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SURGICAL MANAGEMENT OF SKELETAL CLASS II DIV 1 MALOCCLUSION: A REVIEW

Dental Science

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ABSTRACT

Class II malocclusions can be either dental or skeletal in origin. Dental malocclusions can be corrected by pure orthodontics, but an option between growth modulation, camouflage and surgery exists for those patients whose cause of malocclusion is skeletal in origin. If the patient is adult whose growth has been completed, the number of options is reduced to either surgical, or camouflage. To achieve ideal occlusion and Harmony amongst the skeletal jaw bases, surgery is till date the best option. Various surgeries are available that assist in correction of the malocclusion, depending upon which jaw is at fault. This review article highlights such types of surgeries and their appropriate use.

KEYWORDS

INTRODUCTION

Skeletal Class II includes malocclusion with a subnormal distal mandibular development in relation to the maxilla. The skeletal Class II is further divided into two divisions based on the features commonly seen with a mandible placed in a retruded position. In Class II Div 1, the maxillary dental arch is narrow, has crowding in the canine region, a cross bite may be present and the vertical face height is decreased. The maxillary anterior teeth are protruded and the profile is retrognathic.[1]

Since Skeletal class II problems are either due to a mandibular deficiency, the downward and backward rotation of the mandible due to vertical maxillary excess or due to the advanced maxilla. Surgical treatment includes advancement of the mandible, superior repositioning, retraction of the maxilla or a combination of any. Mandibular deficiency is the problem in almost two-third of the surgical patients while one third require maxillary surgery. Although orthodontic camouflage is also an option, which is based on the extraction of premolars and retraction of the anteriors, correcting both the dental occlusion and facial esthetics without correcting the underlying skeletal problem2, still an increasing amount of surgery is being performed to correct the underlying skeletal problem in the treatment of adult malocclusion.[3,4]

Skeletal characteristics of Class II div 1 malocclusion

In general, Class II cases with anteroposterior skeletal discrepancies are characterized by reflecting the malrelationship between the maxilla and mandible.

- Usually associated with skeletal Class II pattern, due to retrognathic mandible.
- Skeletal Class II pattern due to prognathic maxilla.
- Combination of prognathic maxilla and retrognathic mandible.
- The anteroposterior skeletal discrepancies may also be accompanied by a vertical discrepancy, for example, a relatively long or short anterior face.

Cephalometric characteristics of the Class II Division 1 malocclusion
Class II cases with anteroposterior skeletal discrepancies are characterized by a large ANB angle and Wits Appraisal.[5]

Fisk et al described the following six possible morphological variations in their dentofacial complex:

(1) The maxilla and teeth are anteriorly situated in relationship to the cranium;
(2) The maxillary teeth are anteriorly placed in a normally positioned maxilla;
(3) The mandible is of normal size, but posteriorly positioned;
(4) The mandible is underdeveloped;
(5) The mandibular teeth are posteriorly placed on a mandible that is in a normal position;
(6) Various combinations of the above relationships.

On the other hand, the mandible was significantly retrusive with the chin located farther posteriorly resulting in a larger angle of facial convexity. Some authors believes that Class II and normal individuals have essentially the same composite pattern except that the body of the mandible appears shorter and the lower first molars are more posterior in the Class II Division 1 cases.[6]

Principles of Orthognathic surgery

Three kinds of treatment are available when malocclusion is caused by severe skeletal discrepancies:

1. Growth modification: In growing children, dentofacialorthopedics can alter the expression of growth to some extent.

2. Orthognathic camouflage: Dental compensation for a skeletal deformity, or orthodontic camouflage, not only can compromise or even impair the esthetics but also can jeopardize the stability of the results. This option may also increase the treatment time.

3. Orthognathic surgery: Combined orthodontic and surgical correction is considered the best treatment modality for dentoskeletal imbalances once growth has ceased.

Key principles of surgical care and overall patient care include psychologic preparation of the patient, good preoperative and postoperative nutrition; preservation of blood supply to the mobilized teeth and jaw segments; protection of bone, neurovascular structures, and teeth, appropriate postoperative wound management, fixation of bony segments, proper control of occlusion and rehabilitation to full jaw function.[7]

Sequence of Treatment

Preoperative orthodontics basic objective includes (1) levelling and alignment of teeth over basal bone, (2) correcting (reversing) dental

compensation, (3) establishing proper incisor inclination, (4) transverse arch width, and (5) maintenance of the dental midline.

Esthetic Treatment Planning for Orthognathic SurgeryWhen planning treatment for the correction of dentofacial deformities, facial and airway needs should be addressed concurrently with occlusal correction.

