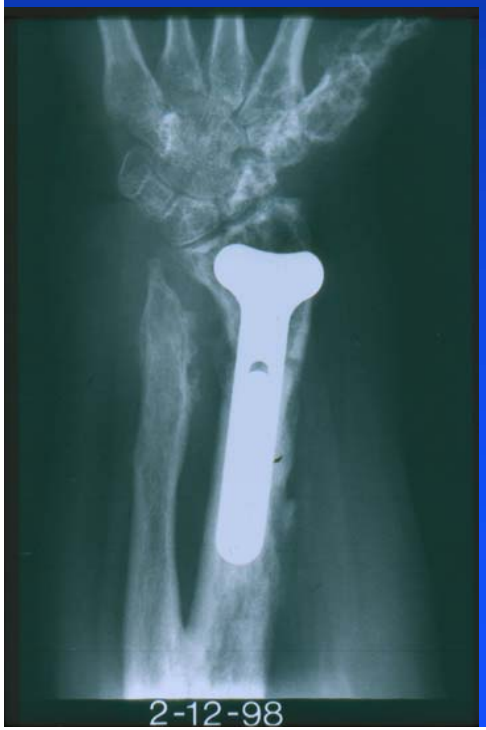
Overview of the Orthopedic Aspects of Melorheostosis:

An Analysis of the Melorheostosis Association database



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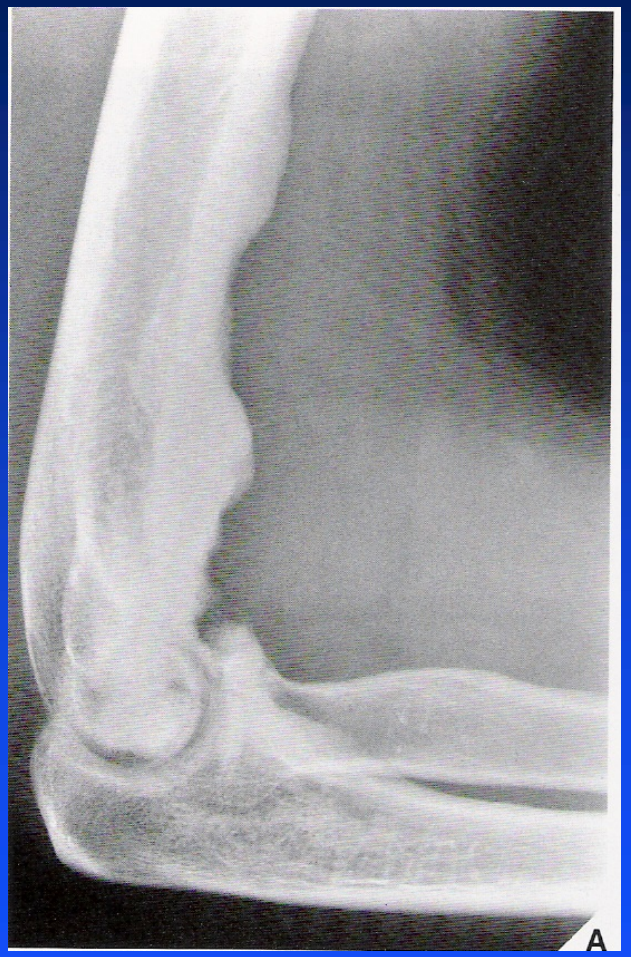
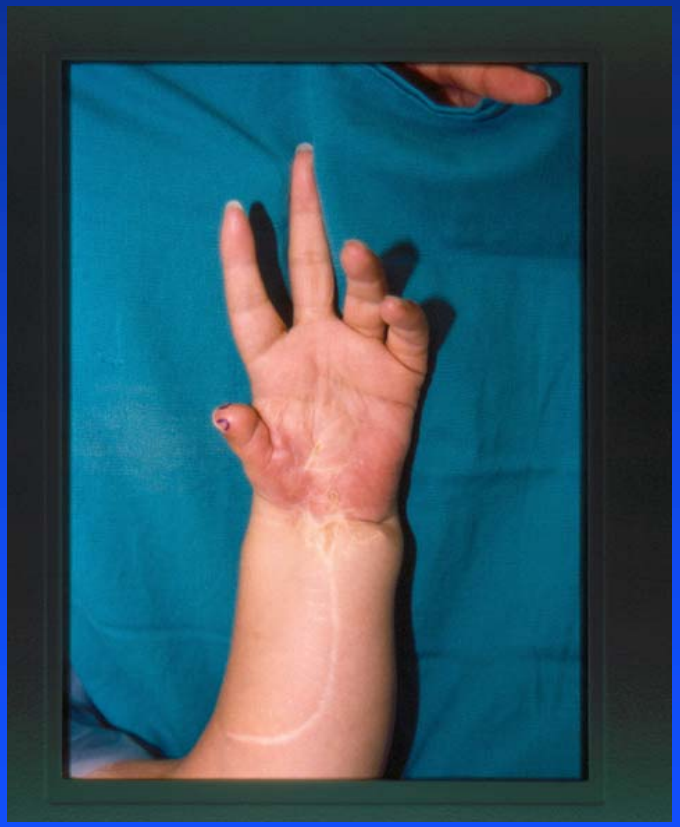
“Dripping candle wax” disease

