Sacral Chordoma: The Loma Linda University Radiation Medicine Experience

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What is a chordoma?

- 1st chordoma discovered in clivus by Virchow and Luschka 1856
- Rare tumor arising from notochordal remnants or ectopic notochordal tissue
Metastasis

- Chordomas are not benign, can have metastatic potential
- Lungs, liver, bone most common
- Other studies report a distant metastasis rate of 5-40% in patients with long term follow up
- Survival time after metastasis was only 2.4 months
Epidemiology

- **Incidence** 0.08 per 100,000 people
- Rare reports of familial chordoma
- Few extensive case series
- In past, grouped with other bone neoplasms rather than studied separately
• Largest population based study for chordomas by McMaster, et al. examining SEER data
• 400 cases from 1973-1995
• 32% cranial, 33% spine, 29% sacrum, 8% other
• Male: Female 1.8:1
• Males more likely to have sacral presentation, females with cranial presentation
• Median age at diagnosis 58.5 years (range 3-95)
• Site of presentation varies with age and gender
• Youngest more likely to have cranial presentation
• Oldest patients, sacral tumors more common
• Median age of sacral presentation is 69
• Sacral lesions (32%) were more likely than cranial lesions (11%) to be treated with radiotherapy alone.

• 5 year survival for sacral presentation 73.6%

• 10 year survival 32.2%
Clinical Presentation

- Symptoms can be vague
- May grow to large size before seeking workup
- Local pain in almost all
- Neurological deficits including bladder, bowel symptoms, radiculopathies
Imaging Findings

- Often 1st detected by CT scanning
- CT: partially calcified soft tissue mass eroding adjacent bone
Treatment Options

- Surgery
- Radiation
- Surgery + Radiation
- Chemotherapy
Surgery

- Surgery is treatment of choice when possible
- Complete excision may lead to neurogenic dysfunction, pelvic instability
- Resection approach may be posterior or combined anteroposterior
• Want margins around tumor, optimally 1-2 cm margin of normal bone

• In large lesions, complete surgical excision usually impossible.
Mayo Clinic

- Mayo Clinic series of sacrococcygeal chordomas between 1980 to 2001
- 52 new presentation patients in the study
- Of these, only 40% were able to resected with wide margin
Mayo Clinic Results

- 5 yr overall survival 74%
- 44% had local recurrence
- Most important predictor of survival was wide margin
• Other studies report local control rate of 60-80% with total excision
• 25-50% with subtotal resection
York MD Anderson retrospective series

- Retrospective study of 27 patients with sacral chordomas at MD Anderson from 1954-1994
- With radical resection disease free interval was 2.2 years vs only 8 months with subtotal resection
• Some patients received post-operative radiation after subtotal and gross total resections
• An improvement in time to recurrence was seen among those receiving post operative XRT
TABLE 2. Surgical Results for Patients with Sacral Chordomas

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Recurrence</th>
<th>Median Time to Recurrence (yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All procedures(^a, b)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal excision</td>
<td>30/33 (91%)</td>
<td>0.67</td>
</tr>
<tr>
<td>Subtotal excision + XRT(^c)</td>
<td>2/6 (33%)</td>
<td>2.12</td>
</tr>
<tr>
<td>Radical resection</td>
<td>10/21 (48%)</td>
<td>2.27</td>
</tr>
<tr>
<td>Radical resection + XRT</td>
<td>5/7 (71%)</td>
<td>4.00</td>
</tr>
<tr>
<td>Total</td>
<td>47/67 (70%)</td>
<td></td>
</tr>
<tr>
<td>First procedure(^a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal excision</td>
<td>10/12 (83%)</td>
<td>0.67</td>
</tr>
<tr>
<td>Radical resection</td>
<td>8/15 (53%)</td>
<td>3.37</td>
</tr>
</tbody>
</table>

\(^a\) Differences between radical resection and subtotal excision were statistically significant for data for all procedures and the first procedure (\(P = 0.001\) and \(P = 0.0001\), respectively).

\(^b\) Difference between subtotal excision with and without radiation therapy was statistically significant for data for all procedures (\(P < 0.02\)).

\(^c\) XRT, radiation therapy administered in conjunction with surgery.
Radiation Options

- Photons
- Charged Particles: Protons, helium, carbon ion
Catton et al. study Princess Margaret (photon)

- Retrospective study of 48 patients with chordoma, including 23 sacral chordoma patients
- 13 sacral patients received XRT, most receiving 50 Gy in 25 fx
- Median survival after diagnosis was 62 months
- No survival advantages for patients receiving >50 Gy vs <50 Gy
Schoenthaler et al. study
Lawrence Berkeley Laboratory

- 14 patients with sacral chordoma treated with charged particles helium and neon between 1977-1989
- Median dose 75.7 CGE given at 2-2.25 GyE daily
- Median follow up 5 years
- All patients received surgery (2 bx, 4 GTR, 8 STR)
• All received helium beam, 5 also received photons, 4 also received neon

• Target: entire sacrum and any evident soft tissue abnormality with 3cm margin to 50 GyE

• Cone down of gross tumor with 1-2 cm margin received 75.7 GyE
• Anterior rectum < 50 GyE
Results of Schoenthaler Study

- 5 year survival 85%
- 5 year local control 55%
- 7 recurrences, with 2 of these patients recurring outside of radiation field
• Of the 4 patients who had total resection, 3 remain free of disease
• Of the 10 patients who had partial excision or biopsy, only 3 remain free of disease
Hug study (protons)

- 1980-1992 47 patients at Massachusetts General Hospital and Harvard Cyclotron Laboratory treated for chordomas, chondrosarcomas, osteogenic sarcomas, giant cell tumors, osteo or chondroblastomas

