Identifying Cystic Fibrosis (CF) Skeletally: A Proposed Differential Diagnosis
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What is Cystic Fibrosis?
- A common genetic disorder in people of European descent
- Linked to over 2,000 different mutations
- Affects approximately 70,000 individuals
- Mutant CFTR channel fails to regulate salt diffusion in and out cells
- Passage ways of lungs and digestive tract blocked by mucus
- With treatment, CF patients can survive into their 50s

Why is Skeletal Diagnosis Important?
- Forensics – as life expectancy increases, CF may become more relevant in forensic casework for identification of unknown remains
- Bioarchaeology – in coastal populations of European ancestry, an individual with a less-severe gene mutation might have survived into early adulthood
- Paleopathology – to add to the field of understanding bone diseases

<table>
<thead>
<tr>
<th>Signs and Symptoms</th>
<th>Skeletal Indicator</th>
<th>Prevalence CF (non-CF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic Sinusitis</td>
<td>Irregular bony growths</td>
<td>74-100% (14%)</td>
</tr>
<tr>
<td>Frontal Sinus</td>
<td>Agenesis</td>
<td>More research needed</td>
</tr>
<tr>
<td>Maxillary Sinus</td>
<td>Medial bulging of lateral nasal wall</td>
<td>More research needed</td>
</tr>
<tr>
<td>Digital Clubbing</td>
<td>Need skeletal quantification method</td>
<td>15% (1%)</td>
</tr>
<tr>
<td>Kyphosis</td>
<td>Vertebral fractures, compression and abnormal curvature</td>
<td>17-51% (12%)</td>
</tr>
<tr>
<td>Bone density loss</td>
<td>Early onset osteopenia/osteoporosis</td>
<td>50-70% (25%)</td>
</tr>
<tr>
<td>Stature</td>
<td>Shorter by ~6 cm</td>
<td>Need population specific data</td>
</tr>
<tr>
<td>Chest Diameter</td>
<td>Need skeletal quantification method</td>
<td>More research needed</td>
</tr>
<tr>
<td>Rib Fracture</td>
<td>Microcracking of ribs and delayed healing of fractures</td>
<td>More research needed</td>
</tr>
</tbody>
</table>

Chronic Sinus Inflammation (Sinusitis) Causes Unique Bony Pathologies in CF
- Medial bulging of the lateral nasal wall and frontal sinus agenesis is unique to CF patients
- Expansion of medial wall of maxillary sinus
- Reduction or absence of ethmoid partitions
- Abnormal pitting and spicules on sinus walls

Kyphosis and Vertebral Compression are Common and Early Onset in CF Patients
- Young CF patients have kyphotic angles higher than 60-year-old controls and decades earlier
- Spinal deterioration accelerated by three decades
- Atraumatic vertebral deformity present in 17-51% of CF patients
- 12% prevalence in non-CF 50- to 79-year-old Europeans

Digital Clubbing Is a Common Symptom of CF, but Its Skeletal Effects Have Not Been Studied
- Clubbing presents in 15% of all CF patients, and is correlated with disease severity

Low Bone Density and Poor Nutrient Uptake Lead to Decreased Stature in CF Individuals
- Shorter stature by about 6 cm
- Early onset osteopenia and osteoporosis
- 40% of CF children below the fifth percentile in height

While low bone density, fractures, and short stature can co-occur due to other etiologies, we feel the combination of the above factors with evidence of chronic sinusitis and digital clubbing makes a strong case for the considering a skeletal diagnosis of CF. Future work is needed to quantify the certainty of diagnosis using these criteria.

References

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