment aims can be summarized as follows **(Wada et al, 1981)**:

1. To improve the aesthetics of the teeth and the function of the teeth and jaw whilst maintaining or improving the facial profile.
2. To relieve crowding and produce alignment within the arches.
3. To correct the incisor relationship to obtain a more normal and inter-incisal angle.
4. To eliminate antero-posterior and unilateral lateral cross bites together with associated displacements.

1.5.2 Treatment planning

When treatment planning a Class III case it is important to establish the true occlusal position after all displacements have been eliminated. It is often of value to have two sets of records, one with the occlusion in the displaced position and the other set at the retruded condylar position with displacements eliminated. The patient will often present complaining of upper arch (canine) crowding associated with a narrow and/or short dental arch. In such cases the crowding should not be relieved without some consideration begin given to the likely effect of future growth on the dental arch relationship. It is wise to

develop a longer-term provisional treatment plan before arranging extraction of any permanent teeth **(Ellis et al, 1984)**.

1.5.3 Treatment options

1. **No treatment**

Where crowding of the dental arches is minimal, there are no displacements apparent, and the Class III appearance of the incisors and/or the jaws is acceptable, the 'no-treatment' option is a reasonable approach to management. It also has the advantages of keeping the Class III growth tendency under review and minimizing any intervention until growth has largely finished and the jaw profile has been finally established **(Shareef et al, 2009)**.

2. **Extractions only**

In many cases where the lower arch is well aligned, the upper arch is crowded, there is no displacement and the appearance of the Class III incisor and jaw discrepancy is acceptable to the patient; under arch extractions only may appear a simple and attractive treatment. Usually upper first premolar loss is considered to facilitate the alignment of buccally excluded upper permanent canines, always provided that they are favorably (mesially) inclined **(Downs et al, 1928)**.

Great care should be taken with this approach, since upper incisors can drop back into any residual extraction space, to worsen the incisor pattern. However, on occasions it is appropriate, although an upper removable space maintainer may, in addition to its usual role, act to support the position of the labial segment **(Danaie et al, 2005)**.

3. **Removable appliance**

Treatment with an upper removable appliance works particularly well where one or two incisors are 'caught behind the bite' and there is an associated forward displacement of the lower jaw. Such an approach is most frequently

employed as an interceptive measure in the mixed dentition. An adequate overbite is essential at the completion of tooth movement to maintain the correction. Occasionally a removable appliance may be used in company with a fixed appliance to clear the occlusion during the early stages of treatment or alternatively to provide an intermittent anchor in the lower arch from which to attach Class III intermaxillary elastics to an upper fixed appliance **(Chnag et al, 2006)**.

4. **Single arch fixed appliance**

An upper single arch fixed appliance may be considered when the lower is well aligned the jaw and incisor discrepancy is acceptable to the patient. In addition there should be no displacement but there are substantial rotations in the maxillary arch. Depending on the crowding, either first or second premolars would often be extracted **(Battagel et al, 1993)**.

Fig. 6: Class III with single arch

1. Full arch fixed appliance

This would be the usual orthodontic approach to a purely dento-alveolar correction of this type of malocclusion. Before prescribing such an appliance a careful assessment is required. The underlying skeletal discrepancy should be relatively mild and susceptible to dento-alveolar camouflage; otherwise surgery will be necessary to achieve a correction. Ideally the upper incisors should at presentation be upright or retroelined and the lowers proclined, such that they may be tipped to make the correction. It is an advantage if there is also an initial anterior displacement on closure. The patient should be checked to see if they can obtain an edge-to-edge incisor contact; this is often indicative of a good prognosis for treatment providing that the incisal inclinations are favorable. Before starting such treatment due consideration should be given to the pattern of growth since if this is unfavorable it could rapidly outstrip the amount of dento-alveolar movement available to disguise the underlying horizontal skeletal discrepancy **(Baik et al, 2004)**.

In patients with a tendency towards an increased lower facial height, special care should be taken since most tooth movements in this type of case will tend to open the bite on the molars and encourage a further increase in the anterior intermaxillary height. This is especially true when upper arch expansion device are employed. In patients with this type of tendency (towards an anterior open bite), growth modification may be possible by means of a high pull headgear to the upper first permanent molars. Such an approach is very dependent on active growth and good patient cooperation **(Baker et al, 1991)**.

