Fibrous Dysplasia: Craniofacial and Dental Implications

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Commonly Asked Questions:

- How is craniofacial fibrous dysplasia (FD) diagnosed?
- When and How do the bone lesions show up?
- Where are most lesions located in the craniofacial skeleton?
- Will more lesions develop?
- What functional problems can occur?
  - Blindness?
  - Hearing loss?
  - Dental problems?
- How do you treat craniofacial FD?
Craniofacial Anatomy
Monostotic FD (MFD) = One bone or region of bony involvement

Polyostotic (PFD) = More than one bone/region involved

McCune-Albright Syndrome (MAS) = FD + skin + endocrine abnormalities

Prevalence – Craniofacial FD

- Monostotic FD is reported to be most common
  - Case reports are inconclusive
  - None of the patients in these studies had thorough skeletal/endocrine screening to determine full extent of disease

- Most common locations are craniofacial bones, proximal femur, pelvis, and ribs
Where are most lesions located?

- In MFD, the zygomatico-maxillary complex (ZMC) most commonly involved

- In PFD and MAS, the craniofacial region is involved in 90% of the cases and the anterior cranial base is involved in over 95% of cases.

- 84% of subjects with craniofacial FD have jaw lesions
  - 31% have FD lesions in both jaws
    - Maxilla > Mandible
How do lesions show up?

- **Signs and Symptoms:**
  - Incidental findings on x-rays
  - Asymmetry of face: eyes, forehead, cheeks, nose, jaws
    - Teeth typically NOT displaced n FD
  - Functional changes:
    - Vision loss/visual disturbances
    - Hearing loss
  - Nasal congestion
  - Epiphora (overflowing of tears)
  - Headaches/bone pain
  - Paresthesia (numbness)
  - Seizures (very rare)
How is a diagnosis made?

- **History and physical exam**
  - Asymmetry & Swelling – most common complaints in facial skeleton

- **Radiographs**
  - Computed tomogram (CT)
  - Bone scan
  - Dental x-rays

- **Genetic Testing**
  - Gsα mutation in affected tissue (FD)

- **Lab values (i.e. growth hormone levels)**

- +/- Biopsy
Craniofacial Fibrous Dysplasia

- Degree of facial asymmetry varies
  - MAS most severely affected, particularly when associated with untreated/inadequately treated growth hormone excess
Craniofacial Exam

- Glabella
- Nasion
- Arch of brow
- Lateral limbus
- Lateral canthus
- Medial canthus
- Lid-cheek junction
- Malar fat
- Nasal ala
- Nasolabial fold
- White roll
- Vermillion border
- Labiomental crease
- Labiomental groove
- Philtrum column
- Philtrum
Imaging: Radiation Risk

- Daily background: 3 mSv/yr
- Airplane Flight: 0.030 mSv
- Chest x-ray: 0.1-0.5 mSv
- Intraoral x-ray/periapical: 0.005 mSv
- Bitewing x-rays (every 1-2 yrs): 0.007 mSv
- Panorex: 0.010-0.026 mSv
- i-CAT/cone beam CT: 0.034-0.068 mSv
- Head CT scan: 2-4 mSv
- Bone scan (full body): 10 mSv
Plain X-rays

Fibrous Dysplasia

No involvement
Plain X-rays: Panorex

FD

No involvement
Computed Tomography (CT)

- Axial/transverse plane
- Bone windows

Fibrous Dysplasia

No Involvement
Bone Scan

Monostotic Fibrous Dysplasia
Craniofacial Fibrous Dysplasia on CT

- Obliteration of normal architecture and landmarks
  - Cortex of bone remains intact

- Variable radiographic appearance
  - Lytic/Lucent
  - Ground glass/mixed
  - Sclerotic
  - Cystic component

- Not uniform

- Appearance changes over time
When do FD lesions present?

- CF-FD lesions are earliest to occur, but can remain “silent” until deformity or growth occurs

![Graph showing % of final bone scan score vs chronologic age (years).](image)

- 100% of final amount of FD detectable by age 3.4
- 90% of FD lesions were present prior to age 15
- 90% of all CF-FD lesions detectable on bone scan by age 3.4
- No new CF-FD lesions reported beyond the age of 10

<table>
<thead>
<tr>
<th>Age</th>
<th>Disease detectable</th>
<th>Clinically significant disease present</th>
</tr>
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<tbody>
<tr>
<td>5.7</td>
<td>50%</td>
<td>90%</td>
</tr>
<tr>
<td>10.7</td>
<td>75%</td>
<td>95%</td>
</tr>
<tr>
<td>15.0</td>
<td>90%</td>
<td>99%</td>
</tr>
</tbody>
</table>

Hart, JBMR, 2007
How do FD lesions progress?

