Correction of Dentofacial Deformities (Orthognathic Surgery)

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Definition

- Orthognathic surgery is a combination of orthodontic treatment and surgery of the jaw to correct or establish a stable functional balance between the teeth, jaws and facial structures.
- Greek “orthos” means straight and “gnathos” means jaw.

Aims of orthognathic surgery

- To treat any jaw imbalance and the resulting incorrect bite, which could adversely affect the cosmetic (esthetic) appearance as well as the proper functioning of the teeth.
- Aims:
  1. Function: Normal chewing, speech, respiratory function.
  2. Esthetics: Establish facial harmony and balance.
  4. Minimize orthodontic treatment time.

Causes of dentofacial deformity

1. Congenital (e.g., hemifacial microsomia, mandibulofacial dysostosis “Treacher-Collins syndrome”, cleft lip and palat).
2. Prenatal Problems (e.g. hypoplasia of midface due to fetal alcohol syndrome).
3. Environmental influences (e.g. abnormal tongue and lip postures, mouth breathing).
4. Trauma (e.g. TMJ trauma).
**Causes of dentofacial deformity**

- Treacher Collins syndrome
- Hemifacial Microsomia
- TMJ trauma

**Dental Dysplasias**

- Dental dysplasias are limited strictly to malocclusions that result from abnormal relationship of the dentition and not from the skeletal position of the upper and lower jaws.
- These can be corrected with orthodontic treatment.

**Skeletal Dysplasias**

- In patients with skeletal dysplasia only, the dentition is in good alignment, but the maxilla and/or mandible are dysplastic.
- Skeletal dysplasias require correcting the skeletal deformity without altering the occlusion.
Dento-Skeletal Dysplasias

• In dento-skeletal dysplasias, the dentition is mal-positioned within each arch and with each other; additionally, the skeletal relationship of the upper and lower jaws is abnormal.
• These are corrected with orthognathic surgery (ortho + surgery)

Evaluation of patients with dentofacial deformities

Clinical examination:
1- full face and profile
2- photographic document
3- dental arch examination
4- TMJ and muscles of mastication
5- Steriolithic model

Radiographic examination:
1. Cephalometric
2. Panoramic
3. Postero-anterior facial films
4. T.M.J. films
5. CBCT
6. C.T. scan

Evaluation of patients with dentofacial deformities

A, Cone beam computed tomography scan clearly demonstrating bone deformity in three dimensions. B, Stereolith graphic model.

Model surgery used to determine direction and distance of surgical movement necessary to achieve desired postoperative occlusion and facial esthetics.
Evaluation of patients with dentofacial deformities

A and B, CT and CBCT Three-dimensional imaging and virtual planning. C and D, The splints are then designed and constructed using CAD-CAM rapid prototyping technology.

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Treatment Phases

1-PRESURICAL TREATMENT PHASE
• Periodontal Considerations
• Restorative Considerations
• Presurgical Orthodontic Considerations
• Final Treatment Planning

2- SURGICAL TREATMENT PHASE

3- POSTSURGICAL TREATMENT PHASE
• Completion of Orthodontics
• Postsurgical Restorative and Prosthetic Considerations

Timing of Surgery
• Usually done when all growth is complete.
• Assessed by superimposition of serial lateral cephalometrics.
• Can be performed when growth is not yet complete in cases of psychosocial problems or great severity when function is compromised (i.e. breathing, chewing).

Procedures
• The surgery might involve one jaw, or the two jaws at the same time (bi-maxillary osteotomy).
Steps:
• Making cuts as planned in the bones (ostectomy).
• Repositioning the cut pieces in the desired alignment.
• Fixation by wires, plates, or screws.
Methods of bone cutting:
• By using special electrical saws, burs and manual chisels.
• Recently by using ultra-sound waves (piezo surgery).
Types of Dentofacial abnormalities

1. Mandibular Excess
2. Mandibular Deficiency
3. Maxillary Excess
4. Maxillary and Midface Deficiency
5. Combination Deformities and Asymmetries

Mandibular Excess (Mandibular Prognathism)

Clinical features:
- Abnormal occlusion with class III molar and cuspid relationships
- A reverse overjet in the incisor area with posterior crossbite
- Flat appearance of the mid face
- Concave profile
- Obtuse gonial angle.
- Diminished labio-mental fold
- Acute naso-labial angle
- Posterior crossbite

Surgical techniques for correction of mandibular prognathism

1) Bilateral sagittal split osteotomy (BSSO)
2) Vertical ramus osteotomy
3) Body osteotomy
4) Anterior mandibular subapical osteotomy.