Fig. 7: Treatment of class III with upper and lower fixed orthodontic appliance

6. Functional appliance

A. Frankel III

The Frankel III (FRIII) regulator is a functional appliance designed to counteract the muscle forces acting on the maxillary complex. According to **Frankel (1970),** the vestibular shields in the depths of the sulcus are placed away from the alveolar buccal plates of the maxilla to stretch the periosteum and allow for forward development of the maxilla. The shields are fitted closely to the alveolar process of the mandible to hold or redirect growth posteriorly. The effectiveness of each appliance is dependent on patient cooperation and wearing them full time. In two separate studies the FRIII appliance appears to effect occlusal changes (i.e. introducing dental compensations) by proclination of upper incisors and retroclination of lower incisors **(Lob and kerr, 1985; Ulgen and Firath, 1994).**

The mandible was repositioned downward and backward, decreasing the prognathism of the mandible and increasing the lower facial height. Changes in the position of the maxilla were minimal. The best response to FRIII treatment was noted in patients with Class III malocclusions with an increased overbite of

4 to 5 mm in the early mixed dentition. The FRIII appliance can also be sued as a retentive device following maxillary protraction treatment **(Ellis et al, 1984)**.

Fig. 8: Frankel III

A. Chin cup

Skeletal Class III malocclusion with a relatively normal maxilla and a moderately protrusive mandible can be treated with the use of a chin cup **(Ishi et al, 1987)**.

Chin cups are divided into two types: the occipital-pull chin cup that is used for patients with mandibular protrusion and the vertical-pull chin cup that is used in patients presenting with a sleep mandibular plane angle and excessive anterior facial height **Frankel (1970)**.

The objective of early treatment with the use of a chin cup is to provide growth inhibition or redirection and posterior positioning of the mandible **(Bittner et al, 1990)**.

Effects on mandibular Growth

The orthopedic effects of a chin cup on the mandible include **(D. Nicodemo et al, 2008)**;

(1) Redirection of mandibular growth vertically.

(2) Backward repositioning (rotation) of the mandible.

Force Magnitude and Direction

Most of the reported studies recommended an orthopedic force of 300 to 500 g per side **(Ishi et al, 1987; Uner et al, 1995; Deguchi and Kitsugi, 1996).** Patients are instructed to wear the appliance 14 hr/day. The orthopedic force is usually directed either through the condyle or below the condyle.

Treatment Timing and Duration

Evidence exists that treatment to reduce mandibular protrusion is more successful when it is started in the primary or early mixed dentition **(Graber, 1977; Uner et al., 1995).** The treatment time varies from 1 year to as long as 4 years depending on the severity of the original malocclusion.

Effects on the Temporomandibular Joint

There is some concern on the adverse effect of chin cup appliance on the TMJ. In a study by **Deguchi and Kitsugi (1996),** several patients complained of temporary soreness of the TMJ during the retention period. Of 40 patients, 2 continued to have TMJ pain and some degree of difficulty in opening the mouth after the end of active treatment several studies indicated that the chin cup affects the growth of not only the mandible, but also the cranial base structures as well **(Ritucci and Nanda, 1984).**

Fig. 9: Chin cup

A. Protraction face mask

The face mask is most effective in the treatment of mild to moderate skeletal Class III malocclusions with a retrusive maxilla and a hypodivergent growth pattern **(Bishara, 2001).**

In **1944 Oppenheim,** believed that one could not control the growth or anterior displacement of the mandible and suggested moving the maxilla forward in an attempt to counterbalance mandibular protrusion.

In the **1960 Delaire** revived the interest in using a face mask for maxillary protraction.

Petit 1983 later modified Delair's basic concept by increasing the amount of force generated by the appliance, thus decreasing the overall treatment time.

In **1987 McNamara** introduced the use of a bonded expansion appliance with acrylic occlusal coverage for maxillary protraction.

Turley 1988 improved patient cooperation in wearing the appliance by fabricating customized face masks.

Parts of protraction face mask

The protraction face mask is made of two pads that contract the soft tissue in the forehead and chin region. The pads are connected by a midline framework and are adjustable through the loosening and tightening of a set screw. Also it contains an adjustable anterior wire with hooks that connected to the midline framework to accommodate a downward and forward pull on the maxilla with elastics. To minimize the opening of the bite as the maxilla is repositioned; the protraction elastics are attached near the maxillary canines with a downward and forward pull of 30 degrees to the occlusal plane **(Flanary et al, 1990)**.