Step 1: Orthodontic Preparation

Orthodontic incisor inclinations have a significant effect on the nasal base and chin projection obtained with orthognathic surgery. Dental and facial discrepancies are often disproportionate because of dental compensations to the anteroposterior skeletal misalignment. These dental compensations involve axial inclination changes of the incisors in response to increased or decreased overjet.[8]

Thus while determining the incisor positioning needs for treatment, all factors - crowding, periodontal needs, lip and facial support, and airway implications - should be considered. Generally speaking, all dental compensations should be removed prior to surgery.

Orthodontic Premolar/Molar Positioning

The best recommendation for buccal segment control is to keep the teeth and roots in the alveolar bone without dental expansion or labial crown torque. Segmental maxillary surgery can manage arch form and arch-width issues without the risk of dental relapse or periodontal decline associated with orthodontic expansion of the maxillary posterior segments. Excessive orthodontic buccal crown torque, in particular, can lead to complications in orthognathic surgery. Multi-segment surgical uprighting of excessive posterior buccal crown torque may result in unpredictable and excessive flaring of the nasal base.[8]

Step 2: Facial examination

Facial examination should be simple yet comprehensive, always considering the airway in the process. Examination should involve standardized clinical posturing of the patient, including natural head posture, centric relation and relaxed lip posture. In this way, actual soft-tissue/hard-tissue relationships can be visualized and recorded in all three planes of space.[8]

As with cephalometric analyses, hundreds of facial soft-tissue traits have been proposed and studied. Selection of a trait for facial examination should depend on a high correlation with successful orthodontic and surgical facial outcomes. The traits used were described in detail by Arnett and Bergman in 19939. Three questions were asked relative to each trait:

1. What is the quality (good or bad) of the existing facial trait? For instance, how is the upper lip positioned in profile: protrusive, normal, or retrusive?

2. How will orthodontic tooth movement to correct the bite affect the existing trait (positively or negatively)? If orthodontic tooth movement results in unacceptable facial balance or facial esthetic decline or leaves sleep apnea symptoms untreated, surgery is indicated.

3. When surgery is necessary, which surgery (maxillary, mandibular, or both) will normalize negative facial traits and maintain positive traits while correcting the bite and the airway?

Answering these three questions allows to develop the ideal treatment plan, as determined by the facial examination. Orthodontic tooth movement alone may produce a satisfactory occlusal and facial correction, if not, then surgery of one or both jaws may be necessary.9

Step 3: Esthetic cephalometric treatment planning

After documentation of clinical facial traits, the treatment plan is further clarified with esthetic cephalometric treatment planning as described by Arnett and Gunson.8 Four treatment plans are attempted for each patient: orthodontics alone, orthodontics plus mandibular surgery, orthodontics plus maxillary surgery, and orthodontics plus surgery on both jaws. Esthetic cephalometric planning for orthognathic surgery involves seven substeps:

1. Maxillary incisor angulation to the maxillary occlusal plane (orthodontic tooth movement)
2. Mandibular incisor angulation to the mandibular occlusal plane (orthodontic tooth movement)
3. Overbite correction (may be obtained with substeps 1 and 2)
4. Overjet correction (may be obtained with substeps 1 and 2)
5. Esthetic anteroposterior and vertical maxillary incisor positioning (may be obtained with substeps 1 and 2 or maxillary surgery)
6. Occlusal plane manipulation to produce esthetic anteroposterior positions of the nasal base and chin (requires two-jaw surgery)
7. Chin osteotomy when necessary (only after steps 1-6)

Surgical techniques: Maxillary surgery

1. Le Fort I osteotomy for maxillary repositioning and distraction techniques

Indications:

- The Le Fort I osteotomy can be used to correct a variety of maxillofacial problems.
- To correct maxillary prognathism
- Superior repositioning of the maxilla, to correct vertical maxillary excess
- Inferior repositioning of the maxilla, to correct vertical maxillary deficiency
- Widening of the maxilla, to correct transverse discrepancies
- 3D repositioning of the maxilla (segmental osteotomies)
- In all instances of apertognathia, Le Fort I osteotomy should be given consideration because of the stability issues.

The three pieces maxillarysegmentation is commonly performed in the Le Fort I osteotomy with down fracture, expansion and three dimensional repositioning (LFI-E), nowadays segmented Le Fort I is frequently associated with other techniques like surgical assisted rapid palatal expansion (SARPE), tooth-borne or bone-borne distraction for specific consideration about related problems, complications and indication:

1. In maxilla, two pieces sagittal segmentation for palatal expansion, relapse is a frequent problem, in association with heavy limits to palatal expansion for fibro-mucosa inextensibility and related risks of aseptic necrosis for excessive tension of the fibromucosa (Cortese, 2014).

