Bone-anchored prostheses for individuals with limb loss: prosthetics or bionics?

Laurent Frossard

Queensland University of Technology, Brisbane, QLD, Australia
University of the Sunshine Coast, Maroochydore, QLD, Australia
YourResearchProject Pty Ltd, Brisbane, QLD, Australia


Introduction

Individuals with limb amputation fitted with conventional socket-suspended prostheses often experience socket-related discomfort leading to a significant decrease in quality of life.[1, 2] Bone-anchored prostheses (BAP) are an alternative method of attachment of artificial limb.[3-7] In this case, the prosthesis is attached directly to the residual skeleton through a percutaneous fixation.

To date, a few osseointegration fixations are commercially available.[3, 5, 8-10] Several devices are at different stages of development particularly in Europe and the US.[11-32]

Figure 1: Schematic representation of the residuum (A) of an individual with transfemoral amputation using conventional method of prosthetic attachment relying on socket (B) in contact with the skin (Left side) or bone-anchored prosthesis (BAP) relying on osseointegrated fixation (C) including a medullar part inserted into the femur (D) and percutaneous part (E) protruding the residuum (Right side) each connecting to the rest of a prosthesis (F).
However, surgical procedures are currently blooming worldwide with Australia having one of the fastest growing populations.

Previous studies focusing on BAP have focused on fragmented biomechanics aspects as well as the clinical benefits and safety of the procedure.\[33-42\]

However, very few publications have synthetized this information and provided an overview of the current developments. \[3, 6, 7\]

The purpose of the presentation was to provide an overview of the state-of-art developments in BAP with as strong emphasis on treatment, clinical outcomes and more importantly opportunities for bone-anchored neuroprostheses.

**Methods**

Mapping of the developments was achieved by scrutinising over 40 scientific publications including literature reviews, research and case reports articles produced over the last decade.

**Results**

Table 1: Overview of current development of bone-anchored prosthesis (ILP: Integral Leg Prosthesis, OPL: Osseointegrated Prosthesis Limb, OPRA: Osseointegrated Prosthesis for Rehabilitation of Amputees, S1: Stage 1)

<table>
<thead>
<tr>
<th></th>
<th>ILP</th>
<th>OPL</th>
<th>OPRA</th>
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</thead>
<tbody>
<tr>
<td>Interface fixation - bone</td>
<td>Press-fit</td>
<td>Press-fit</td>
<td>Screw</td>
</tr>
<tr>
<td>Nb of surgeries</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Duration rehabilitation *</td>
<td>4 mth</td>
<td>4 mth</td>
<td>9-12 mth</td>
</tr>
<tr>
<td>Nb of years since first S1 *</td>
<td>10</td>
<td>4</td>
<td>17</td>
</tr>
<tr>
<td>Nb of patients *</td>
<td>130</td>
<td>250</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>200</td>
<td></td>
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<td>650-750</td>
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Scientific evidence confirmed that BAP engenders major clinical benefits (e.g., quality of life, prosthetic use, body image, hip range of motion, sitting comfort, ease of donning and doffing, osseoperception, walking ability) with acceptable clinical risks (e.g., implant stability, rate of infection, breakage of fixation parts) while providing pathways for bone-anchored neuroprostheses.\[9, 29, 37, 40, 43-63\]

**Conclusion**

BAP are a relevant alternative to socket prosthesis. Furthermore, it is anticipated that implantation of osseointegrated fixations in conjunction with internal wires harvesting physiological signals to activate external prostheses is going to bloom in the next decade. Prosthetic research could potentially make the bionic human a step closer!

**Declaration**

The speaker has now conflict of interest.

**To know more**

**References**


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RESULTS AND DISCUSSION

- Scientific evidence confirmed that BAP:
  - Engenders major clinical benefits (e.g., quality of life, prosthetic use, body image, hip range of motion, sitting comfort, ease of donning and doffing, osseosensory perception, walking ability).
  - Present acceptable clinical risks (e.g., implant stability, rate of infection, breakage of fixation parts).
  - Provide pathways for bone-anchored neuroprostheses.

Table 1: Overview of current development of bone-anchored prosthesis (ILP: Integral Leg Prosthesis, OPL: Osseointegrated Prosthesis Limb, OPRA: Osseointegrated Prosthesis for Rehabilitation of Amputees, SI: Stage I)

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* Estimation based on 2013 data

CONCLUSIONS

- BAP are a relevant alternative to socket prosthesis. Furthermore, it is anticipated that implantation of osseointegrated fixations in conjunction with internal wires harvesting physiological signals to activate external prostheses is going to bloom in the next decade. Prosthetic research could potentially make the bionic human a step closer!

REFERENCES


METHODS

- Literature review. Mapping of the developments was achieved by scrutinising over 40 scientific publications including literature reviews, research and case reports articles produced over the last decade.

SPEAKER’S INFORMATION

Laurent Frossard (PhD)
- Adjunct Professor at QUT and USC
- Director at YourResearchProject
- laurentfrossard@outlook.com
- +61 (0)4 1379 5086
- www.laurentfrossard.com
- www.YourResearchProject.com
- www.ca.linkedin.com/pub/laurent-frossard/5/4b4/159/