Local and Global Initiatives to Address Limb Loss

Alex Hetherington, CP
Corin Shirley, CO
Agenda

▪ About our department
▪ Limb loss
▪ Local programs to support the amputee community
  ▪ Functional Limb Service
  ▪ Amputee Comprehensive Training
▪ Global programs to address prosthetic needs
  ▪ Prosthetic care in East Africa
  ▪ Research initiatives
Services
UCSF Orthotics and Prosthetics: About us

Orthotics is the evaluation, fabrication, and custom fitting of orthopedic braces, known as "orthoses."

Prosthetics is the evaluation, fabrication, and custom fitting of artificial limbs, known as "prostheses."
We are healthcare providers
UCSF Orthotics and Prosthetics: About us

- Our Credentials:
  - Requires B.S., M.S.
  - 1 year residency, certifying exams
  - Certified Orthotist = CO
  - Certified Prosthetist = CP
  - Dual Certification = CPO

American Board for Certification in
Orthotics, Prosthetics & Pedorthics
Where we are
UCSF Orthotics and Prosthetics: About us

- The Orthopedic Institute at Mission Bay: primary prosthetic care
- San Francisco General Hospital: prosthetic and orthotic care with inpatient services
- Benioff Children’s Hospital: pediatric orthotic outpatient and inpatient services
- UCSF Medical Center-Parnassus: adult orthotics and inpatient services
Limb Loss
Definitions
Limb loss

- The Amputee Coalition defines limb loss as “the removal of a limb by trauma, medical illness, or surgery.”

  - Congenital Amputations
    - Amniotic band syndrome
    - Genetic Defects

  - Acquired Amputations:
    - 54% vascular disease
    - 45% trauma
    - < 2% cancer
Rehabilitative Need

Limb loss

- 2.1 Million: People living with limb loss
- 185K: People have an amputation each year
- 507: People lose a limb each day

- 1,558 military personnel lost a limb as a result of the wars in Iraq and Afganistan.
- 3.6 million people will be living with limb loss by 2050.
- 36% of people living with limb loss experience depression.
- 85% of lower-limb amputations are preceded by a foot ulcer.

Gender of Amputation Patients, 2013:
- Female (31%)
- Male (69%)

Causes of Amputation:
- Vascular Disease (54%)
- Trauma (45%)
- Cancer (2%)

Age at Amputation, 2013:
- <1 (0.2%)
- 1-17 (1%)
- 18-44 (11%)
- 45-64 (46%)
- 65-84 (36%)
- 85+ (6%)

Types of Amputations:
- Upper limb (35%)
- Lower limb (65%)
Local Programs in the Community
Outreach Programs
Local programs in the community

1. Mini-Med talks
2. Bay Area Science Festival
3. Local school science fairs
4. STEM Women in Science
5. Functional Limb Service
6. Amputee Comprehensive Training Program
Functional Limb Service: SFGH
Local programs in the community

FLS is a multidisciplinary approach to treat individuals with limb insufficiencies and to improve the health of their limb and quality of life.

Formation of FLS

<table>
<thead>
<tr>
<th>Concept</th>
<th>Hearts Grant</th>
<th>Formalized</th>
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<tbody>
<tr>
<td>February, 2014</td>
<td>September 2015</td>
<td>December 2015</td>
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Functional Limb Service: Goals
Local programs in the community

- Prevention
- Education
- Patient perspective
  - Answer questions
  - Set rehabilitative goals
- Provider perspective
  - Help to ensure safety
  - More efficiently track care
Local and Global Initiatives for Limb Loss

Functional Limb Service: Logistics

Local programs in the community

Where and when does FLS occur?
Involvement

Orthopaedic Surgeons
Vascular Surgeons
Trauma Surgeons
Podiatrists
Prosthetists/Orthotists
Physical Therapists
Occupational Therapists

Nutritionist
Infectious Disease
Endocrinologists
Social Services / Case Managers
Vocational Rehab Counselor
Nurses
Team Coordinator
Benefits of a Team Approach

- Long term studies have proven that a team approach is effective in reducing amputations due to diabetes.

- UK: 60%
- Sweden: 57%
- Spain: 62%
Benefits
Amputee Comprehensive Training Program

The profound and unstoppable power of yes.

Kristen
Cancer survivor
Iron girl

Redefining possible:

UCSF
Benioff Children's Hospitals
Oakland | San Francisco
The mission of the UCSF Amputee Comprehensive Training (ACT) Program is to assist those affected by limb loss in maximizing their physical and functional mobility. With two integral components, rehabilitation and outreach, the ACT program creates both the community and the tools to make a complete recovery following amputation.
Amputee Comprehensive Training Program

- **ACT Rehabilitation**
  - By incorporating a diverse series of training modalities, advanced gait analysis equipment, and a comprehensive team, the ACT program promotes full rehabilitation following amputation. The ACT model utilizes a team approach and goal-oriented treatment to provide individualized care. Integrating experts from the UCSF Department of Orthopaedic Surgery, the ACT team redefines prosthetic rehabilitation, translating care from the clinic to the community, court, or track.

