Hemipelvectomy case study

Sandeep Gupta
Royal Prince Alfred Hospital
Outline

History
Diagnosis
Limb salvage
Amputation
Prosthetic considerations
Prosthesis
Gait retraining
Current function
Ongoing rehabilitation
? “Bikini” socket fabrication
History

- 29 August
  - Presents to GP with 1/52 worsening R buttock and thigh pain
  - Pain radiates into groin and testicles, particularly with coughing
  - Difficulty WB
  - Pain not disturbing sleep
  - In the past week had massage (Chinese) and starting taking Panadol

- GP
  - Conducted a MS assessment of spine
    - Normal motion, no tenderness, SLR 90 bilaterally
  - Started seeing a physiotherapist
- mid November 2011 had hernia surgery

- 3 December 2011
  - R leg caught on carpet, increase in leg pain, LL weakness and inability to WB

- 5 December 2011
  - Presented to GP
    - Normal knee ROM, unable to flex hip and tenderness in R buttock
  - CT scan
    - Large mass from right ilium extending into iliopsoas (7x6x5cm)

- 8 December 2011
  - CT guided biopsy revealed high grade Pleomorphic sarcoma (type of soft tissue sarcoma)
Pleomorphic sarcoma

- Diagnosis of exclusion
- Most common soft tissue sarcoma of late adult life
- Males affected more than females (2:1)
- Caucasians more than Africans or Asians
- Most common in extremities and retroperitoneum
- Metastasis occurs most often in the lungs (90%), bones (8%) and liver (1%)
- Prognosis depends on primary tumour grade, size, whether it can be removed surgically and the presence of metastasis
  - Five year survival is between 35-60%
Figure 6
Overall survival after the amputation operation with free surgical margins (n = 16, continuous line) and with positive surgical margins (n = 25, broken line). The tick marks indicate last follow-up. The difference was significant (Kaplan Meier Log-Rank, p = 0.002).
15 December 2011
- MRI pelvis
  - Destructive lesion of the right ilium, likeliest cause for the lesion is a metastasis. Myeloma and lymphoma are possibilities. There is a second lesion in the superior right ilium
  - Lesion of right femoral neck has the appearance of a benign lesion such as an intraosseus lipoma or fibrous dysplasia

20 December 2011
- Pet Scan
  - Marked increase in glucose metabolism in the large mass involving the right ilium and adjacent soft tissue
Tumour

Fibrous Dysplasia
Fibrous Dysplasia

- Abnormal bone growth where normal bone is replaced with fibrous bone tissue
- Causes abnormal growth or swelling of bone
- Can occur in any part of the skeleton but the bone of skull, thigh, shin, ribs, upper arm and pelvis are most commonly affected
- Very rare, no known cure
- BENIGN
- No symptoms, often diagnosed accidently
- If symptomatic, may have the following
  - Pain due to expansion of bone
  - Irregular bone growth
  - Bone deformity
  - Rarely, increased chance of bone #
Fibrous Dysplasia
LIMB SALVAGE SURGERY
Excision of R ilium and reconstruction with allograft and THR (29/12)

- Right ilium resected halfway down the acetabulum to the SIJ
- Reconstruction through allograft of distal femur (from QLD bone bank) positioned from the sacrum across to the down of the acetabulum with screws down the anterior and posterior columns as well as 50mm Smith and Nephew ring with screws on either side of the ring into host bone and allograft
- Into this was cemented a 44mm Brunswick acetabular cup and an Exeter stem and metal head was used
- The abdominal wall was reattached to the hip abductors directly
Histopathology

- 11x5.5x5.5 tumour
- Fibrous dysplasia of femoral head and ilium
- Large high grade Pleomorphic sarcoma with giant cell tumour
- Most giant cell tumours are benign
- Sarcomatoid dedifferentiation of fibrous dysplasia
2012/13