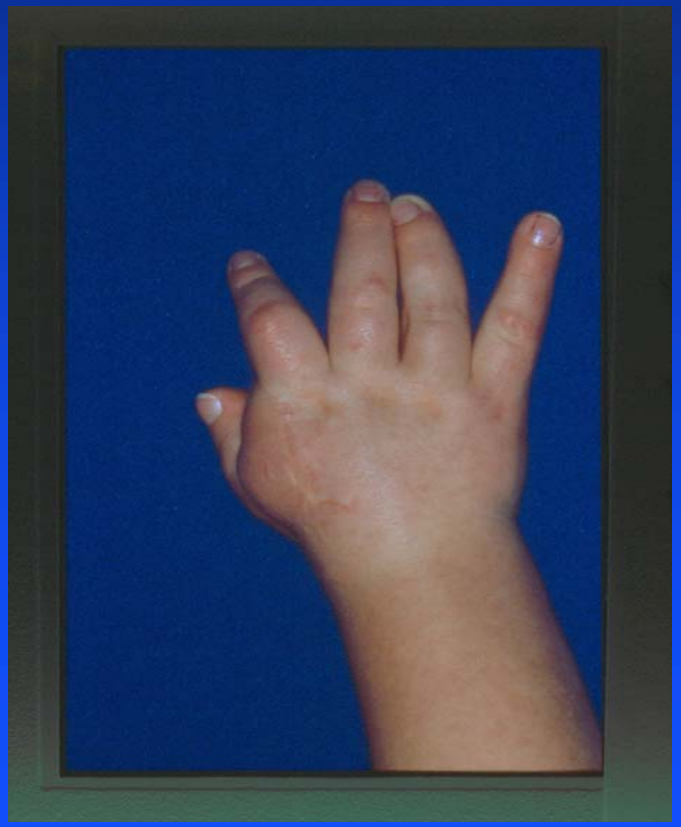
- ***Melo*** **- Limb**
- ***rhein*** **– flow**
- ***osteon*** **– bone**

- **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**



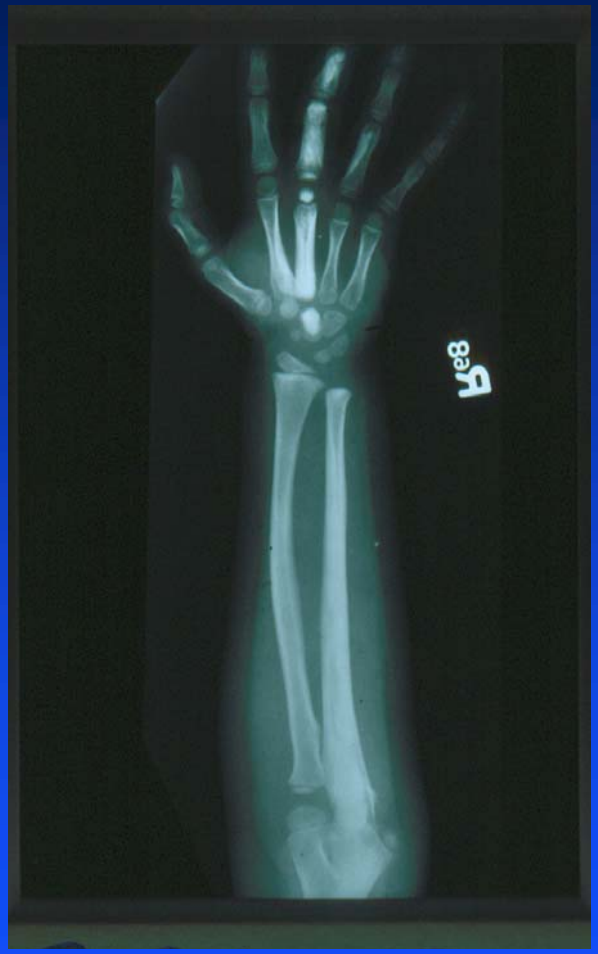
- **It is often these tissues, *not* seen on X-ray, which significantly contribute to the functional impairment of patients.**





Outline

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



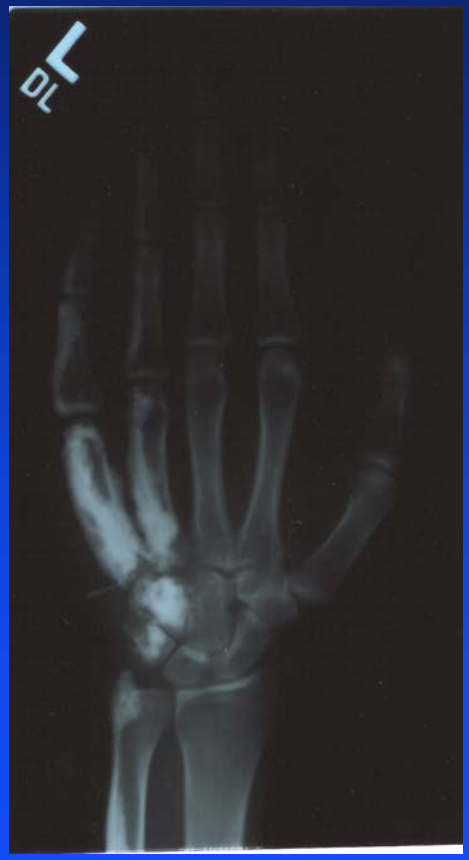
Demographics

- 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

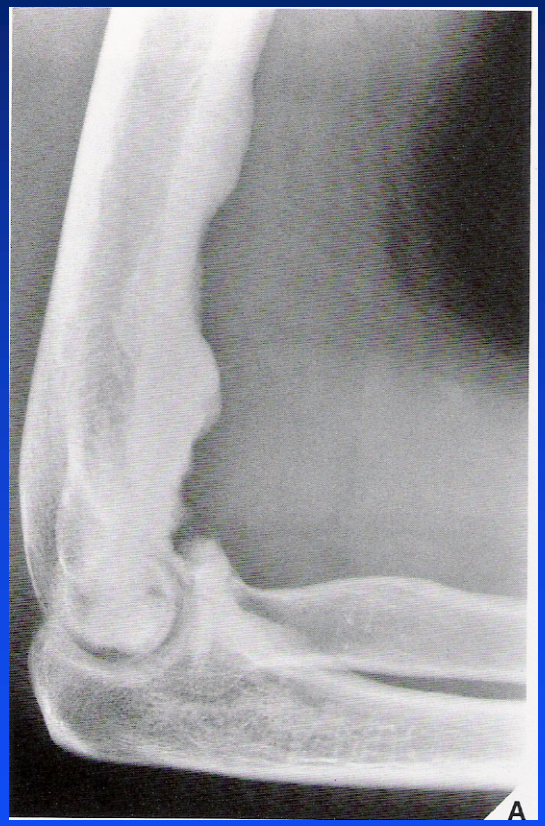
*Age at presentation determines clinical and radiographic manifestations

