Conservative Treatment of Charcot Arthropathy

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Research on Charcot treatment will detail multiple brace design.
Multiple complex case presentations
How to treat?
Part One: Charcot Defined
Jean-Martin Charcot
1825-1893

- Was recognized in 1882 for his work on spinal arthropathies and since then his name has been used to describe the bone and joint changes associated with all of the neuropathic arthropathies.

Taken from Levin and O'Neal's "The Diabetic Foot"
Definition

- Charcot osteoarthropathy
  Highly destructive and relatively painless disorder occurring in neuropathic patients which involves singular or multiple joints

(Frykberg & Mendeszoon, Diabetes Metab Res Rev, 2000)
Pathogenesis

- **Neurotraumatic Theory**

  Neuropathy + repeated trauma = joint destruction

- Neurotrauma: Loss of peripheral sensation and proprioception leads to repetitive "microtrauma" to the joint in question; this damages goes unnoticed by the neuropathic patient, and the resultant inflammatory resorption of traumatized bone renders that region weak and susceptible to further trauma.
Pathogenesis

• Neurovascular Theory

Increased peripheral blood flow = increased bone resorption

Neurovascular: Neuropathic patients have dysregulated autonomic nervous system reflexes, and de-sensitized joints receive significantly greater blood flow. The resulting hyperemia leads to increased osteoclastic resorption of bone, and this, in concert with mechanical stress, leads to bony destruction.
Pathogenesis

- **Combined Theory**
  - Somatosensory and autonomic neuropathy
  - Osteopenia, bone hyperemia, instability, muscle weakness and loss of protective sensation
  - Neuropathic fractures, subluxation and dislocation
  - May require a precipitating event
    - Minor trauma, infection
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Scope of the Charcot Challenge

- Charcot arthropathy may effect up to 7.5% of the diabetic population with peripheral neuropathy (reported range is 0.3%-7.5%) (4)

- Currently 3 million diabetics in Canada (5)

- 40-50% of diabetic patients diagnosed >10 years have peripheral neuropathy (6)

- Charcot arthropathy is thought to be under reported

- The Charcot challenge is big and getting bigger with increased incidence of diabetes (7)
Diagnosis

• Primarily based on clinical assessment

• High index of suspicion needed

• Differential Diagnosis
  - Deep venous thrombosis
  - Cellulitis
  - Fracture
  - Osteomyelitis

• Use clinical assessment and tests to rule out other conditions on your differential diagnosis
Diagnosis

- **History**
  - Trauma
  - Past medical history: 10+ years with DM 11, 30% bilateral involvement.

- **Physical**
  - Fever
  - Appearance of limb/foot
    - Swelling (? change with elevation), erythema, deformity, ulcers
  - Neurological exam
    - LOPS/no LOPS
    - Neuropathy
    - Strength/ROM

- **Lab work**

- **Imaging** (X-ray, bone scan, MRI)
## Modified Eichenholtz Stages

<table>
<thead>
<tr>
<th>Stage</th>
<th>Phase</th>
<th>Clinical</th>
<th>Radiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Inflammatory</td>
<td>Localized warmth, swelling &amp; redness</td>
<td>X-ray – nil</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MRI – may show non-displaced pathological fractures, increased marrow edema</td>
</tr>
<tr>
<td>1</td>
<td>Development</td>
<td>Localized warmth, marked swelling &amp; redness</td>
<td>X-ray – bony debris, fragmentation of bone, periarticular fracture, subluxation &amp;/or dislocation</td>
</tr>
<tr>
<td>2</td>
<td>Coalescence</td>
<td>Continued but ↓ warmth, swelling, redness</td>
<td>X-ray – absorption of fine debris, new bone formation, coalescence of fragments, ankylosis, sclerosis of bone ends</td>
</tr>
<tr>
<td>3</td>
<td>Remodeling</td>
<td>Marked ↓/absence of warmth, swelling &amp; redness, physical deformity</td>
<td>X-ray – remodeled &amp; new bone formation, decreased sclerosis, possible gross deformity</td>
</tr>
</tbody>
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Sanders & Frykberg Classification

- Five patterns of joint involvement
  - Forefoot (I)
  - Tarsometatarsal (II)
  - Naviculocuneiform, talonavicular, calcaneocuboi (III)
  - Ankle and subtalar (IV)
  - Calcaneus (V)

- Pattern II is most common.
Part Two

Conservative Treatment
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- Charcot arthropathy affects people most commonly seen with long term DM Type II Patients (1) and LOPS.