- Bed rest for 12 weeks (till March 2012)
- Radiotherapy and chemotherapy (Feb – April)
- NWB for another 4/12 (till July 2012)
- TWB for a further 2/12 (till September 2012)
- Up to 10kg for another 2/12 (till November 2012)
- Up to 15 kg for another 2/12 (till January 2013)
- Up to 20 kg for another 2/12 (till March 2013)
- Up to 25 kg for 3/12 (till June 2013)
- Up to 50kg for 3/12 (till September 2013)
- September 2013….
24/9/13
- Pt contacted orthopod regarding an increase in pain over the past week impacting on sleep

28/9/2013
- Pelvic x-ray
  - Fracture through the inferior aspect of the acetabular prosthesis with early derangement of the adjacent screw
  - The fracture line through the quadrilateral roof is unchanged

29/9/2013 – CRP of 270 (normal is 0-5)
30/9/2013

CT scan

- The right hemipelvis is markedly deformed, appearances in keeping with the allograft for the treatment of a high grade sarcoma in the right hemipelvis. Two screws from the remaining ilium transfix the right SIJ

- There is a fracture line through the superior medial aspect of the right acetabulum, but the overall alignment of the right hemipelvis is similar to the previous x-ray

5/10/13 – CRP 312

- Started on IV antibiotics

1/11/13 – CRP 176
4/11/13
- Pelvic x-ray
  - Periprosthetic fracture of inferior acetabular cup and inferior screw dislodgement, resulting in a breach of the acetabular rim
  - There is a new lucency abutting the outer lateral margin of the proximal stem component

8/11/13
- PET scan
  - Extensive and moderate to marked increase in glucose metabolism surrounding the right hip prosthesis, the hemipelvis, soft tissues and lymph nodes in the right groin consistent with recent septic arthritis
Hindquarter amputation
21/11/13
Right hemipelvis

- Resection of ilium from the level of the SIJ and the right proximal femur.
- The anterior, posterior, medial wall of the acetabulum, the iliac spine, ischium and pubic rami remain
  ⇒ like a hip disarticulation, but missing almost all of the ilium and hence iliac crest – difficulty with suspension
  ⇒ insertion of rectus abdominus and external obliquus onto pubic symphysis is intact – ability to posterior pelvic tilt

- There is a 3cm area of T2 signal hyperintensity in the soft tissues at the inferior edge of the gluteus medius, just below the level of the inferior acetabular margin and lateral to the ischium.
- It is therefore considered likely to be a post surgical collection rather than a recurrent tumour.
Post surgery – the remnant
O$_2$ consumption is greater in amputees

Table 3.
Mean ± standard deviation free walking speed (FWS), heart rate (HR), oxygen uptake (˙V$_{O_2}$), oxygen cost (O$_2$C), Rating of Perceived Exertion (RPE), step length (SL), step rate (SR), and walk ratio (WR) by type of terrain for two study groups (nondisabled, amputee; N = 20).

