Overview of the Orthopedic Aspects of Melorheostosis: An Analysis of the Melorheostosis Association database

Daniel Lewis, MD*
Orthopedic Resident

Jeffrey C. King, MD*#
Clinical Assistant Professor

*Michigan State University College of Human Medicine
#Division Of Hand and Elbow Surgery
HealthCare Midwest, Kalamazoo, Michigan
“Dripping candle wax” disease

- Melo - Limb
- rhein – flow
- osteon – bone

- The classic X-ray findings lead some to believe it is primarily a disease of the bone... in fact all of the tissues of the mesenchyme are involved including skin, fascia, muscle, tendons and ligaments
It is often these tissues, *not* seen on X-ray, which significantly contribute to the functional impairment of patients.
Outline

- Demographics
- Clinical presentation
- Radiographic presentation
- Childhood vs. adult onset
- Melo Database analysis
- Review of Treatment
  - Non-surgical
  - Surgical
- Conclusions
- Questions
Demographics

- Male = female
- Dominant = sub-dominant side
- Usually involves just one limb
- Lower limbs > upper limbs involved
- Skull, ribs and spine rarely affected
- Can present at any age:
  - infant through senescence

*Age at presentation determines clinical and radiographic manifestations*
Clinical Presentation

- Incidental finding
- Deformity/contracture
- Pain/neurologic symptoms
Radiographic Presentation

Smooth, flowing thickening of the cortex of the long bones
Changes may extend along the entire limb, crossing the joints
Small bones of the hands and feet may be completely involved
Radiographic Presentation

- Pattern of involvement follows the scleroderms
  - Zones of the skeleton supplied by individual spinal sensory nerves
    - Inman
  - Only seen in 2 other diseases
    » Paraxial hemimelia
    » Thalidomide toxicity
Radiographic Presentation

- Typical X-ray appearance occurs after closure of the growth plates.
- Before this, there may be no bony findings or streaking of the inside of the bones and spotty changes of the small bones.
Childhood Presentation

- Birth to mid teens
  » Earlier presentation and multiple limb involvement may predict a poorer prognosis
- Usually presents with deformity or contracture
  » Rarely with pain as a primary complaint
Childhood Presentation

- Deformity/contracture
  - Limb length discrepancy
    » Usually shorter, but can be longer
  - Joint contractures
    » Esp. fingers, toes, knees, hips
- Angular deformity of bone, or at the joints
  » Ankles, fingers
- Thickening of the skin, with tethering of the underlying fascia
Childhood presentation

- **X-ray Findings**
  - Streaking of the inside of the long bones
  - Mottled or patchy thickening of the pelvis and small bones of the hands and feet
  - Changes usually not seen in the skull, ribs or spine
  - X-ray changes usually proportional to the clinical deformity
Adult presentation

- Patients usually present with pain and or neurologic complaints
- May also have mechanical symptoms as well.
- Patients may recall painless deformity as a child
- X-rays show “classic” bony changes
Adult presentation

- Types
  - Macrodactyly
  - Painful deformity
  - Joint stiffness
  - *Carpal tunnel syndrome
Diagnosis

- Childhood diagnosis is difficult as there are no characteristic bony changes
### Differential Diagnosis of Melorheostosis