Force magnitude

Maxillary protraction generally requires 300 to 600 g of force per side, depending on the age of the patient. Tension of the elastics can be estimated using a tension stress gauge. Patients are instructed to wear the face mask for 12 hours a day **(Gresham et al, 1957)**.

Treatment time and duration

Some studies suggest that face mask/ expansion therapy may be most effective in the primary and early mixed dentitions **(Jager et al, 2000)**.

Clinically, anterior cross bites can be corrected with 3 to 4 months of maxillary expansion and protraction depending on the severity of the malocclusion. Improvement in overbite and molar relationship can be expected with an additional 4 to 6 months of maxillary protraction **(Jacobson et al, 1974)**.

Rapid maxillary expansion (RME)

The design of anchorage system for maxillary protraction varies from palatal arches to rapid maxillary expansion (RME) appliances. Most of the studies done by **Ngan et al (1997); Baik (1995) and Nada (1989)** utilize palatal expansion to "disarticulate" the maxilla and initiate cellular response in the circummaxillary sutures, allowing a more positive reaction to protraction forces.

In a study by **Baik (1995),** patients treated with a protraction face mask were divided into two groups with or without RME. The author found significantly greater forward movement of the maxilla (+2.0 mm) when protraction was used in conjunction with RME compared with protraction without RME (+0.9 mm). Does it make a difference if protraction was initiated during palatal expansion or after expansion? In the same study greater forward movement of the maxilla (+2.8 mm) was found when protraction was initiated during maxillary expansion compared with protraction after expansion (+1.85 mm).

Fig. 10: Protraction face mask

7. Orthognathic surgery

Orthognathic surgery, which is performed by the surgeon in conjunction with the orthodontist, is used for the treatment of dentofacial deformities, and is not only important for the correction of malocclusion but also for facial esthetics. Patients with dentofacial deformities present problems of adjustment and social adaptation, with negative consequences for their mental health. Thus, the psychosocial aspects of surgery, such as changes in body image and emotional and cognitive states, improvement of interpersonal relationships and alterations in the reactions of society play an important role **(Flanary et al 1990, Grossbart et al 1999, Ferreira et al 2004)**, Patients with dentofacial deformities require a surgical orthodontic approach, and improvement of their quality of life is one of the objectives of this type of intervention **(Cunningham et al 2002)**.

This has become increasingly popular in the treatment of patients with moderate to severe Class III skeletal discrepancy. An initial orthodontic phase is usually necessary in these patients to decompensate the arches by putting the teeth in the ideal positions to facilitate the surgery. The maxilla may be advanced or the mandible pushed back as the patient's profile and occlusion demands. Often a combination of upper and lower jaw surgery is necessary with the addition of a reduction genioplasty of the chin. Vertical skeletal excess may be dealt with by the addition of a Le Fort I posterior impaction osteotomy. This is a commonly employed approach to the problem of skeletal anterior open bite. Over the last decade surgical correction has become a common approach to patients with significant Class III jaw and/or facial profile discrepancies. Approximately 30-40 percent of patients presenting with a Class III might be suitable to consider a surgical correction. If a young patient shows early signs of developing such a problem and there is a chance of further unfavorable growth, dento-alveolar camouflage generally should be avoided. Such untimely

interventions can create problems later if orthognathic correction is to be considered. Surgery in these cases would usually be performed when all growth has ceased since otherwise there is a danger of the skeletal discrepancy regrown **(Nicodemo et al 2008)**.

