Where is the worst radioactive contamination on the planet?
Hanford, Washington

- Military plutonium enrichment program since 1942
- 40 billion gallons of nuclear wastewater dumped into the soil over 60 years
- More than 200 sq. miles are contaminated
- Will not support human life for 10,000 years
- 20 tons of plutonium still stored there
- Only 2 pounds needed to create a primitive nuclear bomb
Upper Limb Amputation Functional Outcome

Heikki Uustal, MD
JFK-Johnson Rehab Institute
Edison, NJ
There are very few studies that investigate long-term functional outcome in upper limb amputation, and there are no standards on what parameters to study.
Overall there appears to be less functional use of upper limb prostheses than lower limb prostheses, possibly because the unilateral upper limb amputee can be independent in self care without a prosthesis.
If we take into account the discomfort, inconvenience, weight, and limited cosmesis of most prostheses, then it is no surprise that many patients use their device on a limited basis or none at all.
Bilateral upper limb amputees are much more dependent on their prosthetic devices, and therefore more likely to use them regularly.
Several functional assessment tools have been developed over the years (FIM, Bartels, NYU, RIC), but they look at functional tasks, not prosthetic use during a task. The patient may become very proficient at performing many tasks without the prosthesis.
Wearing time of the prosthesis may not correlate to any functional use of the prosthesis.
Some specialized amputee centers will establish individualized functional goals, involving prosthetic use, for each patient, but then there is no way to compare a population of patients.
Pinzur, 1994, J Hand Surg

- Studied 19 traumatic upper limb amputees over 9 years
- 11 TRA, 5 THA, 3 SD
- 18 fitted with prosthesis
- 15/18 used prosthesis on a daily basis
Jones, 1995, Disabil Rehabil

- Follow-up study of 27 upper limb amputees
- All levels included
- Time since amputation ranged 5-15 years
- Only 37 % were using prosthesis >8 hr/day
- Occasional use by another 18 %
I did my own study at Baylor to assess long-term functional outcome in 1987.
Population

- Includes: All unilateral upper extremity amputees seen at TIRR for initial visit, 1977 – 1985
- Excludes: Partial hand amputation, Congenital amputees, Patients who already had prosthesis
Functional Outcome Categories

- Did not receive prosthesis
- Not wearing prosthesis
- Cosmetic use only
- Gross motor activities with prosthesis
- Fine motor activities with prosthesis
Data Gathered

- Age
- Sex
- Right/Left limb loss
- Dominance
- Level of amputation
- Etiology of injury
- Time to initial visit
- Time to prosthesis
- Functional outcome
- Wearing time
- Work status
- Complications
- Duration of follow-up
- Number of visits
- Type of prosthesis
- Method of payment
Patients who met criteria = 103 (100%)
Patients contacted for follow-up = 93 (90%)

Follow-up Group Statistics (N=93)
Sex: Male 85%          Female 15%
Dominant Limb Loss: 50%

<table>
<thead>
<tr>
<th>Average Age</th>
<th>Age Distribution</th>
<th>Age Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>31.2</td>
<td>15 – 24</td>
<td>15 – 62</td>
</tr>
<tr>
<td></td>
<td>35 – 44</td>
<td></td>
</tr>
<tr>
<td></td>
<td>45 – 54</td>
<td></td>
</tr>
<tr>
<td></td>
<td>55 – 64</td>
<td></td>
</tr>
<tr>
<td></td>
<td>41%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>19%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5%</td>
<td></td>
</tr>
</tbody>
</table>
Etiology

Mechanical Trauma 69%
Electric/Burn injury 16%
Brachial Plexus injury 9%
Cancer 4%
Vascular injury 1%
Infection 1%

Method of Payment

Workman’s Comp 56%
Private Insurance 44%
<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S/D</td>
<td>Shoulder disarticulation, forequarter, very short above elbow fitted as S/D</td>
</tr>
<tr>
<td>A/E</td>
<td>Above elbow, elbow disarticulation</td>
</tr>
<tr>
<td>B/E</td>
<td>Below elbow</td>
</tr>
<tr>
<td>W/D</td>
<td>Wrist disarticulation</td>
</tr>
</tbody>
</table>
## Distribution by Level

<table>
<thead>
<tr>
<th>Level</th>
<th>Number</th>
<th>Percent of total</th>
<th>Percent of level Receiving Prosthesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>S/D</td>
<td>19</td>
<td>(20%)</td>
<td>68%</td>
</tr>
<tr>
<td>A/E</td>
<td>29</td>
<td>(31%)</td>
<td>86%</td>
</tr>
<tr>
<td>B/E</td>
<td>36</td>
<td>(39%)</td>
<td>89%</td>
</tr>
<tr>
<td>W/D</td>
<td>9</td>
<td>(10%)</td>
<td>100%</td>
</tr>
</tbody>
</table>
Complications

Delayed healing (more than 4 weeks post-injury)
Revision of stump (more than 1 week post-amputation)
Prolonged initial course
Associated major trauma
Pain – stump or phantom pain requiring meds or injection more than 4 weeks post-amputation
**Functional Outcome by All Levels**

