Stakeholder Input on the Development of a Residual Limb Monitoring System

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BACKGROUND

- Socket fit and suspension issues, heat, sweat, and rubbing at the socket-limb interface (Fig. 1) lead to skin breakdown (Fig. 2), impede daily prosthetic use and reduce mobility and quality of life for lower-limb amputees [1].
- Recent development of thin, flexible, ‘skin-like’ sensors (Fig 3) [2] may address these problems, leading to the development of a residual limb monitoring system.
- To ensure clinical utility of any such system, input from stakeholders is necessary.

Objective: To gather information from certified prosthetists (CP) and prostheses users (Px Users) about the residual limb problems they encounter, how a residual limb monitoring system might be used in clinical practice, and how it might best be configured.

METHODS

Two focus groups were held, one with CPs and one with lower-limb Px Users. Participant criteria are listed in Table 1.

| Table 1 |
|------------------|------------------|
| CP               | Px Users         |
| Currently practicing CP/CPD | Currently using LL prosthesis on daily basis |
| ≥ 2 yrs clinical experience with *LL prostheses | Different levels of major LL amputation |
| Different levels of time in practice | Different types of etiologies |
| Work in different practice settings | Range of time with amputation |
| N = 8 | 18-80 yrs old |
| Males and females | |

An experienced moderator guided focus group discussions with prepared questions (Fig. 4). Discussions were audio recorded and transcribed. Four investigators performed thematic analysis to assess the focus group transcripts for repeating ideas and themes (Fig. 4) [3].

RESULTS

Participant Characteristics

<table>
<thead>
<tr>
<th>Certified Prosthetists (CP)</th>
<th>Lower Limb Prosthesis Users</th>
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<tbody>
<tr>
<td>Subject</td>
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<td>8</td>
<td>Failed to attend</td>
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A Multi-facility practice, publicly owned
B Multi-facility practice, privately owned
C Hospital or rehabilitation center

Residual Limb Problems

- Volume
  - Phantom
  - Cramping
  - Pain from socket
- Pain
  - Rashes
  - Wounds
- Sensation
  - Sores
  - Blisters
  - Allergies
- Skin
  - Pressure over bony prominences
- Discomfort
  - Bulk behind the knee
  - Itchiness
  - Clunky/inflexible prosthesis
- Health Concerns
  - Effect of sensor skin
  - Effect of wireless technology on body
  - Skin absorbs sensor ink/material
- Reimbursement
  - Quantitative evidence
- Justification
  - Verify activity level
- Potential Inconveniences
  - Cost
  - Invasiveness
  - Weight/bulk
  - Compliance
  - Burden of wearing another component
- Potential Benefits
  - Decreased time for writing medical reports
  - Early detection
  - Less clinical visits
  - Assist in diagnosis
  - Assist in troubleshooting
  - Assist in troubleshooting

CONCLUSION

- Residual limb problems reported by focus group participants were similar to findings from the literature regarding problems that interfere with prosthetic use [1,4].
- Both prosthetists and prosthesis users indicated that:
  - In-socket temperature and pressure were priorities for measurement.
  - The most immediate benefit of monitoring the residual limb was in troubleshooting socket fit issues.
- A wireless sensor system to monitor residual limb health should be used in the clinic and perhaps short term at home, so long as it is easy to use and inexpensive.

Discussions

- In developing a user-friendly residual limb monitoring system for widespread clinical use, system benefits need to strongly outweigh any inconveniences for either the prosthetist or prosthesis user.
- Focus group input will be used in the development of a residual limb monitoring system using wireless, ‘skin-like’ sensors [1] that can measure temperature and pressure inside a prosthetic socket, helping to detect issues before they become problematic.

References


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