Clinical Presentation

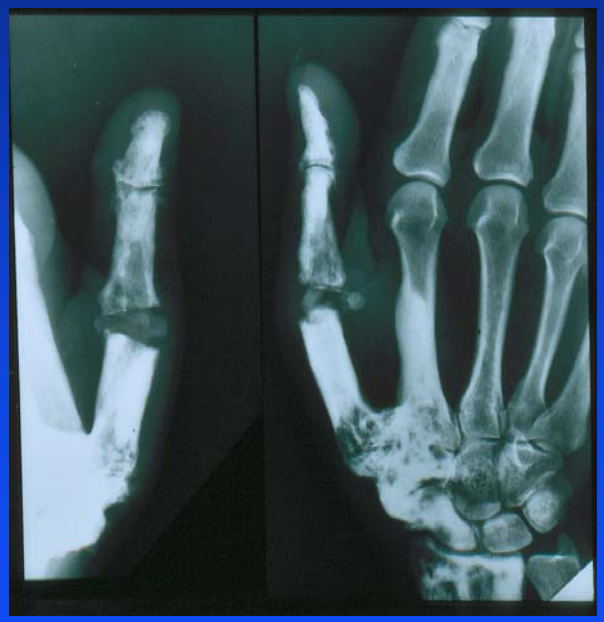
- Incidental finding
- Deformity/ contracture
- Pain/ neurologic symptoms



Radiographic Presentation



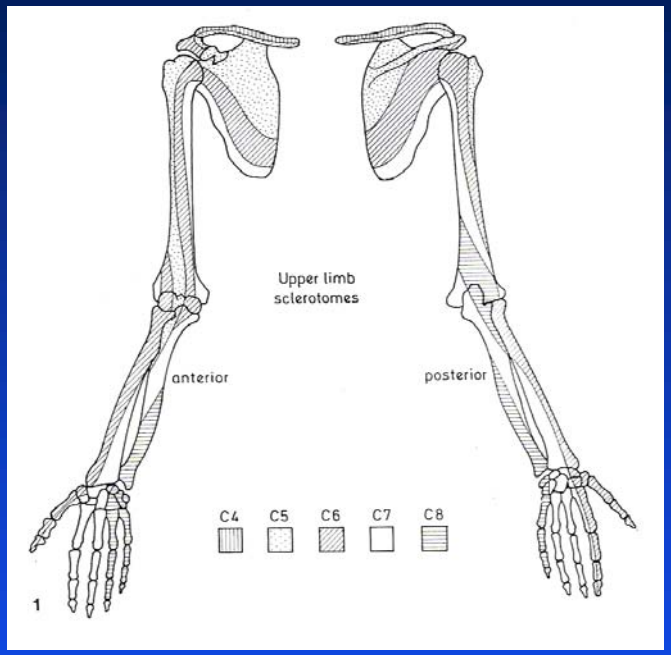
- Smooth, flowing thickening of the cortex of the long bones
- Changes may extend along the entire limb, crossing the joints
- Small bones of the hands and feet may be completely involved