<table>
<thead>
<tr>
<th>Disease</th>
<th>Expected Findings</th>
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<tbody>
<tr>
<td>Intermediate osteosclerosis</td>
<td>Replacement of normal spongiosa by sclerotic bone, normal outer two thirds of cortex</td>
</tr>
<tr>
<td>Infantile cortical hyperostosis (Calley's disease)</td>
<td>Periosteal reaction is less dense, different locations, remodels to more normal-appearing bone</td>
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<tr>
<td>Scleroderma</td>
<td>Skin changes may be similar but no oseous changes</td>
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<tr>
<td>Dysplasia epiphysae hemimelica</td>
<td>Asymmetrical abnormal cartilage proliferation and associated enchondral ossification</td>
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<tr>
<td>Gambr's chronic sclerosing osteomyelitis</td>
<td>Pronounced sclerosis with isolated cystic areas</td>
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<td>Pyknody sostosis</td>
<td>Hereditary, dwarfism and mental retardation possible, generalized osteosclerosis</td>
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<tr>
<td>Metaphyseal dysplasia (Pyler's disease)</td>
<td>May simulate osteopetrosis at birth</td>
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<tr>
<td>Idiopathic painful periostosis</td>
<td>Smooth to undulating periosteal osseous thickening</td>
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<tr>
<td>Albright-Schönberg disease (osteopetrosis)</td>
<td>Marble bone, autosomal recessive and dominant variants</td>
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<tr>
<td>Osteopetrosis</td>
<td>Autosomal dominant, spotty opacities predominantly epiphyseal, no diaphyseal dense tracks</td>
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<tr>
<td>Osteopathia striata (Woolf's disease)</td>
<td>Typically affects metaphysis of long bones, thin vertical bands of dense bone</td>
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<tr>
<td>Hypertrophic (pulmonary) osteoarthropathy</td>
<td>Long bone subperiosteal calcification, secondary to intrathoracic process, nail clubbing</td>
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<tr>
<td>Osteogenesis imperfecta</td>
<td>Autosomal dominant, generalized skeletal hypoplasia and fragility</td>
</tr>
<tr>
<td>Ollier's disease</td>
<td>Multiple discontinuous enchondromas arranged like longitudinal tracks</td>
</tr>
<tr>
<td>Arthrogyrosis multiplex congenita</td>
<td>Flexion contractures without bone changes</td>
</tr>
<tr>
<td>Jaffe-Lichtenstein polyostotic fibrous dysplasia</td>
<td>Osteolytic areas frequent, histologically reveals fibrous dysplasia with cartilaginous bands</td>
</tr>
<tr>
<td>Progressive diaphyseal dysplasia (Camarasa-Esbelmann disease)</td>
<td>Autosomal dominant, thickened long-bone diaphyses</td>
</tr>
<tr>
<td>Hyperostosis corticale generalista (van Buchem's disease)</td>
<td>Autosomal recessive, acromegaly, diffuse bone sclerosis</td>
</tr>
<tr>
<td>Thyroid acropathy</td>
<td>History of thyrotoxicosis associated with pretibial myxedema, periosteal reaction that tends to be spiculated and florid</td>
</tr>
<tr>
<td>Warfarin-induced chondrodystrophy calcicans congenita (&quot;stippled epiphyses&quot;)</td>
<td>In pregnant women may result in infants with stippled epiphyses and mesomelic dwarfism</td>
</tr>
<tr>
<td>Chester-Edenhorn disease</td>
<td>Generalized increase in sclerotic bone usually affects lower limb bones, characterized histologically by widened haversian canals and histocytes containing lipid</td>
</tr>
</tbody>
</table>
Diagnosis

- Diagnosis in adults is typically straightforward with classic bony changes
- Mixed sclerosing bone dystrophy has been reported.

Melorheostosis +
Osteopoikilosis +
Osteopathia Striata +/- others
Treatment

- **Non-surgical**
  - Deformity/stiffness
  - Pain relief

- **Surgical**
  - Deformity/stiffness
  - Length inequality
  - Pain relief
  - Neurologic symptoms
Non-surgical treatment

- Childhood deformity
  - Splinting, bracing and serial casting are reported but typically have been ineffective at preventing progression of deformity.
- Physical therapy is generally recommended to attempt to maintain joint mobility, but may fail as well.