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Prosthesis</td>
<td>15</td>
</tr>
<tr>
<td>Not Wearing</td>
<td>10.5</td>
</tr>
<tr>
<td>Cosmetic Use</td>
<td>10.5</td>
</tr>
<tr>
<td>Gross Motor</td>
<td>39</td>
</tr>
<tr>
<td>Fine Motor</td>
<td>25</td>
</tr>
</tbody>
</table>

Users: 64%

Wearers: 74.5%
Functional Outcome by Level

Percent

- No Prosthesis
- Not Wearing
- Cosmetic Use
- Gross Motor
- Fine Motor

Legend:
- S/D
- A/E
- B/E
- W/D

Percentages:
- No Prosthesis: S/D
- Not Wearing: A/E
- Cosmetic Use: B/E
- Gross Motor: W/D
- Fine Motor: W/D

Note: The image contains a bar chart showing the percentage distribution across different categories.
## Functional Outcome by Level

<table>
<thead>
<tr>
<th>Level</th>
<th>Wearers</th>
<th>Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>S/D</td>
<td>47%</td>
<td>42%</td>
</tr>
<tr>
<td>A/E</td>
<td>72%</td>
<td>51%</td>
</tr>
<tr>
<td>B/E</td>
<td>86%</td>
<td>78%</td>
</tr>
<tr>
<td>W/D</td>
<td>89%</td>
<td>89%</td>
</tr>
</tbody>
</table>
Functional Outcome for Females

- No Prosthesis: 36%
- Not Wearing: 0%
- Cosmetic Use: 50%
- Gross Motor: 8%
- Fine Motor: 4%
Functional Outcome by Age

No Prosthesis
Not Wearing
Cosmetic Use
Gross Motor
Fine Motor
## Functional Outcome by Age

<table>
<thead>
<tr>
<th>Age</th>
<th>Wearers</th>
<th>Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-19</td>
<td>72%</td>
<td>65%</td>
</tr>
<tr>
<td>20-24</td>
<td>71%</td>
<td>71%</td>
</tr>
<tr>
<td>25-34</td>
<td>81%</td>
<td>62%</td>
</tr>
<tr>
<td>35-44</td>
<td>83%</td>
<td>72%</td>
</tr>
<tr>
<td>45 +</td>
<td>63%</td>
<td>44%</td>
</tr>
</tbody>
</table>
Functional Outcome by Time to Prosthesis

Months

- No Prosthesis
- Not Wearing
- Cosmetic Use
- Gross Motor
- Fine Motor
## Follow-up

<table>
<thead>
<tr>
<th>Level</th>
<th>Total F/U</th>
<th>F/U Visits</th>
<th>Wearing Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>S/D</td>
<td>12 MO</td>
<td>1.6</td>
<td>42 HR/WK</td>
</tr>
<tr>
<td>A/E</td>
<td>23 MO</td>
<td>3.9</td>
<td>44 HR/WK</td>
</tr>
<tr>
<td>B/E</td>
<td>28 MO</td>
<td>3.4</td>
<td>60 HR/WK</td>
</tr>
<tr>
<td>W/D</td>
<td>9 MO</td>
<td>1.7</td>
<td>59 HR/WK</td>
</tr>
</tbody>
</table>

Average F/U time = 21/3 MO after prosthesis
Functional Outcome by Follow-up after Prosthesis

- No Prosthesis: 0 Visits, 0 Months
- Not Wearing: 1.4 Visits, 13 Months
- Cosmetic Use: 3.1 Visits, 25 Months
- Gross Motor: 4.2 Visits, 23 Months
- Fine Motor: 2.7 Visits, 21 Months
Functional Outcome by Return to Work

Percent

Overall 49.5%

No Prosthesis 7
Not Wearing 40
Cosmetic Use 30
Gross Motor 58
Fine Motor 74

32
# Post Injury Work Status

<table>
<thead>
<tr>
<th>Level</th>
<th>Returned to work</th>
</tr>
</thead>
<tbody>
<tr>
<td>S/D</td>
<td>32%</td>
</tr>
<tr>
<td>A/E</td>
<td>41%</td>
</tr>
<tr>
<td>B/E</td>
<td>61%</td>
</tr>
<tr>
<td>W/D</td>
<td>67%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Returned to work</th>
<th>Insurance Pain</th>
<th>Insurance Worker’s Comp</th>
<th>Insurance Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>17%</td>
<td>65%</td>
<td>35%</td>
</tr>
<tr>
<td>NO</td>
<td>30%</td>
<td>47%</td>
<td>53%</td>
</tr>
</tbody>
</table>
Conclusions

- Patients with more distal amputation will have better functional use of the prosthesis and better chance of return to work
- Females tend to selectively use a prosthesis for cosmetic reasons/activities
Bilateral trans-radial amp with cable control
Bilateral trans-radial amp with myo-electric control
Bilateral trans-radial amp with test sockets
Training with unilateral trans-humeral prosthesis
Training with unilateral trans-humeral prosthesis
THANK YOU