- **ACT Community Outreach**
  - The ACT community introduces people affected by limb loss to a variety of athletic and fitness activities, encouraging full recovery through training and awareness. By utilizing a broad range of resources offered by the University of California San Francisco, the ACT program offers monthly clinics to improve function and confidence on your prosthesis. It creates a community of individuals motivated to engage in activities they enjoyed prior to amputation and recover a healthy and active lifestyle.
Amputee Comprehensive Training Program
ACT Rehabilitation at the UCSF Human Performance Center
Amputee Comprehensive Training Program
ACT Rehabilitation at the UCSF Bakar Fitness Center
Amputee Comprehensive Training Program

ACT community grows over the years

2012

2017
Amputee Comprehensive Training Program
ACT community partners with the Challenged Athletes Foundation
Amputee Comprehensive Training Program
ACT community partners with the Challenged Athletes Foundation
Amputee Comprehensive Training Program
ACT community partners with the Golden State Warriors
Amputee Comprehensive Training Program

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Other community events and outreach programs
Amputee Comprehensive Training Program
Other community events and outreach programs

- San Francisco CrossFit
- Bay Area Outreach and Recreation Program (BORP)
- Achilles International
Amputee Comprehensive Training Program

www.act.ucsf.edu

Every day we make breakthroughs that turn hope into reality.
Global Initiatives in Prosthetic Care
Global Burden of Amputation
Disability Adjusted Life Year

**DALY**
Disability Adjusted Life Year is a measure of overall disease burden, expressed as the cumulative number of years lost due to ill-health, disability or early death

\[
\text{DALY} = \text{YLD} + \text{YLL}
\]

- **YLD**: Years Lived with Disability
- **YLL**: Years of Life Lost

Healthy life
\[\text{Healthy life} \quad \rightarrow \quad \text{Disease or Disability} \quad \rightarrow \quad \text{Expected life years}\]

Early death
Global Burden of Amputation
Increasing due to diabetes and road traffic accidents

**Figure 27: Ten leading causes of burden of disease, world, 2004 and 2030**

<table>
<thead>
<tr>
<th>Disease or injury</th>
<th>As % of total DALYs</th>
<th>Rank</th>
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<th>Rank</th>
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<tbody>
<tr>
<td>Lower respiratory infections</td>
<td>6.2</td>
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<tr>
<td>Diarrhoeal diseases</td>
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<td>5.5</td>
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<td>Unipolar depressive disorders</td>
<td>4.3</td>
<td>3</td>
<td>4.9</td>
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<tr>
<td>Ischaemic heart disease</td>
<td>4.1</td>
<td>4</td>
<td>4.3</td>
<td>4</td>
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<tr>
<td>HIV/AIDS</td>
<td>3.8</td>
<td>5</td>
<td>3.8</td>
<td>5</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>3.1</td>
<td>6</td>
<td>3.2</td>
<td>6</td>
</tr>
<tr>
<td>Prematurity and low birth weight</td>
<td>2.9</td>
<td>7</td>
<td>2.9</td>
<td>7</td>
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<tr>
<td>Birth asphyxia and birth trauma</td>
<td>2.7</td>
<td>8</td>
<td>2.7</td>
<td>8</td>
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<tr>
<td><strong>Road traffic accidents</strong></td>
<td><strong>2.7</strong></td>
<td><strong>9</strong></td>
<td><strong>2.7</strong></td>
<td><strong>10</strong></td>
</tr>
<tr>
<td>Neonatal infections and othera</td>
<td>2.7</td>
<td>10</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>COPD</td>
<td>2.0</td>
<td>13</td>
<td>1.9</td>
<td></td>
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<tr>
<td>Refractive errors</td>
<td>1.8</td>
<td>14</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td>Hearing loss, adult onset</td>
<td>1.8</td>
<td>15</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td><strong>Diabetes mellitus</strong></td>
<td><strong>1.3</strong></td>
<td><strong>19</strong></td>
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**2030**

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<th>As % of total DALYs</th>
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Source: WHO Burden of Disease, 2004
Global Burden of Amputation
Increasing due to diabetes

- The global prevalence of diabetes mellitus is expected to double by 2030 from the 171 million cases recorded in 2000.

