Distraction osteogenesis is a process that results in new bone formation between the surfaces of bone segments gradually separated by incremental traction. The volume of soft tissue adjacent to the generating bone is also increased.
• **DO can:**
  - Lengthen bones
  - Increase volume of bones 3-dimensionally
  - Increase the soft tissue envelope
  - Decrease relapse
  - Used for craniofacial hypoplasia


• **DO cannot:**
  - Decrease bone length
  - Retroposition bones

• **To Distract:**
  - If magnitude is too great for other procedures to be stable
  - If function demands early and/or large magnitude correction
  - If stability is better with DO
  - If it sets up the patient for a more stable and precise definitive procedure at skeletal maturity
  - If skill of the team can deliver an excellent result
Diagnostic Decisions

- Timing of distraction
- LeFort I vs LeFort III
- Osteotomy/Osteotomy design in the mandible
- Internal vs External Distraction Devices
- Distal segment manipulation
- Most stable techniques/relapse/magnitude/cleft
- Most precise technique
- Risk/benefit

Diagnostic Decisions

- Timing of distraction
  - Based on:
    - Function
      - Speech
      - Airway
      - Mastication/Feeding
      - Facial appearance
      - Psychosocial development
    - Magnitude
    - Canine position

Function:
- Globe protection
- Airway
- Psychosocial development
- Mastication
Diagnostic Decisions

- LeFort I vs LeFort III
  - Where is the deficiency
  - Is the correction required the same at the LeFort III &/or LeFort I level
  - Early LeFort III often with the understanding that a LeFort I orthognathic surgery may be required later/skeletal maturity

- Le Fort III vs Le Fort I
  - The LeFort III
    - Can be done at skeletal immaturity
    - The distal segment extends from the orbital floor vertically to the incisal edge of the maxillary teeth.
    - Distraction will decrease the disharmony by a more stable modality
    - Any movement affects the extra-dental segment
    - At the LeFort III level, there is symmetry
      - Canine substitution & Max midline is off to the cleft side (left), therefore will need rotation, but only at the LeFort I level
      - Diagnostic decision: If do LeFort III prior to skeletal maturity, it obligates the patient to a LeFort I refinement at skeletal maturity.
      - Because the advancement is completed earlier, when the LeFort I is completed it will be a smaller magnitude move, improving the stability

- Mx dental midline 6mm L of facial midline
  - Canine substitution
LeFort III level R to L symmetry
LeFort I level asymmetry
Midline is 4mm L of facial and Mn midline

Treatment:
LeFort III advancement at skeletal immaturity
Midface/Maxilla
Orbital rims
Zygoma
Address midface A-P hypoplasia

LeFort I advancement & rotation of the Mn at skeletal maturity
Address Mn A-P hypoplasia and asymmetry
Diagnostic Decisions

• Corticotomy/Osteotomy design in the mandible
  – Surgical cut must be above the angle of the mandible to avoid obliterating the angle

• Internal vs External Distraction Devices
  – Different length of devices
  – Less length available when placed internally
  – May require a second procedure
  – Hard tissue/soft tissue ratio decreases as device moves away from the bone
  – Internal distraction devices deliver a higher hard tissue/soft tissue ratio than external distraction devices
  – A longer distraction device is required if using an external device.
  – Once length of distraction is determined, a device capable of delivering 2X that length is required
  – Bilateral devices and parallelism
  – More difficult on internal devices
  – Can induce asymmetry if not placed parallel
ST & AT - Vector control

- R to L devices symmetric
- Vector/device placement carefully planned & placed
- Vertical vector
  - increase posterior intraoral space
  - Mandibular advancement is CCW rotation of the mandible
- Horizontal vector
  - More direct AP advancement
  - Potential for CW rotation of the Mn if posterior dental interference

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**Diagnostic Decisions**

- Distal segment manipulation
  - Understanding where you want the distal segment to end up

Figure 15.1 17 year old Aperts male undergoing midface advancement by distraction. a) Midface advancing.

b) Midface advancement overcorrects occlusion in order to achieve desired aesthetic midface result. Note: posterior dental interference and resultant openbite.

c) Cl III elastics (opposite the distraction vector) to settle the occlusion.

d) Final occlusion. DO & ortho only.

Le Fort III DO Midface advancement
Figure 16: 17 year old Apert's male with midface advancement. Each image is less than a week apart of lateral cephalometric views and orthodontic images, showing improvement of midline with posterior dental interference and reduction in anterior open bite. Improved midline, improved occlusion, improved posterior, improved midline, increased posterior open bite closure.

Pre DO
Ortho prep

Le Fort III DO
A-P DO
Vertical forces

Ortho prep
DO device placement
Pre distraction

8 weeks post device placement
Anterior open bite closure
Global occlusal increase

The diagnostic decision is: will vertical Distal segment manipulations be tolerated? Must consider tooth-to-tissue relationships. Can the maxillary vertical position be addressed at a later/secondary surgery?

**Diagnostic Decisions**

- Most stable techniques/relapse/magnitude
  - Large magnitude surgical movements generally are more stable with distraction
• Significant Cl III skeletal anterior openbite
• Past Hx of multiple cleft surgeries
  – Compromised maxillary vascularity
  – Therefore, increased risk
• Orthognathic surgery
  – 3 piece LeFort I with differential impaction to level the arch & close the anterior openbite
  – Max advancement
  – Mandibular CCW rotation
• Skeletally mature
  – Should be definitive surgery
  – Questionable stability, due to:
    • Magnitude of skeletal move
    • Compromised vascularity
Diagnostic decision

- Premaxillary vertical distraction
  - More stable
  - Improves vascularity
  - Increases soft tissue envelop
- Level the plane of occlusion in a more stable manner
- Followed by a single piece LeFort I
  - Smaller move, more stable
Goal of vertical distraction of the premaxilla in this cleft patient:

Create single plane of Mx occlusion, followed by:

- Orthognathic Single piece LeFort I
- Increase vascularity, soft tissue & bone in an iatrogenically compromised Mx
- Improve stability, decrease relapse & decrease magnitude of Mx surgical movement

Post distraction:

- Single Mx plane of occlusion
- Decreased magnitude of orthognathic surgery
- Improved stability
Orthognathic surgery 6 months post distraction consolidation
LeFort I advancement and impaction
Anterior ideal Mx to lip
Posterior to facilitate maxillary advancement & address any open bites posteriorly

Diagnostic Decisions
• Most precise technique
  – Orthognathic surgery more precise, limited by magnitude

Diagnostic decisions
• Risk/benefit
  Minimal bone in Mx left posterior quadrant
  Risky to move Mx with the bone deficiency
Amniotic Band Syndrome
Asymmetric
Significant bone deficiency
Occlusal cant
Goal: Increase bone volume
Secondary surgery Orthognathic refinement

Age 14

Age 14
Pamela R. Hanson, DDS, MS  
AAO 2019  
Distraction Osteogenesis-The New Frontier

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