- Included 14 spinal and sacral chordoma patients (8 sacral)

- Of spinal/sacral chordoma patients, mean dose given was 74.6 CGE
• 10 patients received pre and postop XRT to mean dose of 75.2 CGE
• Mean follow up time 3.2 years
• 5/14 patients (36%) failed locally
• 4 within the radiation field, 1 outside
• 1/4 patients (25%) with gross total resection failed locally
• 3/8 patients (38%) with subtotal resection failed locally
• Trend toward local control for target doses $>77$ CGE but not statistically sig
• 5 year local recurrence free survival rate 53%
• 5 year overall survival rate 50%
Fig. 3. Actuarial local control (LC) and overall survival (OS) of 14 patients with chordoma (ch) and 6 patients with chondrosarcoma (cs) of the thoracic and lumbar spine and sacrococcygeal region following combined photon and proton radiation therapy (group 1).
Study Design

- Retrospective review of 22 patients treated at LLUMC for sacral chordomas between 1992-2004
- 3 patients excluded from analysis due to metastatic disease at presentation
- 6 records unavailable for followup
• Endpoints to be examined included overall survival, disease free survival, local control

• All patients had a surgical procedure: 1 biopsy only, 7 subtotal resection, 11 gross total resection
• Radiation dose ranged from 66.6 CGE to 81 CGE
• Average dose 73.6 CGE
• 8 patients had combination therapy of proton and photon beams
• GTV: preoperative tumor volume
• CTV: Add 0.5 cm around GTV
• Limit rectal dose to 50.4 CGE
70 yo male presenting with 15 yr history of coccygeal pain
52 yo male with recurrent sacral chordoma, s/p 3 subtotal resections
Patient Description

- 4 females, 15 males
- Age range: 25-82
- Average age: 60.8
Distant Mets

- On initial presentation 2 patients had distant metastases
- Areas include lung, liver
Overall Survival

5 yr OS 80%
Disease Free Survival

5 yr DFS 60%
• Median time before recurrence 64 months
  (95% CI of 43 to 85 months)
Local Control

5 yr LC 60%
Distant Control

5 yr DC 75%
• Analyzed by extent of surgery:
  • total resection vs subtotal resection
Overall Survival by Surgery Type

5 yr OS: Total resection 89%
Subtotal resection 73%
p=0.60
• Median time to recurrence 86 months for patients with total resection
• Median time to recurrence 44 months for patients with subtotal resection
Local Control by Surgery Type

5 yr LC: Total resection 90%
Subtotal resection 29%
p = .02
Distant Control by Surgery Type

5 yr DC: Total resection 100%
Subtotal 40%
p=0.84
• Patients analyzed by status at study entry
• “Before Failure” group: Patients treated after initial diagnosis without recurrence
• “After Failure” group: Patients treated after recurrence
Overall Survival by Study Entry

5 yr OS: Before Failure 100%
After Failure: 61%
p=0.11
Local Control by Study Entry

5 yr LC: Before Failure 70%
After Failure 52%
p=0.70
Distant Control by Study Entry

5 yr distant control:
Before Failure 80%
After Failure 71%
p=0.29
Symptomatic Relief

- 15 patients had pain on presentation
- 11 had improvement in pain
- 4 did not have pain relief and/or worsened
Motor Symptoms

• 7 had motor difficulty at presentation
• Of these 5 had improvement
## Late Morbidity

<table>
<thead>
<tr>
<th>ORGAN TISSUE</th>
<th>0</th>
<th>Grade 1</th>
<th>Grade 2</th>
<th>Grade 3</th>
<th>Grade 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>SKIN</td>
<td>None</td>
<td>Slight atrophy</td>
<td>Patch atrophy;</td>
<td>Marked atrophy;</td>
<td>Ulceration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pigmentation change</td>
<td>Moderate telangiectasia; Total hair loss</td>
<td>Gross telangiectasia</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Some hair loss</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUBCUTANEOUS TISSUE</td>
<td>None</td>
<td>Slight induration (fibrosis) and loss of</td>
<td>Moderate fibrosis but asymptomatic Slight</td>
<td>Severe induration and loss of subcutaneous</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>subcutaneous fat</td>
<td>field contracture</td>
<td>tissue Field contracture</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;10% linear reduction</td>
<td>&gt;10% linear measurement</td>
<td></td>
</tr>
<tr>
<td>BONE</td>
<td>None</td>
<td>Asymptomatic</td>
<td>Moderate pain or tenderness</td>
<td>Severe pain or tenderness</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>No growth retardation</td>
<td>Growth retardation</td>
<td>Complete arrest of bone growth</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reduced bone density</td>
<td>Irregular bone sclerosis</td>
<td>Dense bone sclerosis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Necrosis/ Spontaneous fracture</td>
<td></td>
</tr>
</tbody>
</table>
Late Morbidity

- Skin morbidity: No patients developed Grade 3 or higher late morbidity
- 5 patients had Grade 1, 2 scores
- Subcutaneous morbidity: 1 patient had grade 3
- 3 patients had Grade 1, 2 scores
- Only other late morbidity was one patient who developed Grade 3 bone complication
Summary

- 5 yr overall survival 80%
- 5 yr disease free survival 60%
- 5 yr local control 60%
- 5 yr distant control 75%
Conclusions

• Surgery is important factor for local control (significant difference)

• In our study patients with total resection had a 5 year local control rate of 90%, subtotal resection 29%

• However, total resection often not possible
Future Followup

- **Dose escalation possibilities**
- Appears most failures are within radiation field in past studies
- Investigate rectal toxicity
- Increase dose to rectum, bladder to determine if dose escalation possible for increased tumor control