Global Burden of Amputation
Increasing due to diabetes

- Lack of physical activity, increased access to high energy dense foods, obesity, expected life years
- Diabetic foot ulcers are rapidly becoming a leading source of morbidity and mortality, especially in low and middle income countries
- Diabetes is recognized as an important cause of premature death and disability
Global Burden of Amputation
Increasing due to road traffic accidents

- Road traffic injuries are one of the leading causes of death and life-long disability

Source: WHO Global Burden of Disease project, 2002
Global Burden of Amputation
Increasing due to road traffic accidents

- Leading cause of death among young people aged 15-29
- Ninety percent of DALYs lost worldwide due to traffic injuries occur in low and middle income countries
- Partly due to economic development, increased number of vehicles on the road, including motorcycles
- Road infrastructure and road traffic safety
Global Burden of Amputation

Minimal access to prosthetic care

According to the WHO, there are 25 million people without access to basic prosthetic and orthotic services

- Loss of functional mobility and independence
- Isolation, reclusion, loss of employment, ability to care for self and family
- Profound economic, social, and psychological effects
Global Burden of Amputation
Minimal access to prosthetic care

- Barriers to care
  - Solution does not exist
  - Solution exists, but not accessible
  - Technology exists and is accessible, but is not adopted

Appropriate prosthetic technology must be affordable, durable, functional, and cosmetic

Ikeda et al., 2014
Global Burden of Amputation

Minimal access to prosthetic care

Table 5. Coded responses by income level.

<table>
<thead>
<tr>
<th>Response frequencies (%) from general category for each income group</th>
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<tbody>
<tr>
<td>Low income (n = 41) %</td>
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<tr>
<td>----------------------</td>
</tr>
<tr>
<td>Cost 14.6</td>
</tr>
<tr>
<td>Part/material availability 14.6</td>
</tr>
<tr>
<td>Practitioner training/skills 7.3</td>
</tr>
<tr>
<td>Gait training 7.3</td>
</tr>
<tr>
<td>Number of choices 7.3</td>
</tr>
<tr>
<td>Component weight 4.9</td>
</tr>
<tr>
<td>New technology transfer 4.9</td>
</tr>
<tr>
<td>Governmental policy 4.9</td>
</tr>
<tr>
<td>Other 12.2</td>
</tr>
<tr>
<td>No response 22.0</td>
</tr>
</tbody>
</table>


- Survey of 192 individuals working in the field of lower limb prosthetics
- 64 different countries represented
Global Burden of Amputation
Increasing access to prosthetic care

- UCSF O&P is ideally suited to assist our international partners
  - Education
  - Training
  - Research
  - Implementation
  - Building capacity
  - Policy and legislation
Muhimbili Orthopaedic Institute, Tanzania

Burden of amputation is increasing due to diabetes and road traffic accidents
Access to Prosthesis in Tanzania: A Qualitative Study
Qualitative Interviews
Observations of pathway
Process map of provision
Table 1: Demographics of Healthcare Providers Interviewed (N = 18)

<table>
<thead>
<tr>
<th>Profession</th>
<th>n(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Worker</td>
<td>1 (5.55)</td>
</tr>
<tr>
<td>Medical Director*</td>
<td>1 (5.55)</td>
</tr>
<tr>
<td>Orthopedic Technician (Prosthetist)</td>
<td>4 (22.22)</td>
</tr>
<tr>
<td>Junior Doctor (Resident)</td>
<td>4 (22.22)</td>
</tr>
<tr>
<td>Physical Therapist</td>
<td>4 (22.22)</td>
</tr>
<tr>
<td>Orthopedic Surgeon (Attending)</td>
<td>4 (22.22)</td>
</tr>
</tbody>
</table>
Barriers to care include costs and communication
Numbers under-estimated
Multi-disciplinary approach
Surgical education
Predictors of health related outcomes after traumatic lower extremity amputation in Sub-Saharan Africa
Specific Aims:

1. To determine the quality of life and functional outcomes in above-knee amputees before and after receiving a prosthesis.
2. To estimate the direct and indirect medical costs associated with above-knee amputations in Tanzania, and the economic impact and cost-effectiveness of prosthetics for individuals with above-knee amputations.
3. To estimate the incremental cost-effectiveness ratio (ICER) for lower extremity prostheses in US Dollars per Quality-Adjusted Life Year (QALY).

UCSF Orthotic and Prosthetic Centers
Predictors of health related outcomes after traumatic lower extremity amputation in Sub-Saharan Africa
Predictors of health related outcomes after traumatic lower extremity amputation in Sub-Saharan Africa
Predictors of health related outcomes after traumatic lower extremity amputation in Sub-Saharan Africa
Research

Global initiatives in prosthetic care

- Assessing foot durability via mechanical simulations before distributing to low resource settings
Research

AMPUTEES IN LOW INCOME COUNTRIES

- Have a Prosthetic
- Without Prosthetic

95%

5%

World Health Organization, 2005

“Durability of the foot determines durability of the entire prosthesis”[2]

Goal: to keep 5% maintained, while working on meeting the need of the other 95%.[1]

Previous studies have shown environmental exposure has a significant effect on degradation of SACH feet designed for low income nations.[3]
Research
Research

Shoe Sample

No Shoe Sample
Research

No Shoe Sample

Shoe Sample

No Shoe Samples
Conclusions

- Multidisciplinary team approach
- Expanding care beyond the clinic
- Engaging local community
- Education, training, and research for a sustainable programs
- Local initiatives can have a global impact
References

- Wyss, D, et al. Priorities in lower limb prosthetic service delivery based on an international survey of prosthetists in low and high income countries. 2015. Prosthetics and Orthotics International.
Questions?