<table>
<thead>
<tr>
<th>Terrain</th>
<th>FWS (m/min)</th>
<th>HR (bpm)</th>
<th>˙V$_{O_2}$ (mL O$_2$/kg/min)</th>
<th>O$_2$C (mL O$_2$/kg/min)</th>
<th>RPE</th>
<th>SL (m)</th>
<th>SR (step/min)</th>
<th>WR (m/step/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Nondisabled</td>
<td>91.4 ± 6.7</td>
<td>99.2 ± 10.2</td>
<td>13.43 ± 0.21</td>
<td>0.147 ± 0.020</td>
<td>9.1 ± 0.7</td>
<td>0.816 ± 0.09</td>
<td>112 ± 4.1</td>
<td>7.28 × 10$^{-3}$</td>
</tr>
<tr>
<td>Amputee</td>
<td>89.3 ± 9.2</td>
<td>101.0 ± 15.3</td>
<td>14.55 ± 0.19</td>
<td>0.163 ± 0.015</td>
<td>8.7 ± 0.5</td>
<td>0.826 ± 0.12</td>
<td>108 ± 7.3</td>
<td>7.64 × 10$^{-3}$</td>
</tr>
<tr>
<td>Mown Lawn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nondisabled</td>
<td>90.1 ± 9.4</td>
<td>103.0 ± 12.1</td>
<td>14.05 ± 0.15</td>
<td>0.156 ± 0.022</td>
<td>9.6 ± 1.1</td>
<td>0.811 ± 0.07</td>
<td>111 ± 6.2</td>
<td>7.30 × 10$^{-3}$</td>
</tr>
<tr>
<td>Amputee</td>
<td>88.1 ± 7.3</td>
<td>101.0 ± 8.9</td>
<td>15.06 ± 0.23</td>
<td>0.171 ± 0.010</td>
<td>9.4 ± 2.3</td>
<td>0.808 ± 0.13</td>
<td>109 ± 6.8</td>
<td>7.41 × 10$^{-3}$</td>
</tr>
<tr>
<td>High Grass</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nondisabled</td>
<td>77.5 ± 9.8</td>
<td>107.0 ± 13.5</td>
<td>15.63 ± 0.14</td>
<td>0.182 ± 0.023</td>
<td>12.3 ± 1.7</td>
<td>0.745 ± 0.11</td>
<td>104 ± 9.2</td>
<td>7.16 × 10$^{-3}$</td>
</tr>
<tr>
<td>Amputee</td>
<td>74.7 ± 6.9</td>
<td>115.0 ± 16.8</td>
<td>18.29 ± 0.20</td>
<td>0.245 ± 0.015</td>
<td>16.9 ± 0.9</td>
<td>0.685 ± 0.10</td>
<td>109 ± 11.4</td>
<td>6.28 × 10$^{-3}$</td>
</tr>
</tbody>
</table>

PAYSANT et al. Influence of terrain on amputee gait

JRRD, Volume 43, Number 2, 2006
Oxygen cost with different levels of amputation

<table>
<thead>
<tr>
<th>Table II</th>
<th>Unrestrained Walking in Amputees (Mean Values and Standard Deviation)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Velocity (m/min)</td>
</tr>
<tr>
<td>----------</td>
<td>------------------</td>
</tr>
<tr>
<td>Vascular amputees</td>
<td></td>
</tr>
<tr>
<td>Above the knee</td>
<td>36 ± 15</td>
</tr>
<tr>
<td>Below the knee</td>
<td>45 ± 9</td>
</tr>
<tr>
<td>Syme</td>
<td>54 ± 10</td>
</tr>
<tr>
<td>Traumatic amputees</td>
<td></td>
</tr>
<tr>
<td>Above the knee</td>
<td>52 ± 14</td>
</tr>
<tr>
<td>Below the knee</td>
<td>71 ± 10</td>
</tr>
</tbody>
</table>

R. E. Waters, Jacquelin Perry, Daniel Antonelli, and Helen Hislop

The Journal of Bone and Joint Surgery
### Table 3.
Results of metabolic measurements for each subject.

<table>
<thead>
<tr>
<th>Subject</th>
<th>CWS (m/min)</th>
<th>Oxygen Consumption Rate ± SE (mL/kg/min)</th>
<th>Oxygen Cost ± SE (mL/kg/m)</th>
<th>%VO$_2$max</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30</td>
<td>18.0 ± 0.8</td>
<td>0.600 ± 0.151</td>
<td>44.2</td>
</tr>
<tr>
<td>2</td>
<td>35</td>
<td>20.5 ± 1.2</td>
<td>0.587 ± 0.037</td>
<td>55.8</td>
</tr>
<tr>
<td>3</td>
<td>27</td>
<td>18.3 ± 2.1</td>
<td>0.679 ± 0.078</td>
<td>56.5</td>
</tr>
<tr>
<td>4</td>
<td>17</td>
<td>13.9 ± 0.8</td>
<td>0.822 ± 0.052</td>
<td>43.3</td>
</tr>
<tr>
<td>5</td>
<td>47</td>
<td>20.4 ± 2.3</td>
<td>0.435 ± 0.049</td>
<td>59.6</td>
</tr>
<tr>
<td>6</td>
<td>23</td>
<td>20.1 ± 1.4</td>
<td>0.878 ± 0.062</td>
<td>69.6</td>
</tr>
<tr>
<td>7</td>
<td>35</td>
<td>16.6 ± 0.5</td>
<td>0.475 ± 0.057</td>
<td>72.0</td>
</tr>
</tbody>
</table>