2. Even if in maxillary three or four pieces segmentation for palatal expansion and occlusal plane levelling, fibro-mucosa tension is distributed in multiple sites, the aforementioned problems and complication occur any way for the extensive dissection need of the palatal fibro-mucosa; moreover multiple segment management during operation is difficult.[10]

3. About the maxillary segmentation technique for space closure after bicuspid extraction for Class II correction, it is nowadays frequently avoided in favour of mandibular advancement alone or in combination with maxillary expansion for correct interdental arches relations after mandibular advancement.

2. Classic maxillary segmentation techniques: Anterior sub-apical osteotomies Segmented maxillary osteotomy surgery was usually performed in the decade of the sixty years to achieve correction of class II malocclusions by frontal teeth set back following the techniques of Wassmund and Wunderer.11 With the evolution of the Le Fort I osteotomy techniques this anterior subapical osteotomy for pre-maxilla set back was relegated for few particular cases because new concepts about beauty of the face and cephalometric and photometric analysis suggest that maxillary and upper frontal teeth are usually in good position for most of the patients with class II malocclusions (Arnett &Gunson, 2010).[8]

Also in that few cases where upper frontal teeth are in a protruded position these condition is frequently associated with a narrowed palate: by transversal palatal expansion a consequent set back of the upper teeth is achieved by an orthodontic dentoalveolar movement related to basal bone and dentoalveolar enlargement in the transversal dimension.

Marcos et al stated that 3 years after the segmental Le Fort I osteotomy and orthodontic treatment, no TMD sign or symptom was observed and the occlusal results had not changed.[12]

Kretschmer stated that segmentation of the maxilla does not provoke

major skeletal or dental instability and should be considered whenever indicated. Adequate bone grafting provides good stability in anterior and inferior repositioning of the maxilla.[13]

Balachander et al concluded that the cosmetic correction was achieved by superior repositioning of maxilla with Le Fort I osteotomy, along with orthodontic treatment. The patient's facial appearance was markedly improved along with functional and stable occlusion.[14]

Problems and complicationsof maxillary surgery: Nasal airway obstruction, Facial oedema, Residual bleeding, Maxillary bone necrosis, Bad fracture of maxillary bones,Malpositions and Dislocation and Periodontal defects

Surgical techniques: Mandibular surgery

1. Bilateral Sagittal Split Osteotomy

Nowadays bilateral sagittal split osteotomy (BSSO) is the most common technique for treatment of mandibular skeletal deformities.

Advantages

- Healing is quick because of a good bony interface
- Three dimensional flexibility in repositioning the distal fragments.
- Broad bony overlap of osteotomized segments
- Minimal alteration of the position of muscles of mastication – prevents relapse from muscular traction
- The surgery can advance or set back the mandible, correct most asymmetries
- Rigid fixation can be used, eliminating the need for MMF. Rigid fixation significantly improves the stability and predictability of results.
- Minimal alteration of the position of TMJ – prevents postoperative TMJ dysfunction

According to Colin A.Mihalik (2003)2 it was observed that patient's perception of outcomes were highly positive in both the orthodontic and surgical groups. The orthodontics only (camouflage) patients reported fewer functional or temporomandibular joint problems than did surgery patients and had similar reports of overall satisfaction with treatment, but patient who had their mandibles advanced were significantly more positive about their dentofacial images.

According to Brittany Potts (2009)15presurgical orthodontics treatment often does not fully decompensate the incisors, this then limits the surgical outcomes.

It has been shown that mandibular advancement by a modified sagittal osteotomy proves to be an acceptable procedure with good skeletal stability16and resulted in greater reduction of overjet and greater improvement in most cephalometric skeletal, dental, and soft tissue criteria.[17]

Hans et al18 A negative effect of treatment counteracting Class II correction had an increase in the mandibular plane angle. Such an angular increase would also be a disadvantage, especially in those Class II subjects with increased anterior facial height.

Ruf and Pancherz (2004)19 For Class II correction, the success rate and predictability of Herbst treatment is as high as for orthognathic surgery. If, however, the patient's main wish is a greatly improved facial profile, orthognathic surgery is the better treatment alternative.

Kinzinger, Frye and Diedrich (2008)20 concluded that in young adults fixed functional appliances can be considered as a treatment alternative to extraction therapy but to a lesser extent to orthognathic surgery. Because of their limited skeletal effects and minor changes in the profile they were indicated only in patients with a moderately severe Class II malocclusion. Pre-treatment proclined mandibular incisors limit the scope of indications for fixed functional appliances, as they can cause an increase in lower incisor proclination. Significant reductions in profile convexity are achievable only by combined orthodontic and surgical treatment of the malocclusion.