– Younge, et al.
Non-surgical treatment

- Pain management
  - NSAIDS
  - Diphosphonates
  - Analgesics
  - Nifedipine
  - Nerve blocks/ sympathetic blocks
Surgical treatment

- Contracture releases
- Tendon lengthening
- Fasciotomy
- Capsulotomy
- Nerve decompression
- Osteotomies
- “Bumpectomies”

- Joint fusion
- Growth plate arrests
- Distraction limb lengthening (Ilizarov technique)
- Amputation
Analysis of the MA Database

- Public, voluntary, website where patients with melorheostosis describe their histories, treatments, and outcomes.
  - Information is based solely upon the patients accounts
  - Limited information regarding presentation and treatment
  - It has not been verified by medical record review
  - No statistical analysis has been applied to this data
  - The information may contain reporting bias

Nonetheless, this information represents the largest data pool of its kind, and we believe merits careful scrutiny, and further investigation

* Data taken from Melorhostosis.org website
Purpose

• In light of the proceeding statements, we believed that it would be beneficial to perform an analysis of operative treatments and outcomes on patients with melorheostosis

• Aid in predicting treatment and outcomes of operative management
  • Location of disease
  • Type of deformity (bony vs. soft tissue)
  • Procedures and indications
  • Complications
  • Recurrences
Analysis and methods

The primary objective of our analysis was to identify the:

1. Number of patients who underwent operative treatment for melorheostosis related problems
2. Average age of onset
3. Involvement of upper vs. lower extremities
4. Type of operative procedures (bony, soft tissue, or both)
5. Complications
6. Recurrences
Patients

- 117 total posts
  - 76 (65%) patients managed with non-operative treatment
  - 41 (35%) underwent at least one operative treatment for melorheostosis related problems
Operative group - Gender

- **MA Database**
  - Male (11) 27%
  - Female (30) 73%

- **Pooled Literature**
  - Male = Female
Operative group - Age

**MA Database**
- Average age at diagnosis: 14.3 years old
  - Females: 15.3 years old
  - Males: 12.7 years old

**Younge, et al. data**
- Average age at onset of sx = 0-6 yrs.
- Average age at diagnosis = 9 yrs.
- Average delay in diagnosis = 6 yrs.

**Misdiagnosis is common until bony changes identified on X-rays**
## Operative group - Location

<table>
<thead>
<tr>
<th>MA Database</th>
<th>Morris, et al</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Upper extremity (12) 29.3%</td>
<td>- Upper extremity (41/131) 21.4%31%</td>
</tr>
<tr>
<td>- Lower extremity (25) 61%</td>
<td>- Lower extremity (65/131) 78.6%49.6%</td>
</tr>
<tr>
<td>- Multiple extremities (4) 9.75%</td>
<td>- Multiple extremities (25/131) 19%</td>
</tr>
<tr>
<td>- Axial (1) 2.4%</td>
<td>- Both upper and lower extremities (1) 7.1%</td>
</tr>
<tr>
<td></td>
<td>- Axial (13/131) 10%</td>
</tr>
<tr>
<td></td>
<td>- Axial (2) 14.3%</td>
</tr>
</tbody>
</table>
Non-operative management of the operative group

- **MA database**
  - Medications
    - NSAID’s 5/6
    - Bisphosphonates 1/2
    - Nifedipine 1/1
  - Therapy 5
  - TENS 1/1
  - Pain Clinic 2/2

- **King, et al data**
  - Medications
    - NSAID’s 2/4
    - Bisphosphonates 0/2
    - Nifedipine 0

- **Pooled literature**
  - Medications
    - NSAID’s 2/3
    - Bisphosphonates 1/1
    - Nifedipine 1/1
Operative group - Procedures

MA Database
- Bone (32 pts) 78%
  - Biopsy 5
  - Exostectomy 33
  - Osteotomy 5
  - Fusion 2
  - Length/shortening 2
  - Total Joint replacement 2
  - Amputation 2
  - Other 4

King, et al. data
- Bone (7 pts) 70%
  - Biopsy 1
  - Exostectomy 1
  - Osteotomy 2
  - Lengthening 1
  - Amputation 3