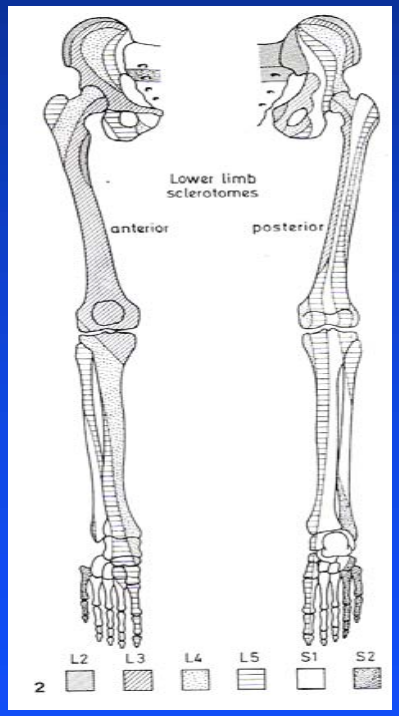


Radiographic Presentation

- 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

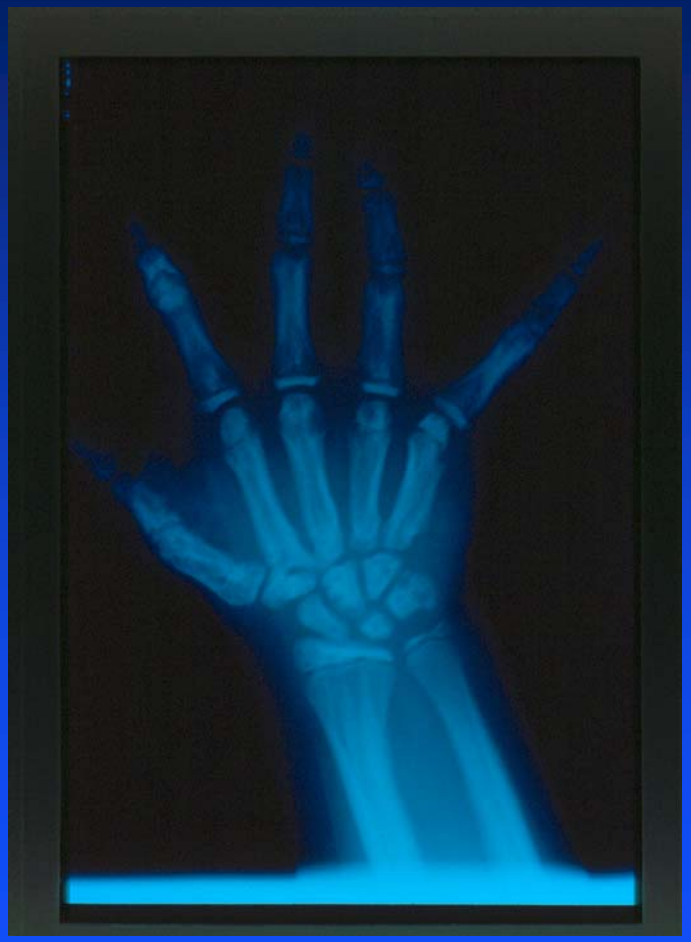




Radiographic Presentation

- 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

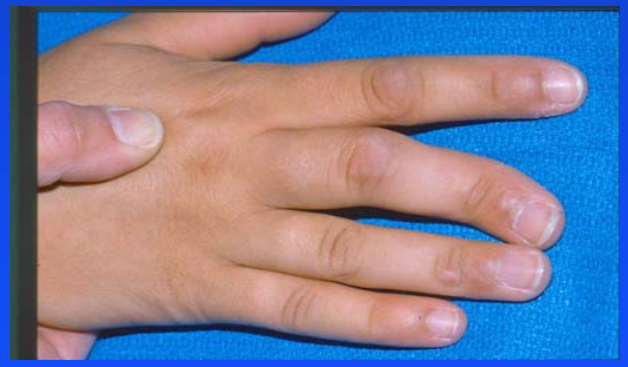


Childhood Presentation

- 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

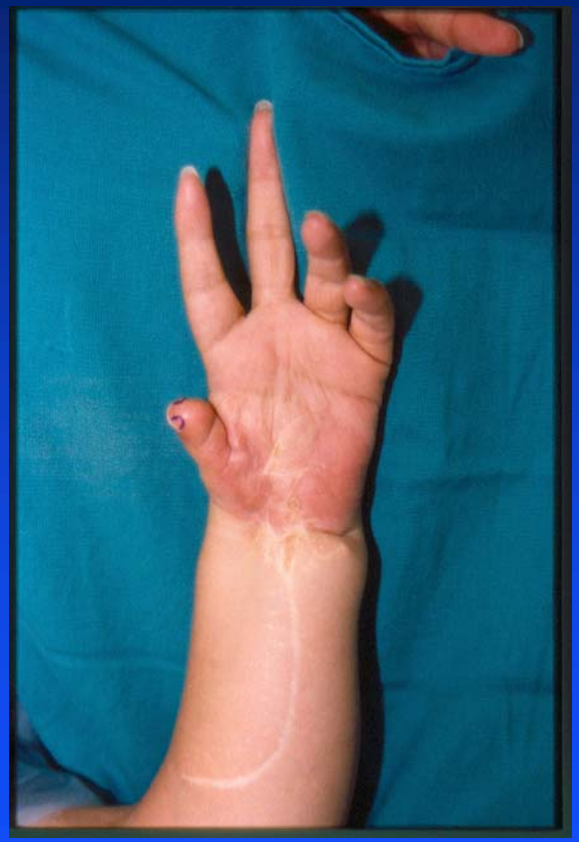
- Deformity/contracture
  - Limb length discrepancy
    - » Usually shorter, but can be longer
  - Joint contractures
    - » Esp. fingers, toes, knees, hips
  - Angular deformity of bone, or at the joints
    - » Ankles, fingers
  - Thickening of the skin, with tethering of the underlying fascia