%VO$_2$max = maximum oxygen uptake during exercise as a proportion of predicted maximum oxygen uptake, CWS = comfortable walking speed. SE = standard error of the mean.
Table 2: Usage of the custom made prosthesis by the patients.

<table>
<thead>
<tr>
<th></th>
<th>HD</th>
<th>HP</th>
<th>SD</th>
<th>ISTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>15</td>
<td>3</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>N with custom made prosthesis</td>
<td>8</td>
<td>0</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Regular use</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Rare use</td>
<td>3</td>
<td>0</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>No use</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

HD = hip dysarticulation, HP = hemipelvectomy, SD = shoulder dysarticulation, ISTA = interscapulothoracic amputation.
Table 1  Characteristics of patients (n = 46), reason for amputation and outdoor ambulation

<table>
<thead>
<tr>
<th></th>
<th>Total group (n = 46) mean (SD)</th>
<th>HD (n = 31) mean (SD)</th>
<th>HP (n = 15) mean (SD)</th>
<th>P-value (t-test/\chi^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at time of amputation, years</td>
<td>32.7 (18.7)</td>
<td>29.1 (19.9)</td>
<td>40.2 (13.6)</td>
<td>0.57</td>
</tr>
<tr>
<td>Age at time of inclusion, years</td>
<td>55.8 (12.1)</td>
<td>55.7 (12.5)</td>
<td>55.9 (11.7)</td>
<td>0.97</td>
</tr>
<tr>
<td>Interval, years</td>
<td>23.0 (17.5)</td>
<td>26.6 (18.8)</td>
<td>15.6 (11.9)</td>
<td><strong>0.04</strong></td>
</tr>
<tr>
<td>Gender, no. (%)</td>
<td></td>
<td></td>
<td></td>
<td>0.17</td>
</tr>
<tr>
<td>Male</td>
<td>21 (46%)</td>
<td>12 (39%)</td>
<td>9 (60%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>25 (54%)</td>
<td>19 (61%)</td>
<td>6 (40%)</td>
<td></td>
</tr>
<tr>
<td>Reason for amputation*, no. (%)</td>
<td></td>
<td></td>
<td></td>
<td>0.74</td>
</tr>
<tr>
<td>Tumour</td>
<td>36 (78%)</td>
<td>24 (77%)</td>
<td>12 (80%)</td>
<td></td>
</tr>
<tr>
<td>Vascular</td>
<td>6 (13%)</td>
<td>4 (13%)</td>
<td>2 (13%)</td>
<td></td>
</tr>
<tr>
<td>Trauma</td>
<td>2 (4%)</td>
<td>1 (3%)</td>
<td>1 (7%)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>2 (4%)</td>
<td>2 (7%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>Outdoor ambulation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Able to drive a car</td>
<td>37 (80%)</td>
<td>25 (81%)</td>
<td>12 (80%)</td>
<td>0.95</td>
</tr>
<tr>
<td>Able to ride a mobility scooter</td>
<td>19 (41%)</td>
<td>14 (45%)</td>
<td>5 (33%)</td>
<td>0.44</td>
</tr>
<tr>
<td>Able to ride an adapted bicycle</td>
<td>22 (49%)</td>
<td>14 (47%)</td>
<td>8 (53%)</td>
<td>0.67</td>
</tr>
<tr>
<td>Other topics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adapted home</td>
<td>25 (56%)</td>
<td>19 (63%)</td>
<td>6 (40%)</td>
<td>0.13</td>
</tr>
<tr>
<td>Sport</td>
<td>18 (39%)</td>
<td>14 (45%)</td>
<td>4 (27%)</td>
<td>0.22</td>
</tr>
<tr>
<td>In paid employment</td>
<td>25 (54%)</td>
<td>17 (55%)</td>
<td>8 (53%)</td>
<td>0.92</td>
</tr>
<tr>
<td>Pregnancies 7/25b</td>
<td>7 (28%)</td>
<td>7/19</td>
<td>0/6</td>
<td></td>
</tr>
</tbody>
</table>