* Numbers do not = cases as multiple procedures per pt.
Operative group - Procedures

**MA Database**
- Soft tissue procedures (contracture release, CTR, etc.) (11pts) **26.8%**
  - Trigger release (2)
  - Carpal tunnel release (4)
  - Soft tissue release (9)
  - Tendon transfers (1)

**King, et al data**
- Soft tissue procedures (4 pts) **40%**
  - Trigger release (1)
  - Carpal tunnel release (4)
  - Ulnar n exploration (1)
  - Soft tissue releases (5) in 3 patients
  - Tendon transfers (1)
  - Free flap (2)
**Operative group - Procedures**

**MA Database**
- Combined bony and soft tissue procedures
  - (9) **22%**
  Most frequently exostectomy and another procedure.
- 8/9 in pts below 14 yo. at diagnosis

**King, et al data**
- Combined bony and soft tissue procedures
  - (3) **30%**
  Combine procedures most common in patients with early onset

* MA Database: Several patients report “multiple hand surgeries”
Operative group - Multiple Procedures

MA Database
- 61% (25/41) underwent multiple surgeries

King, et al., data
- 66% (6/9) underwent multiple surgeries

Younger age at onset seems to correlate with increased incidence of multiple procedures
Operative group - Complications

- **MA Database**
  - 4/41 (10%) complications reported
    - post-op infection
    - nerve injury
    - growth arrest
    - unspecified

- **King, et al., data**
  - 2/10 (20%) complications reported
    - Post-op infection, non-union --> pseudoarthrosis
    - Skin slough
Operative group - Recurrence

- **MA Database**
  - Total recurrence (26/40) **65%**
    1. Bony recurrence (17/26) **65.6%**
    2. Soft tissue recurrence (3/5) **60%**
    3. Both bony and soft tissue recurrence (6/9) **66.7%**

- **King, et al., data**
  - Total recurrence (4/10) **40%**
    1. Bony recurrence (1/3) **33%**
    2. Soft tissue recurrence (2/3) **60%**
    3. Pain recurrence (1/5) **20%**
Whew!??!
Surgical treatment

- Despite reports that conservative management is typically ineffective...
- …failure of surgical management, with a high complication and recurrence rate has also been shown!
Indications for Surgery *(Making the decision to have surgery)*

- Maximize conservative management
- Activity/ ergonomic modifications
- Clear understanding of the risk/benefit ratio
  - “Risk tolerance”
- Specific functional deficits? vs. appearance.
- Establish realistic expectations between pt/family and physician.
Surgical treatment

- Results
  - Soft tissue procedures in children often “fail”. Recurrence is common (even with joint pinning) and surgical correction should be delayed as long as possible.
  - Treatment principles described for arthrogryposis have been used with some success
    - Drummond, et al.
  - Multiple releases have been necessary in some patients

Supported by the MA database
Surgical treatment

• Results

  • Nerve decompression (Carpal tunnel release)
    » Successful in 75% of cases
      – One patient required 3 operations
      – King, et al.

  » Open technique is recommended

MA database info is equivocal
1 better, 1 recurrence, 2 unknown???
Surgical treatment

• Results
  • Osteotomy
    » Children - deformity often recurs
      – (Younge: 100% failure rate)
    » Adults - non-union rate is high
    » Complication rate is high!!!
      – Wound problems, stiffness, distal ischemia
    » The healing bone is abnormal
    » Alignment and appearance may improve but function usually does not

Supported by the MA database
Surgical treatment

• Results
  • Exostectomy/ Bumpectomy
    » Deformity often recurs
  • Joint fusion
    » Limited experience.
    Limited success.

Supported by the MA database
90% recurrence rate
Limb lengthening

» Several case reports of success
  – Also for correction of joint deformity

» The new bone formed was half normal, half abnormal!