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

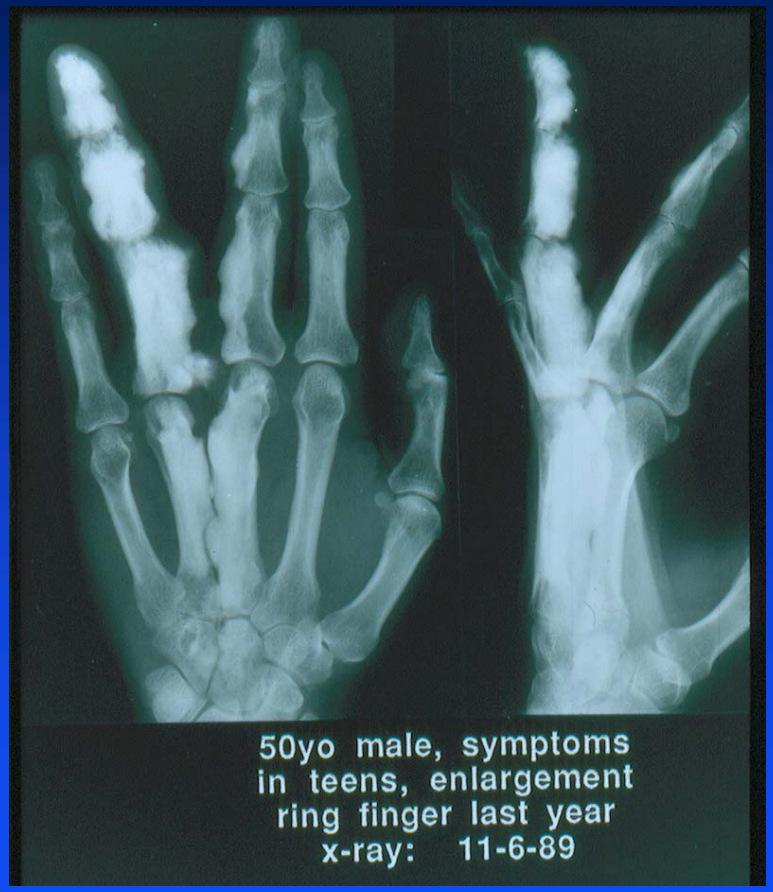
Adult presentation



- 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

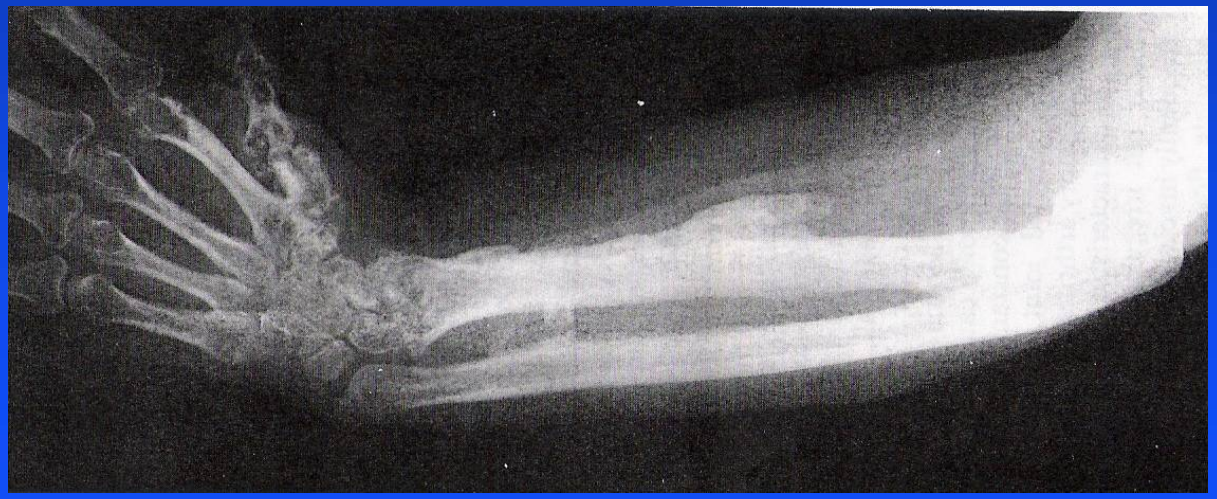
Differential diagnosis

Table. Summary of Differential Diagnosis of Melorheostosis

Disease	Expected Findings
Intramedullary osteosclerosis	Replacement of normal spongiosa by sclerotic bone, normal outer two thirds of cortex
Infantile cortical hyperostosis (Caffey's disease)	Periosteal reaction is less dense, different locations, remodels to more normal-appearing bone
Scleroderma	Skin changes may be similar but no osseous changes
Dysplasia epiphysealis hemimelica	Asymmetrical abnormal cartilage proliferation and associated enchondral ossification
Garré's chronic sclerosing osteomyelitis	Pronounced sclerosis with isolated cystic areas
Pyknodysostosis	Hereditary, dwarfism and mental retardation possible, generalized osteosclerosis
Metaphyseal dysplasia (Pyle's disease)	May simulate osteopetrosis at birth
Idiopathic painful periostosis	Smooth to undulating periosteal osseous thickening
Albers-Schönberg disease (osteopetrosis)	Marble bone, autosomal recessive and dominant varieties
Osteopoikilosis	Autosomal dominant, spotty opacities predominantly epiphyseal, no diaphyseal dense tracks
Osteopathia striata (Voorhoeve's disease)	Typically affects metaphysis of long bones, thin vertical bands of dense bone
Hypertrophic (pulmonary) osteoarthropathy	Long-bone subperiosteal calcification, secondary to intrathoracic process, nail clubbing
Osteogenesis imperfecta	Autosomal dominant, generalized skeletal hypoplasia and fragility
Ollier's disease	Multiple discontinuous enchondromas arranged like longitudinal tracks
Arthrogryposis multiplex congenita	Flexion contractures without bone changes
Jaffe-Lichtenstein polyostotic fibrous dysplasia	Osteolytic areas frequent, histologically reveals fibrous dysplasia with cartilaginous islets
Progressive diaphyseal dysplasia (Camurati-Engelmann disease)	Autosomal dominant, thickened long-bone diaphyses
Hyperostosis corticalis generalista (van Buchem's disease)	Autosomal recessive, acromegaly, diffuse bone sclerosis
Thyroid acropachy	History of thyrotoxicosis associated with pretibial myxedema, periosteal reaction that tends to be spiculated and florid
Warfarin-induced chondrodystrophia calcificans congenita ("stippled epiphyses")	In pregnant women may result in infants with stippled epiphyses and mesomelic dwarfism
Chester-Erdheim disease	Generalized increase in sclerotic bone usually affects lower limb bones, characterized histologically by widened haversian canals and histiocytes containing lipid

Diagnosis

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

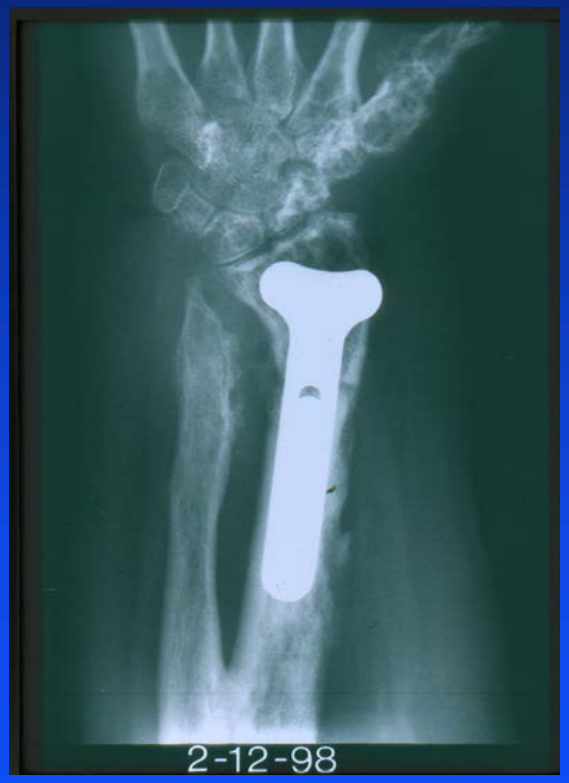


Melorheostosis
+
Osteopoikilosis
+
Osteopathia Striata

+/- others

Treatment

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



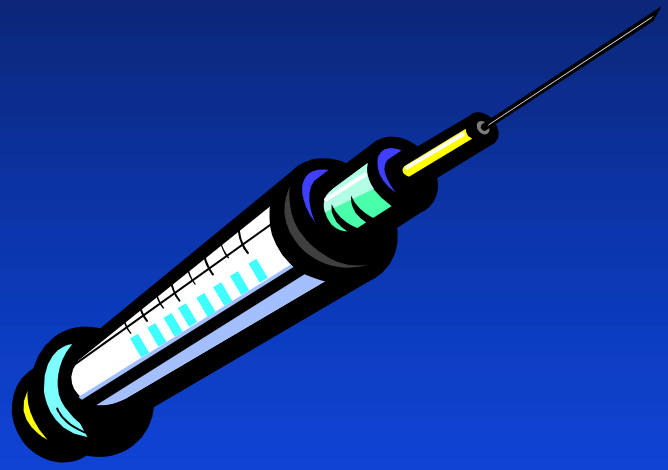
Non-surgical treatment

- 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
- Osteotomy
- “Bumpectomy”