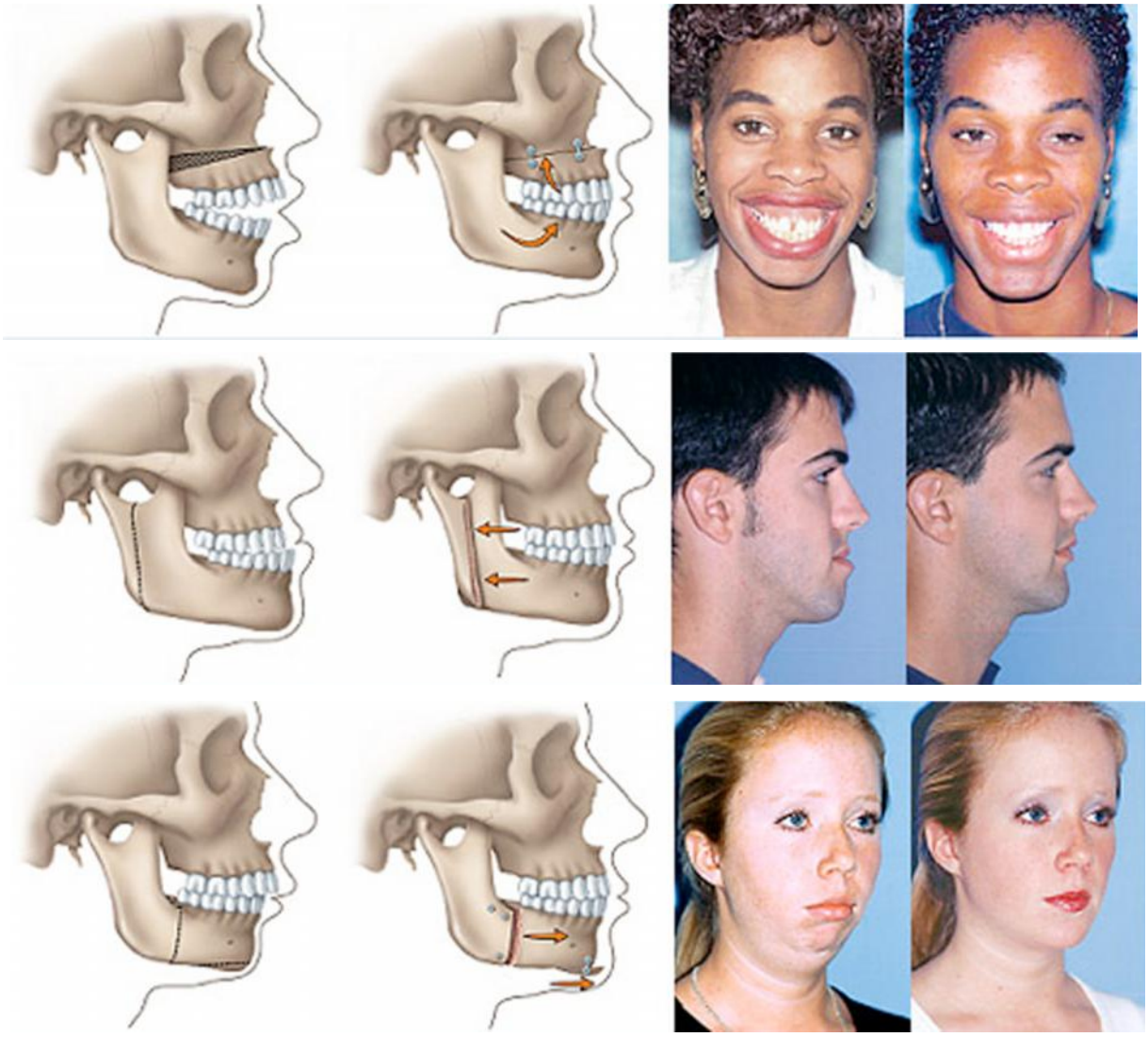

Fig. 11: Sever class III malocclusion with orthographic surgery

1.6 Post-treatment stability

Stability of overjet correction depends in the short term on an adequate overbite and in the long term on facial growth. The greater part of orthodontic treatment is undertaken in the growing patient. On average, the mandible grows downwards and forwards slightly faster than the maxilla. In Class III patients this is an adverse growth trend and may result both in a worsening (or relapse) of the overjet and a reduction in overbite. An early sign of this happening is loss of overbite on the upper lateral incisors with the result that they relapse into a reverse overjet. In some patients the Class III skeletal pattern will become markedly more sever after treatment and in these cases relapse is inevitable. In other patients the facial proportions change little during the later stages of growth and no adverse occlusal changes should result. In Class III, more than in other types of malocclusion, long-term stability depends on a favorable growth pattern, and this holds true whatever treatment approach is adopted **(Jones and Oliver, 2000).**

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