Complications:Injury to inferior alveolar nerve, Avascular necrosis, Acute/progressive condylar resorption, Malpositioned proximal segment, TMJ Dysfunction and hypomobility,Haemorrhage and Relapse during correction of Class II problems.

2. Genioplasty

Among the various orthognathic surgical procedures, genioplasty is one of the most widely performed surgical procedures used for correcting chin deformities.[21]

(i). Radiographic evaluation
(ii). Evaluation of face: The correct method of evaluating the face should always be with the teeth in occlusion and the lips in response.

a. Frontal analysis: The mandible should have a smooth and well defined inferior border, from angle to chin, along with a definite separation of the lower third of the face from the neck region. The size, shape, and form of the chin should be in harmony with the gender and the particular facial type of the patient.

Transversedimensions: People with leptoprosopic (narrow and long) facial features also usually have ―pointed chins, transversely deficient chins that seem separate from the mandible on the other hand, dolicoprosopic (broad and wide) faces usually have strong broad chins.[22]

Verticaldimensions: The height of the labiomental fold to soft tissue menton (Me) should be equal to the distance from the lower lip stomion (Stms) to the labiomental fold.[21]

Symmetry: The symmetry of the chin is evaluated in relation to both the dental and the facial midline of the mandible.

b. Profile analysis: The chief contributing factors that are responsible for the chin contour or shape is the anteroposterior position of the lower lip, the height and depth of the labio-mental fold, lip-chin-submental angle, chin-neck length, chin throat angle (cevico-mental angle) and the shape of the chin button.[21]

Advantages of chin osteotomy

1. Very versatile procedure
2. Corrects vertical problems
3. Corrects AP excess and asymmetry
4. Stable over time
5. Increases submental length and cervicomental angle.
6. Advances genial-tongue-hyoid position of benefit in sleep apnea.

Disadvantages of chin osteotomy

1. Requires osteotomy, adding risk from surgery and anesthesia.
2. Significant surgical armamentarium.
3. Significant micro droplet blood aerosol.
4. Vascular injury risk.
5. Airway embarrassment risk
6. Not easily reversible.

Currently, the horizontal sliding osteotomy of the mandibular symphysis with advancement of the mobilized segment is the technique of choice for correction of anterior posterior deficiency, known as microgenia (decrease of chin eminence with an essentially normal mandible). This technique achieves harmony of the lower face because the results are predictable and stable. [23]

Shaughnessy et al24 concluded that (1) Advancement genioplasty appears to be a fairly stable procedure. Three years after surgery, mean relapse at Pg was 8.2% of the surgical advancement. Part of this change is most likely due to bone remodelling. (2) The soft tissue of the chin was found to follow the bony movement in a ratio of 0.9:1. (3) Mentolabial fold depth increased as a result of the treatment. (4) Effects of advancement genioplasty on the lips were small. No change in lip thickness could be noted.

Stephen (2010)25The Sagittal split genioplasty is a new variation of the sliding osteotomy genioplasty technique for correction of the small and retrusive chin. The frontal hourglass deformity and lateral notching with increased soft tissue jowling are thus eliminated, leading to an improved esthetic result.

Kumar et alstated that vertical reduction and advancement genioplasty can be considered as an adjunctive procedure that produces predictable results and the bony and soft tissue stability were generally very good.[26-27]

Sylvain et al They concluded that the outcomes of forward-upward genioplasty including increased symphysis thickness, bone apposition above point B, and remodelling at the inferior border.[28]

(iv). Postoperative Complications:are tooth devitalization, neurosensory loss, soft tissue chin ptosis, dental root exposure, asymmetry and irregularities and step deformities.[21]

CONCLUSION

A Class II malocclusion may be accompanied by an anteroposterior skeletal discrepancy between the maxilla and mandible, often with mandibular retrusion, however the maxilla may also be protrusive.

Orthognathic surgery relies on a close collaboration between the surgeon and the orthodontist across all stages of treatment, from preoperative planning to finalization of occlusion.

Using these three steps (1) Orthodontic preparation (2) Facial examination (3) cephalometric diagnosis and treatment planning approach, the orthodontist and oral surgeon can reliably produce bite correction, facial balance, and airway patency.

Thus to paraphrase, Diagnosing and treating a skeletal problem at an early age is always beneficial and in the past it was the sole way of correcting these types of deformities. But now with the advent of newer techniques and technology surgical orthodontics has a major role in treating and giving a better life to people with these types of deformities.

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