- 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:

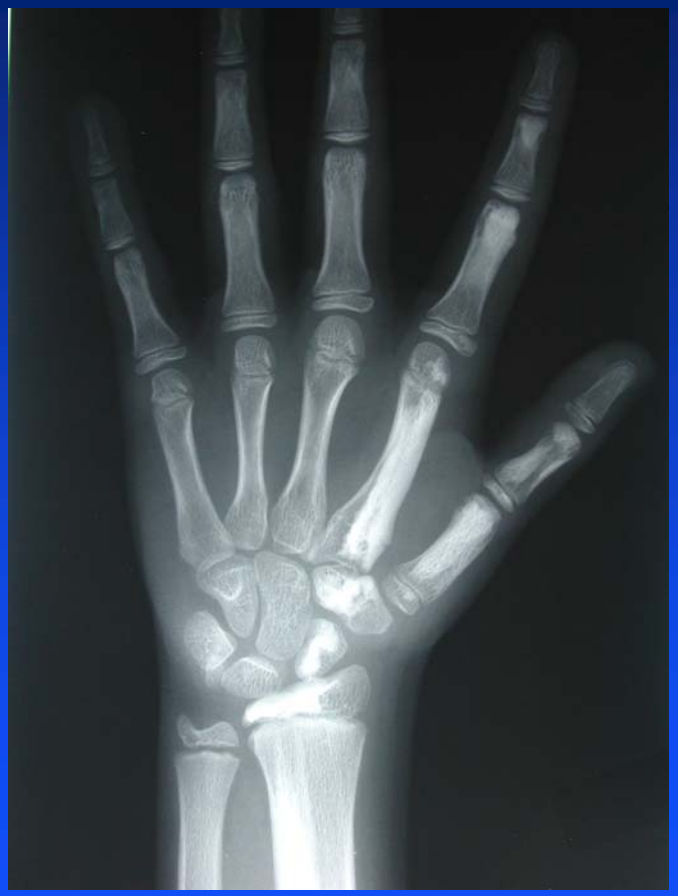
1. **Number of patients who underwent operative treatment for melorheostosis related problems**
2. **Average age of onset**
3. **Involvement of upper vs. lower extremities**
4. **Type of operative procedures (bony, soft tissue, or both)**
5. **Complications**
6. **Recurrences**

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

MA Database

- Upper extremity (12) 29.3%
- Lower extremity (25) 61%
- Multiple extremities (4) 9.75%
- Axial (1) 2.4%

Morris, et al

- Upper extremity (41/131) 31%
- Lower extremity (65/131) 49.6%
- Multiple extremities (25/131) 19%
- Axial (13/131) 10%

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

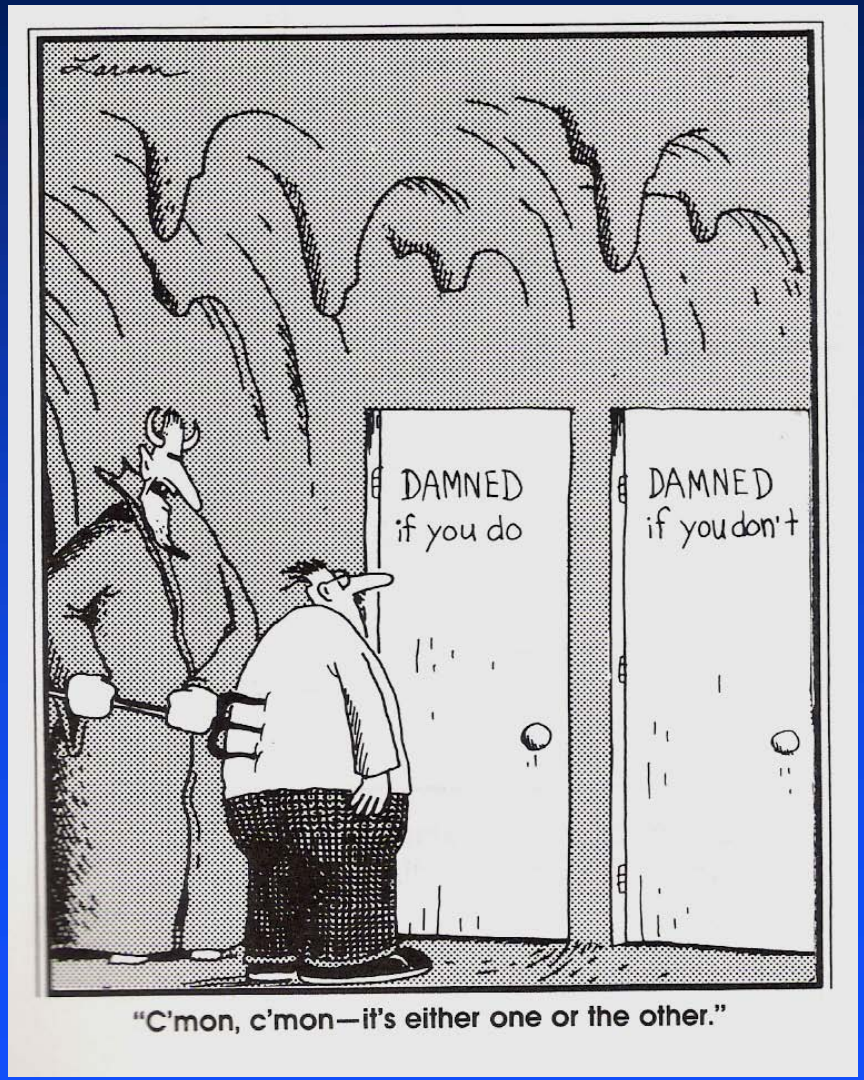
- **MA Database**
- Total recurrence (26/40) 65%
  1. Bony recurrence (17/26) 65.6%
  2. Soft tissue recurrence (3/5) 60%
  3. Both bony and soft tissue recurrence (6/9) 66.7%

- **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.