Age 5

Age 15

Uninvolved
Will more FD lesions develop?

- More new lesions are not likely to develop

- Lesions can expand and may change over time
  - Radiographic changes
    - Suggests changes in the activity of the abnormal bone-forming cells as a function of age
    - Most dramatic change occurs in the second decade (11-20 yrs)
      - Patients undergoing growth and hormonal changes
  - Become associated with other rapidly growing lesions
    - i.e. aneurysmal bone cysts
  - Extremely rare transformation to malignancy, <1%
  - Growth Hormone excess can exacerbate
What functional problems can occur?

- Vision loss/Visual disturbance
- Hearing Loss
- Dental problems
- Numbness
Polyostotic fibrous dysplasia: frequent anterior cranial base involvement

- Proximity of FD to optic nerve
- Sporadic case reports of vision loss
- Most commonly reported neurologic symptom is vision loss (Sassin & Rosenberg, 1968)

Assumption:
- FD around the optic nerve inevitably leads to blindness $\rightarrow$ prophylactic optic nerve decompression is necessary
4y 9m

15y

optic nerve canal

Photos c/o Dr. Collins
Fibrous Dysplasia and Vision Loss

- Statistically significant narrowing of the optic canal occurs

- Majority (94.7%) of patients had normal eye exams
  - 2 of 38 (5.3%) had an abnormal exam

- **Prophylactic optic nerve decompression is not recommended based on radiographic findings alone since these findings DO NOT correlate with vision loss**

- FD is NOT a progressive condition which results in inevitable blindness

Lee JS et al, NEJM, 2002
Fibrous Dysplasia and Hearing Loss

- Abnormal tympanogram is the most common audiologic finding in PFD
  - Tympanogram = test to check conduction of middle ear

- Hearing loss occurs, but is mostly mild
  - Sensorineural = nerve affected
  - Conductive = eardrum, bone, outer ear affected

- Ear canal cholesteatoma – rare
  - Abnormal skin growth in the middle ear behind the eardrum
  - Secondary to narrowing of ear canal
  - Can lead to destruction of bones and hearing loss
Ear canal narrowing is the most common physical finding

~20% of NIH cohort was found to have evidence of mild hearing loss
Fibrous Dysplasia and Hearing Loss
Fibrous Dysplasia and Congestion

- Functions:
  - Nasal cavity and turbinates:
    - Humidify, filter, and moisturize air
  - Sinuses: Controversial
    - Less mass to our skull
    - Affect resonance of voice
    - Congestion/Sinus infection
  - Well-documented that nasal cavity and sinuses are affected in FD
Fibrous Dysplasia and Congestion

Maxillary sinus & turbinate

Ethmoid & Sphenoid sinuses
Fibrous Dysplasia and Congestion

- Nasal congestion is the most common paranasal sinus problem in FD

- True sinus infections are not as frequent as previously thought
FD & Dentistry:
Types of Dental Specialists

- Pediatric Dentist
- Orthodontist (dentofacial orthopedics)
- Oral and Maxillofacial Surgeon
- Prosthodontist
- Periodontist
- Endodontist
Dental Problems

- Because of often complex co-morbidities, dental aspects are frequently overlooked
  - Variable presentations cause some dental practitioners to delay or avoid dental procedures

- Patients can receive various dental therapies (restorations, root canals, extractions) without exacerbating lesions

- Increased rate of cavities
  - May require more frequent hygiene visits, electric toothbrush, application topical fluoride

- Medication-induced osteonecrosis of the jaws (ONJ)
  - Very rare despite higher doses
Dental Anomalies in FD Patients

43% had dental anomalies
28% anomalies w/in FD bone

n = 23 pts PFD/MAS + 9 pts MFD

Attrition
Retained tooth
Taurodontism
Enamel hypomineralization
Enamel hypoplasia
Displacement
Oligodontia
Rotation

Patients with dental anomaly (%)
Dental Problems

- Tooth extraction may be needed in cases with teeth “floating,” or if they are impacted.