HD, hip disarticulation; HP, hemipelvectomy; SD, standard deviation.

*Total of percentages is not 100% because of rounding off.

bFemale.
Table 3  Mobility of hip disarticulation and hemipelvectomy amputees assessed using the Rising and Sitting Down, Walking and Climbing Stairs questionnaire

<table>
<thead>
<tr>
<th></th>
<th>Total group (n=46)</th>
<th>HD (n=31)</th>
<th>HP (n=15)</th>
<th>P-value (t-test)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td></td>
</tr>
<tr>
<td>Walking</td>
<td>55.0 (22.1)</td>
<td>51.8 (20.8)</td>
<td>61.6 (23.8)</td>
<td>0.16</td>
</tr>
<tr>
<td>Rising and sitting down</td>
<td>53.6 (13.1)</td>
<td>52.3 (12.7)</td>
<td>56.1 (14.0)</td>
<td>0.35</td>
</tr>
<tr>
<td>Climbing stairs</td>
<td>58.1 (28.2)</td>
<td>54.2 (28.3)</td>
<td>66.2 (27.1)</td>
<td>0.17</td>
</tr>
</tbody>
</table>

HD, hip disarticulation; HP, hemipelvectomy; SD, standard deviation.

Table 4  Amputation-related factors in hip disarticulation and hemipelvectomy amputees

<table>
<thead>
<tr>
<th></th>
<th>Total group (n=46)</th>
<th>HD (n=31)</th>
<th>HP (n=15)</th>
<th>P-value (χ²-test)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. (%)</td>
<td>No. (%)</td>
<td>No. (%)</td>
<td></td>
</tr>
<tr>
<td>Phantom pain</td>
<td>36 (78%)</td>
<td>25 (81%)</td>
<td>11 (73%)</td>
<td>0.57</td>
</tr>
<tr>
<td>Skin problems</td>
<td>4 (9%)</td>
<td>3 (10%)</td>
<td>1 (7%)</td>
<td>0.73</td>
</tr>
<tr>
<td>Prosthetic use</td>
<td>35 (76%)</td>
<td>24 (77%)</td>
<td>11 (73%)</td>
<td>0.57</td>
</tr>
<tr>
<td>Cosmetic prosthesis</td>
<td>1 (2%)</td>
<td>1 (3%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>Overload upper extremity</td>
<td>20 (43%)</td>
<td>13 (42%)</td>
<td>7 (47%)</td>
<td>0.76</td>
</tr>
<tr>
<td>Sit comfortably</td>
<td>32 (71%)</td>
<td>23 (74%)</td>
<td>9 (60%)</td>
<td>0.49</td>
</tr>
<tr>
<td>Seating device</td>
<td>19 (42%)</td>
<td>10 (32%)</td>
<td>9 (60%)</td>
<td><strong>0.04</strong></td>
</tr>
</tbody>
</table>