Supported by the MA database and Dr Paley
Surgical treatment

- Results
  - Amputation
    - Successful for management of mechanical symptoms
      - King, et al
    - Used for salvage of multiple surgical failures.
      - Younge, et al
    - Unsuccessful for pain relief

Supported by the MA database
For salvage
Overall surgical “success”

- **Melorheostosis Association database** 13/59 22%
  - Soft tissue release 4/11, osteotomy 1/4, exostectomy 3/33, amp 2/2, CTR 1/2,
    Other 2/5 Unknown procedures = 25

- **King, et al** 10/19 52%
  - Soft tissue release 3/6=> 1 amp recc but not done, bone 3/6, CTR 3/4
  amputation 2/3

- **Campbell, et al** 5/21 24% (2 of 5 were salvage amps)
  - Soft tissue release 3/8, Amputation 2/5 succeed
  - Exostectomy 0/1, Osteotomy 0/1, Epiphysodesis 0/2, Fusion 0/1, Bunionectomy0/1,
    Lumbar sympathectomy all failed

- **Younge** 5/29 17% (4 of 5 were salvage amputations)
  - Soft tissue release 1/10 =>1 amp, osteotomy 0/7 =>2 amps
  fusion 0/1 => 1amp
Summary

• Treatment of the deformity and pain associated with melorheostosis remains quite problematic. Factors include:
  » Difficulties in early diagnosis
  » Multi tissue involvement
  » Failure of non-operative mgmt to arrest progression
  » High complication and recurrence rate with surgical mgmt
  » Lack of physician knowledge of condition

*Management of Melorheostosis

General Information and Considerations Handout
Summary

• The patient reported melorheostosis.com database information is largely consistent with the reported literature.

• Patient’s frustration with physicians lack of knowledge about melorheostosis is evident in the postings.

• All of the reported treatments in the postings have previously been reported in the literature. *there is nothing new under the sun!*
Summary

• While advances in our understanding of the etiology of melorheostosis are critical to planning management long term...

...in the near term, better, more informed discussions between patients and surgeons prior to embarking on a treatment path may maximize the effectiveness of the current operative and non-operative options.
Surgical management Synopsis

**“Good” procedures**
- More reliable
- Thumb release in children
- Carpal tunnel release
- Osteotomy for appearance or alignment only
- Amputation for mechanical symptoms/salvage
- Limb lengthening
- Ilizarov contracture correction

**“Not so good” procedures**
- Less reliable
- Most soft tissue releases
- Osteotomy in kids
- Joint fusion?
- Growth plate arrest?
- Any type of surgery for the purpose of pain relief
“Pearls”

- Therapy/splints etc. may not stop progression but may slow progression and buy some time/delay surgery.
- Recurrence is common with early surgery, but *may* allow for overall better correction.
- Surgery can improve, but will *not* normalize appearance or function.
“Pearls”

- Shortening or gradual correction of deformity limits vascular/neurologic complications.
- Surgery for mechanical symptoms works best.
- Surgery for pain relief does not seem to help (including amputation).
- Patients report pain clinics are helpful.
Future directions

- Better reporting and pooling of clinical experience to develop improved guidelines for treatment.
- Improved technology and adjuvant treatments (i.e., locked plates, BMP, etc.)
- Ultimately, a better understanding of the etiology of the disease allowing early diagnosis and new treatment techniques (i.e., gene therapy?)
Future directions

• We would like to propose a standardized data collection device:
  • to improve information collection
  • facilitate data analysis
  • to aid in diagnosis and treatment.

Interested???
Questions

• Would traditional treatment for heterotopic ossification help prevent recurrence of melo?
• What can we do to facilitate healing of melo bone?
• Thoughts about timing of releases in kids…?
Thank you
Arthrogryposis procedures

- **Finger flexion:**
  - If active flexion - volar release, skin graft and joint pinning
  - If no active flexion - PIP joint fusion

- **Thumb deformity:**
  - Web space deepening with rotation flap, and MCP fusion.

  - Bennett et al, Drummond