1-Bilateral sagittal split osteotomy (BSSO)

- The osteotomy splits the ramus and posterior body of the mandible in a sagittal fashion which allows either setback or advancement of the mandible.
2- Vertical ramus osteotomy

- In this technique the lateral aspect of the ramus is exposed through a submandibular incision, the ramus is sectioned in a vertical fashion, and the entire body and anterior ramus section of the mandible are moved posteriorly, which places the teeth in proper occlusion.

3- Body osteotomy

- By removing sections of bone in the body of the mandible, which allowed the anterior segment to be moved posteriorly.
- Could be done through intra-oral, or extra-oral approach or combination.

4- Anterior mandibular subapical osteotomy.

- When the reverse overjet relationship is isolated to the anterior area of the mandible, a subapical osteotomy technique can be used for correction of mandibular dental prognathism.
- In this technique, bone is removed in the area of an extraction site of a bicuspid or molar tooth, and the anterior dentoalveolar segment of the mandible is moved to a more posterior position.
Mandibular Deficiency (Mandibular Retrusion or Micrognathia)

Clinical features:
- Retruded position of the chin as viewed from the profile (bird face deformity)
- Excess labio-mental fold
- Abnormal posture of the upper lip, and poor throat form.
- Intraorally, class II molar and cuspid relationships
- An increased overjet in the incisor area with incisor crowding in the lower jaw
- Acute gonial angle.

Surgical techniques for correction of mandibular deficiency

1) Vertical osteotomy and iliac crest bone grafts in the osteotomy defect.
2) Bilateral sagittal split osteotomy (BSSO)
3) Total mandibular subapical osteotomy.
4) Inferior border osteotomy (Genioplasty) with advancement.

1- Vertical osteotomy and iliac crest bone grafts in the osteotomy defect.

- Mandibular advancement using vertical osteotomy and iliac crest bone grafts in osteotomy defect.

2-Bilateral sagittal split osteotomy (BSSO)

- This procedure is easily accomplished through an intraoral incision. The significant bony overlap produced with the BSSO allows for adequate bone healing and improved postoperative stability.
Bilateral sagittal split osteotomy with advancement of mandible.

3- Total mandibular subapical osteotomy:
- Indicated when the antero-posterior position of the chin is adequate but a class II malocclusion exists.
- By combining the osteotomy with interpositioned bone grafts, this technique can be used to increase lower facial height.

4- Inferior border osteotomy (Genioplasty):
- When a proper occlusal relationship exists or when anterior positioning of the mandible would not be sufficient to produce adequate projection of the chin, an inferior border osteotomy (i.e., genioplasty) with advancement is performed.

Maxillary excess (maxillary protrusion)

- Clinical features:
  - Elongation of the lower third of the face
  - Excessive gingival & incisal exposure (gummy smile).
  - Lip incompetence
  - A narrow nose
  - Convex facial profile
  - Class II molar occlusion
  - High arched palate.

Maxillary and Midface Deficiency

- Clinical features:
  - A retruded upper lip.
  - Deficiency of the paranasal and infraorbital rim areas.
  - Inadequate tooth exposure during smile.
  - A prominent chin relative to the middle third of the face
  - A class III malocclusion with reverse anterior overjet
Orthognathic surgeries of maxilla and midface

1. Anterior maxillary osteotomy (Wassmund approach).

2. Total maxillary osteotomy.
   - Le Fort I osteotomy.
   - Le Fort II osteotomy.
   - Le Fort III osteotomy.

Anterior maxillary osteotomy (Wassmund 1935)

- Indicated for correction of dento-alveolar protrusion of anterior maxilla.
- The anterior segment can be moved: Superiorly, Inferiorly, posteriorly.

Indications:
- maxillary protrusion
- marked protrusion of maxillary teeth
- open bite

Total maxillary osteotomy.
(complete le fort I osteotomy)

- By creating a le fort I fracture to allow mobilization of the maxilla and articulation in any other position desired. (backward/forward/upward/downward/rotation), Then fixation in its new place using miniplates.