HD, hip disarticulation; HP, hemipelvectomy;
Prosthetic consideration

- 6/3/2014
  - Pt attended the amputee clinic at RPA
  - Discussion about the difficulty learning to mobilise and mobilising with a prosthesis
    - Energy consumption with a prosthesis (Hip Disart 3-9 times able bodied people) V wheelchair or crutches
    - Requires determination and motivation
    - Up to 73% of patients utilise a prosthesis
    - Rejection due to age, difficulty in ambulating, intolerance of the socket and excessive weight
  - Patient very keen to try and learn
    - Given posterior pelvic tilt exercises
  - Prescription completed
    - Diagonal/bucket socket
    - 7E7 hip joint
    - Polycentric knee
    - Dynamic foot
This patient has rectus abdominus and external oblique to posterior pelvic tilt the pelvis

Ability to posterior pelvic tilt is critical to breaking the knee joint and swing phase

This also means the patient does not have to vault to swing the prosthesis
Social History

- Lives with his wife in 2 storey home (14 steps)
- Previously independent in ADLs
- Works for North Sydney Council with heavy machinery, currently on desk duties
- Drives an automatic

- Currently independent with crutches (hopping) and driving
Prosthetic training

- **25/5/2014**
  - Pt receives prosthesis – instructed to stand in prosthesis only
  - Started standing to help his wife with chopping vegetables at home

- **13/6/2014** – started prosthetic retraining
  - Don/doff – independent
  - Gait (in bars) – R heel raising (vaulting) in L swing
    - R knee flexion in stance with posterior pelvic tilt tp swing L leg
  - Adjusted straps to improve suspension
  - Posterior pelvic tilt practice with knee extension
  - Gait practice in bars – keeping R heel on ground and R knee extension in stance
  - Sideways walking in bars – difficulty hitching hip
2-4 treatments

- Less vaulting (7/13 steps), down to 2/13
- Trialed with Canadian crutches – pt safe to use indoors
- Stepping exercise in bars with and without UL
- Sideways walking in bars with UL – difficult as unable to hitch L hip
- Pelvic hitching exercises
- Walking without UL in bars with standby assistance x 1
- Step ups 7cm, 12 cm, 15 cm with UL in bars
- Suspension worsening – began catching toe, increase in vaulting. Rang prosthetist – trialed adding folded pillowcases to add suspension
- Prosthesis in IR - Appointment made with prosthetist that day (30/6)
Milestones

- Seen prosthetist – hip not laminated properly, prosthesis shortened by 10mm, and packing to superior brim

- 3/7 – outdoors on ramps and cambers with crutches, up and down stairs with crutches

- 7/7 - Pt trialed stairs with crutches at home without difficulty

- 14/7 - Went shopping with prosthesis and crutches, caught the bus
  - Outdoor mobility 300m with w/s x2

- 17/7 – wearing less layers (warmer day) resulted in toe catching in swing secondary to a loss of suspension

- 22/7 – more packing this time to anterior/posterior dimensions
Milestones

- 24/7 – outdoor mobility with w/s x 1
- 31/7 – getting off floor practice
- 12/8 – more packing, booked into amputee clinic for new socket and rotator
- 14/8 – outdoor mobility without aids and standby assistance
- 25/8 – walking around cones
- Main complaint is difficulty ambulating (10 times more difficult than premorbid ambulation) and difficulty sitting, esp with driving
- SatPro on 28/8 – 80% (36/45)
outdoor mobility
Where to next.....

- Prosthetist viewing a DVD to see if it is feasible to fit patient with a different socket design

- If possible:
  - Appliance and Limb Centre to hold a directors meeting to approve or not approve fitting patient with new socket

- If patient is fitted with new socket, then objective measures (10m walk, outdoor mobility and LCI) to be utilise to build a case to submit to EnableNSW for consideration of funding new socket design
HIP DISARTICULATION AND HEMIPELVECTOMY LEVEL INTERFACE, USING COMPLIANT FORCE DISTRIBUTION

Technology developed by:
Jay Martin, CP, LP, FAAOP
Captures Pelvic Rotation
• If new socket design is fabricated, a follow-up presentation will occur at the next PAR meeting....