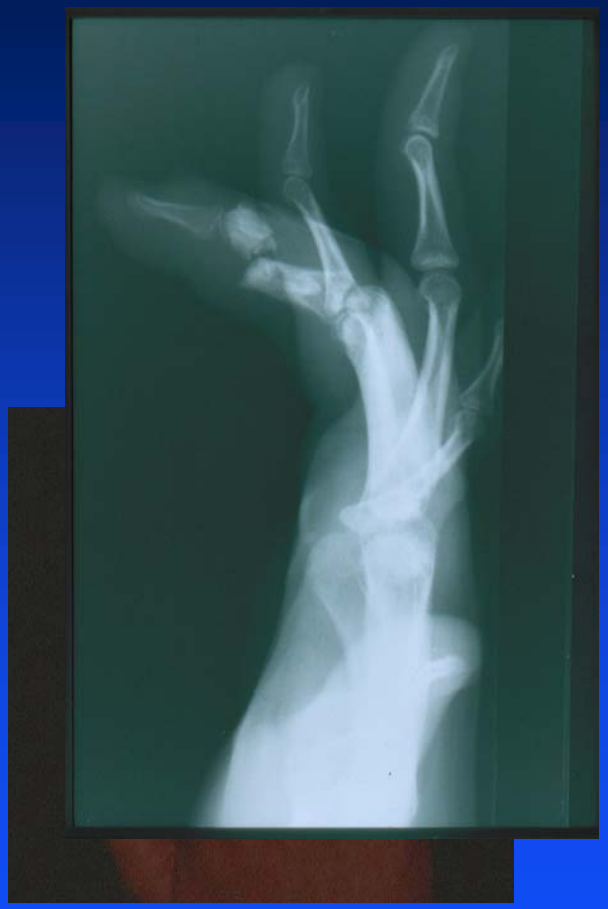
- » Open technique is recommended

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

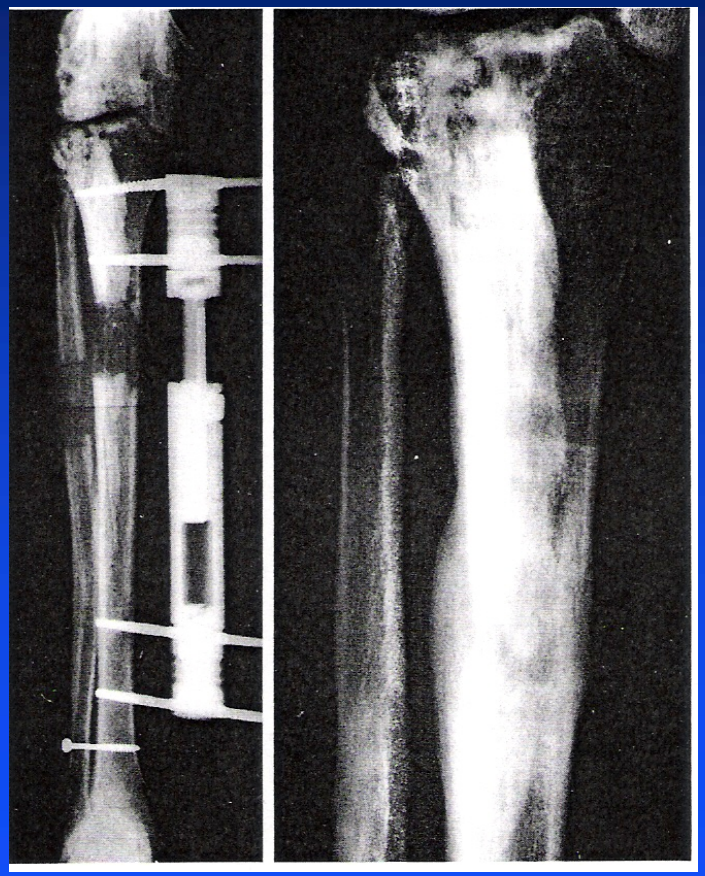
- Results
  - Exostectomy/ Bumpectomy
    - » Deformity often recurs
  - Joint fusion
    - » Limited experience.
      Limited success.

Supported by the MA database

90% recurrence rate

Limb lengthening

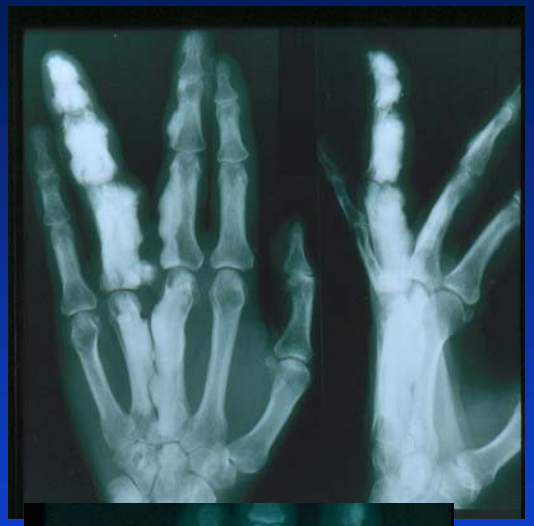
- Several case reports of success
  - Also for correction of joint deformity
    - (Atar, et al, Choi, et al, and Marshall, et al)
- The new bone formed was half normal, half abnormal!