- It can cause massive destruction to the anatomy of the foot and ankle.

**BUT...**
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- The Charcot foot can be protected through early detection and treatment (2)

- Treatment goals: minimize deformity and stabilize the foot. (3)

- Usage of cast walkers with total contact insoles or CROW walkers during acute deformative stages for all ADL
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After Diagnosis is Confirmed

- Immobilization with NON-weight bearing during acute phase (9)
  Most published protocols prohibit *any* weight bearing until after the acute phase however at least one recent study suggests that moderate weight bearing in a TCC is not harmful to the Charcot foot. (10)

- When weight bearing starts it must be done in a TCC or Cast Walker + custom moulded total contact insert

- Be blunt
  “The foot never touches the ground without the cast walker or CROW...EVER”
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Cast Walkers

- Multiple cast walkers available
  Aircast product are best

- The walker must:
  accommodate the total contact moulded insert and immobilize the foot/ankle
  Needs shoe on contralateral side

NB air bladders can be risky with insensate skin, do not use
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The moulded Insole

- Must be total contact

- Low temp, direct moulded inserts
  12 or 15mm “Intuition” brand foam

  Higher Temp, moulded on a plaster cast

  Accommodate all contractures

- Little or no relief areas
  Too much relief (pockets) will “choke” the bony areas at risk
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CROW devices

- CROW (Charcot Restraint Orthotic Walker) [multiple references]

  The goal is to immobilize and safely house the moderately or severely deformed foot within the orthosis

  Follow-Up is critical to ensure proper function throughout treatment

  Many different CROW designs, Rigid AFO designs also acceptable

- Flexible insert with a laminated or thermoplastic superstructure can work very well
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When Reconstruction is complete (stage 3)

- Minimally deformed feet: extra depth and width orthopaedic shoes and custom foot orthotics, to be worn at all times for all ADL

- Moderately or severely deformed feet: custom made footwear with custom made foot orthotics built into footwear, to be worn at all times for all ADL

- Rockered out-sole profile beneficial

- Neuropathy friendly design with minimal seams

- Return to Aircast Walker or CROW device if flare-ups or re-ulceration occurs
Charcot Time Line

**Stage 0**
Swollen, warm foot, no radiological findings

**Stage 1 (acute aka destructive)**
2-6 months, radiological changes evident

**Stage 2 (sub-acute aka coalescence)**
Swelling/temp decrease. Fractures begin healing

**Stage 3 (Reconstruction)**
Minimal swelling or increased temp. Final stage of healing.

Onset

6 months

12 months

24 months

On-going follow-up*

Immobilization and non/minimal Weight Bearing
TCC or customized cast walker

Immobilization with protected weight bearing
CROW for mod/severe deformity OR customized cast walker min deformity

**Minimal** deformity = Orthopaedic Footwear and custom FO

**Mod/severe** deformity = Custom footwear and custom FO

NB* In cases of profound joint instability an AFO may be required for long-term treatment
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- Take home Messages:

Charcot arthropathy needs to be **diagnosed early**

**Immobilize** the foot and ankle immediately without compromise. No breaks from the orthosis until MD give the “OK”. Stages 0, 1 and 2

Minimize Weight Bearing /compliance critical

Full time wear of custom made or stock footwear and FO for all ADL inside and out once stabilized (stage 3)

Follow-up very carefully
References

1) Eichenholz Charcot Joints 1966; Levin and O’Neal’s Diabetic Foot, Chapter 12 by Sanders and Frykberg 7th ed. 2008; Berlet and Shields The Diabetic Foot, pg 123-134 2000
5) L.J.deSouza, 2008 Journal of Bone and Joint Surgery
6) Perkins BA, 2007,Canadian Diabetes
7) Treatment of Charcot arthropathy “has emerged as a major component of the American Orthopaedic Foot and Ankle Society Diabetes Initiative” (Pinzur et al Foot & Ankle Int 2000)
8) Capobianco et al Journal of Orthopedic Surgery and Research 2010; Levin and O’Neal’s Diabetic Foot, Chapter 12 by Sanders and Frykberg 7th ed. 2008]
10) L.J.deSouza, 2008 Journal of Bone and Joint Surgery