Indications:
1. Treatment of maxillary protrusion and retrusion.
2. Correction of open and closed bite.

Le Fort II osteotomy

- For patients with central midface hypoplasia extending into the naso-ethmoidal area.
- It allows a certain amount of lengthening of the midface, especially of the nose with a complete advancement of the central midface.
Complete craniofacial dysjunction by the LeFort III osteotomy allows the surgeon to alter the orbital position and volume, zygomatic projection, position of the nasal root, fronto-nasal angle, and position of the maxilla and to lengthen the nose. Used primarily for correction of total midface hypoplasia, usually of cranio-synostotic origin as in: Alpert syndrome and Crouzon’s syndrome.

bi-maxillary osteotomy
(Maxillary and mandibular osteotomy)

Le Fort I osteotomy for maxillary advancement and bilateral sagittal osteotomies for setback of the mandible.

Postoperative facial appearance.
Complications of orthognathic surgery

1. Vascular complications.
2. Nonunion or delayed union.
3. Dental and periodontal defects.
5. Unanticipated fractures.
6. Temporomandibular joint dysfunction.
7. Postoperative occlusal discrepancies.

Distraction Osteogenesis

- Distraction osteogenesis (DO), also called callus distraction, callotasis and osteodistraction
- It is the process of generating new bone in a gap, created by osteotomy, between two bone segments in response to the application of graduated controlled tensile stress across the gap

Advantages of DO

1. Large volume of new bone formation.
2. Simultaneous regeneration of both hard and soft tissues.
3. Complex 3D bone reconstruction.
4. No additional bone graft.
5. Decreased bone resorption.
7. Less relapse.
Indications of distraction Osteogenesis

1. Children or infants with severe retrognathia associated with a syndrome (Pierre Robin syndrome, Treacher Collins).
2. Unilateral hypoplasia of the mandible (Hemifacial microsomia).
3. Mandibular hypoplasia due to trauma and/or ankylosis of the temporomandibular joint.
4. Nonsyndromic mandibular hypoplasia associated with a dental malocclusion where movement of mandible required is >10mm.
5. Severe obstructive sleep apnea in patients who are morbidly obese.
6. Shortened vertical height of the alveolar bone to receive an implant.

Distraction Osteogenesis

Distraction Osteogenesis

- Craniofacial distraction devices classification:
  1. External (bone borne)
  2. Internal (tooth borne or bone borne).
    a. Intraoral.
    b. Subcutaneous.
- According to the direction of bone formation can be classified as:
  1. Unidirectional
  2. Bidirectional
  3. Multidirectional

Unidirectional Intraoral device
Distraction Osteogenesis

Sequential periods of DO:
1. Osteotomy.
2. Latency.
3. Distraction.
5. Remodeling.

1- Osteotomy

- Division of bone in two segments.
- Triggers bone healing (# healing)
  - Recruitment of osteoprogenitor cells.
  - Osteoinduction
  - Osteoconduction
- Typically, a linear osteotomy is created through the mandible with burs or saws, except in the location of the inferior alveolar neurovascular bundle. The osteotomy is completed with osteotomes.

2- Latency period

- Period from bone division to onset of traction.
- Represents time allowed for callus formation.
- Sequence of events
  - Hematoma
  - Clot
  - Bone necrosis at the ends of segments
  - Ingrowths of vasoformative elements & cellular proliferation
  - Stage of inflammation (1-3 days)
  - Clot is replaced by granulation tissue
  - Granulation tissue is converted to fibrous and cartilage tissue
  - Callus formation
- The latency period ranges from 0 to 10 days, although the most common latency period is 5 days, and is applicable in adults.
3- Distraction period

- Application of traction forces to osteotomised bone segments.
- Bone segments are gradually pulled apart resulting in formation of new bone tissue with progressively increasing inter-segmentary gap.
- The gold standard for clinical distraction osteogenesis is 1 mm per day, divided into 2 or 4 activations per day.

4- Consolidation period

- Time between cessation of traction and removal of distraction devices.
- This period represents the time required for complete mineralization.
- The consolidation period in adults should be a minimum of 3 months and can extend up to 6 months as needed.
- Consolidation time is related to the magnitude of the distraction distance and the age of the patient.

5- Remodeling period

Period from the application of full functional loading to the complete remodeling of newly formed bone.

Last stage of cortical reconstruction (1 year)