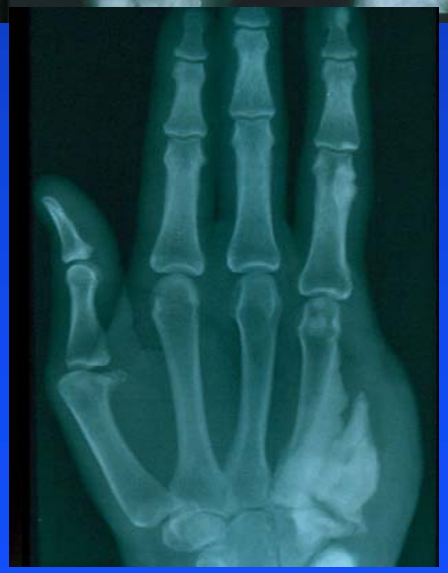


Supported by the MA database and Dr Paley

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

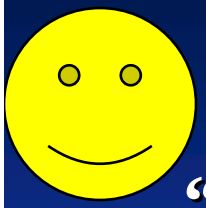
- The patient reported melorheostosis.com database information is largely consistent with the reported literature.
- Patient's frustration with physicians lack of knowledge about melorheostosis is evident in the postings.
- All of the reported treatments in the postings have previously been reported 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

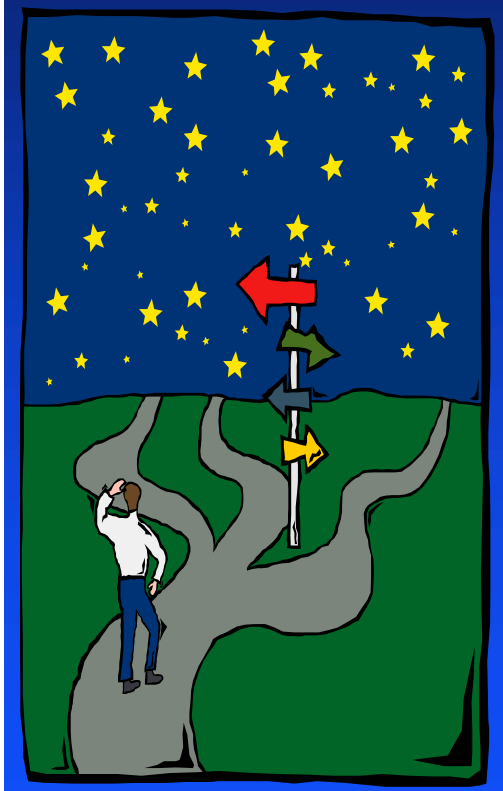
“Pearls”

- **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 adjuvent treatments (ie locked plates, BMP, etc.)
- Ultimately, a better understanding of the etiology of the disease allowing early diagnosis and new treatment techniques (ie. gene therapy?)

Future directions

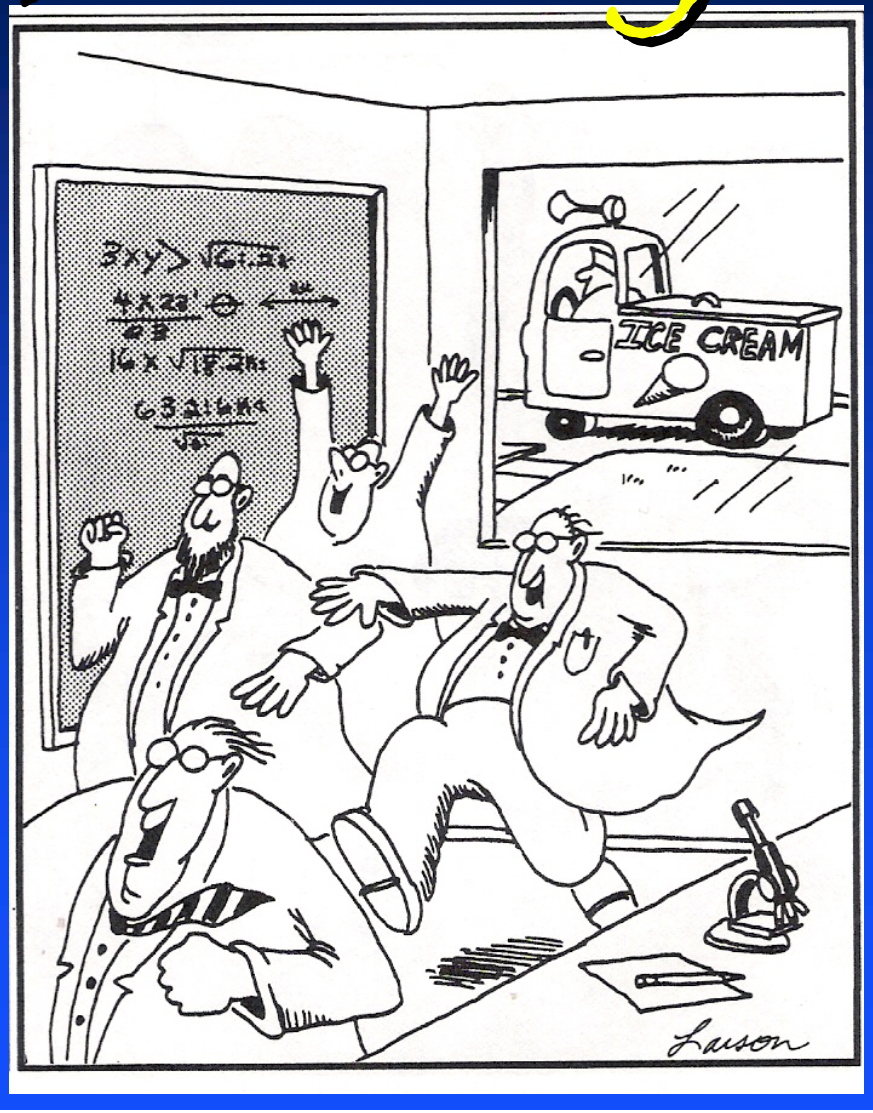
- We would like to propose a standardized data collection device:
  - to improve information collection
  - facilitate data analysis
  - to aid in diagnosis and treatment.

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