- In severe instances, children may require prostheses which need adjustment with growth.
  - Can improve function and aesthetics.
Orthodontic Therapy

- The majority of patients with jaw FD have malocclusion (disorganized arrangement of the teeth)

- Malocclusion seems to be significantly correlated with growth-hormone excess and other endocrinopathies (*unpublished data*)

- Dental malocclusion/crowding
  - Orthodontic treatment is *safe* to perform in FD patients
  - Orthodontic therapy may take shorter (or longer) in FD bone?
  - Relapse may be more common because teeth tend to return to their initial position
Malocclusion

- Delay orthodontics until skeletal maturity?
  - Does not seem to be necessary in FD

- Orthognathic surgery (jaw repositioning) + orthodontics is also an option for severe malocclusion
  - Hold off until skeletal maturity
  - Titanium plates were safe and did not require removal
  - Healing occurred normally after bones were reset
Dental Implants

- Bone healing and integration of the implants occurs
  - May be slower and the quality of bone is thin

- Reported case of 32 yo female w/MAS:
  - Successful integration and loading of dental implants in maxilla and mandible occurred
  - Maxillo-mandibular lesions had been quiescent for 3 years
  - Dental implants were at least 15 mm in length
  - Functional after 5 years

- Literature is limited - unclear risk of implant failure

- Recommend that implant(s) placed after skeletal maturity AND once growth of the FD lesion has subsided

Medication-Related Osteonecrosis of the Jaws (MRONJ)

- Formerly only BRONJ (Bisphosphonate-related)

- What is ONJ?
  - Dead “necrotic” bone due to loss of blood supply
  - Exposed bone for > 8 weeks with history of drug exposure

- Case Reports:
  - Bisphosphonates
  - Denosumab
  - Anti-angiogenic drugs
  - Tyrosine-kinase Inhibitors

- Why does it affect the jaws more???

- NIH Cohort: 5.4% prevalence of BRONJ

Mewally et al. JOMS, 2016
How is CF-FD Treated?

- Craniofacial Multi-disciplinary Team
  - Craniofacial surgeon(s)
    - Oral & Maxillofacial Surgeon
    - Plastic & Reconstructive Surgeon
    - Otolaryngologist (ENT)
    - Neurosurgeon
    - Oculoplastic Surgeon (Ophthalmology)
  - Pediatrician
  - Pediatric Dentist
  - Orthodontist
  - Audiologist
  - Speech & Language Pathologist
  - Geneticist
  - Psychologist
  - Social Worker
  - Nursing (various specialties)
How is CF-FD Treated?

- Management based on the extent, aggressiveness and clinical behavior

- Management depends on age/skeletal maturity and clinical findings
  - Lesions can be characterized as:
    - Quiescent (stable with no growth)
    - Non-aggressive (slow growing)
    - Aggressive (rapid growth +/- pain, paresthesia, etc.)

- Monitor, observation and close follow-up
  - Clinical assessment, including photographs
  - Sensory nerve testing
  - Maxillofacial CT – depending on clinical findings

- Medical management – bone pain

Lee, JS et al, Orphanet, 2012
How is CF-FD Treated?

- **Indications for surgery:**
  - Biopsy if diagnosis is questionable
  - Concern for aggressive growth/atypical or unusual behavior

- **Surgical options:**
  - “Contouring” – should be done after growth has stopped
  - Resection and reconstruction – if lesion can be completely removed or if there is concern for associated disease/malignancy
  - Orthognathic surgery – correct malocclusion or facial/dental asymmetry
    - No documented contraindication if lesions are quiescent
    - Bone healing is normal
How is CF-FD Treated?

- *However,* there is evidence that lesions can regrow after surgery and even become aggressive.

- We cannot predict or prevent regrowth.

- Surgery is not typically indicated for cosmetic purposes.
  - Dependent on psychosocial situation.
NIH CF-FD Outcomes Data

- CF-FD regrowth and reoperation are common, particularly after “debulking” or “recontouring” procedures.

- Less regrowth outcomes with Aneurysmal Bone Cysts (ABCs) and bone biopsies.

- Bone resection and reconstruction with hardware and/or grafting material may result in less regrowth and fewer reoperations, but has increased morbidity.

Indications for Surgery

- Facial asymmetry (70%)
- Nasal airway obstruction (16%)
- Malocclusion (9%)
- Otic canal obstruction (6%)
NIH CF-FD Outcomes Data

- MAS w/GH-excess is a risk factor for regrowth and may go undiagnosed perioperatively

![Graph showing regrowth rates with and without GH excess](image)

- Importance of a multidisciplinary approach
  - Surgical and medical practitioners
  - Need for individualized care with long-term follow-up

Boyce et al., *PRS* 2016
Thank you!

Thank you to all of the patients & families

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