Osseointegrated Prosthetic Limb for Amputees - Over Hundred Cases

Aditya Khemka [1,2], Laurent Frossard [3,4], Sarah J Lord [5,6], Belinda Bosley [2], Munjed Al Muderis [1,2,7,8]

[1] School of Medicine, University of Notre Dame Australia, Auburn, Australia
[2] Norwest Private Hospital, Bella Vista, Australia
[3] Queensland University of Technology, Brisbane, QLD, Australia
[4] University of the Sunshine Coast, Maroochydore, QLD, Australia
[5] School of Medicine, University of Notre Dame Australia, Auburn, Australia
[6] NHMRC Clinical Trials Centre, The University of Sydney, Sydney, Australia
[7] Macquarie University Hospital, Macquarie, Australia
[8] The Australian School of Advanced Medicine, Macquarie University, Macquarie, Australia

Khemka A, Frossard L, Lord S, Bosley B, Al Muderis M. Osseointegrated Prosthetic limb for amputees - Over hundred cases. 6th International Conference Advances in Orthopaedic Osseointegration. 2015. Las Vegas, Nevada, USA. p 22

Background

The Osseointegrated Prosthetic Limb (OPL) was introduced in 2011. Prior to its advent all prostheses consisted of stump and socket mechanisms which did not changed dramatically since Ambroise Pare lower limb prosthesis in 1525. These socket prostheses failed to address a few major requirements of normal gait. Our hypothesis was that using an Osseointegrated Prosthetic limb will result in superior function of daily activities, without compromising patients' safety.

Aim

A. To describe the surgical procedure of the OPL; and
B. To present data on potential risks and benefits with assessment of clinical and functional outcomes at follow up.

Methods

This paper presents our first 100 cases operated between 2011 and 2015 in a single centre, Sydney, Australia by a single surgeon. The criterion for inclusion was strict including a formal interview with the team including the surgeon, radiologist, anaesthetist, pain physician, psychiatrist, physiotherapist, rehabilitation physician and the prosthetist. Patient characteristics and demographics were collected. Outcomes assessment included health related quality of life questionnaires (SF 36 and Q-TFA), Mobility Predictor (K Levels – AMPRO), functional testing (6MWT and TUG) and evaluation of energy expenditure.[1-22] The data was collected at all stages of the patient journey and statistically analysed.

Results

The total number of patients was 101 with 107 implantations. 7 patients were bilateral amputees. Average age at amputation was 33 years (range 3-76), at implantation 44.3 (range 17-76). Average period from amputation to implantation was 13 years (range 0-46). Traumatic amputations occurred in 61 patients (77%). Infection was the second most common cause for amputation consisting 12%. Neoplasia was the cause for amputation in 10% of the cases. 30% of the patients included in the study were wheelchair bound. Both K scores, Time Up and Go and 6 MWT tests showed a statistically significant improvement, with high significance p=0.0006, and p=0.0149, respectively. HRQOL improved dramatically for all patients. The energy expenditure

increased at an average 4 fold after the surgery at their final follow up.

Discussion and Conclusion

This study shows favourable results for OPL treatment for above knee as well as below knee amputees, compared to Socket prosthesis. Our experience of over 100 patients has revealed encouraging results with a major improvement in patient's functionality and quality of life, and a low rate of complications.

References

1. Frossard, L., D.L. Gow, K. Hagberg, N. Cairns, B. Contoyannis, S. Gray, R. Branemark, and M. Pearcy, Apparatus for monitoring load bearing rehabilitation exercises of a transfemoral amputee fitted with an osseointegrated fixation: a proof-of-concept study. Gait Posture, 2010. 31(2): p. 223-8.
2. Frossard, L., K. Hagberg, E. Haggstrom, and R. Branemark, Load-relief of walking aids on osseointegrated fixation: instrument for evidence-based practice. IEEE Trans Neural Syst Rehabil Eng, 2009. 17(1): p. 9-14.
3. Frossard, L., K. Hagberg, E. Häggström, D.L. Gow, R. Brånemark, and M. Pearcy, Functional Outcome of Transfemoral Amputees Fitted With an Osseointegrated Fixation: Temporal Gait Characteristics. JPO Journal of Prosthetics and Orthotics, 2010. 22(1): p. 11-20.
4. Frossard, L., N. Stevenson, J. Smeathers, E. Haggstrom, K. Hagberg, J. Sullivan, D. Ewins, D.L. Gow, S. Gray, and R. Branemark, Monitoring of the load regime applied on the osseointegrated fixation of a trans-femoral amputee: a tool for evidence-based practice. Prosthet Orthot Int, 2008. 32(1): p. 68-78.
5. Frossard, L., N. Stevenson, J. Smeathers, D. Lee Gow, S. Gray, J. Sullivan, C. Daniel, E. Häggström, K. Hagberg, and R. Brånemark, Daily activities of a transfemoral amputee fitted with osseointegrated fixation: continuous recording of the loading for an evidence-based practice. Kinesitherapie Revue, 2006. 6(56-57): p. 53-62.
6. Frossard, L., R. Tranberg, E. Haggstrom, M. Pearcy, and R. Branemark, Fall of a transfemoral amputee fitted with osseointegrated fixation: loading impact on residuum. Gait & Posture, 2009. 30(Supplement 2): p. S151-S152.
7. Frossard, L.A., R. Tranberg, E. Haggstrom, M. Pearcy, and R. Branemark, Load on osseointegrated fixation of a transfemoral amputee during a fall: loading, descent, impact and recovery analysis. Prosthet Orthot Int, 2010. 34(1): p. 85-97.
8. Lee, W., L. Frossard, K. Hagberg, E. Haggstrom, and R. Brånemark, Kinetics analysis of transfemoral amputees fitted with osseointegrated fixation performing common activities of daily living. Clinical Biomechanics, 2007. 22(6): p. 665-673.
9. Lee, W.C., L.A. Frossard, K. Hagberg, E. Haggstrom, D.L. Gow, S. Gray, and R. Branemark, Magnitude and variability of loading on the osseointegrated implant of transfemoral amputees during walking. Med Eng Phys, 2008. 30(7): p. 825-833.
10. Vertriest, S., P. Coorevits, K. Hagberg, R. Branemark, E. Haggstrom, G. Vanderstraeten, and L. Frossard, Static Load Bearing Exercises of Individuals With Transfemoral Amputation Fitted With

an Osseointegrated Implant: Reliability of Kinetic Data. IEEE Trans Neural Syst Rehabil Eng, 2014. In press.
11. Hagberg, K., E. Hansson, and R. Branemark, Outcome of Percutaneous Osseointegrated Prostheses for Patients With Unilateral Transfemoral Amputation at Two-Year Follow-Up. Arch Phys Med Rehabil, 2014. 95(11): p. 2120-2127.
12. Van de Meent, H., M.T. Hopman, and J.P. Frolke, Walking ability and quality of life in subjects with transfemoral amputation: a comparison of osseointegration with socket prostheses. Arch Phys Med Rehabil, 2013. 94(11): p. 2174-2178.
13. Berlin, Ö., P. Bergh, M. Dalen, S. Eriksson, K. Hagberg, S. Inerot, B. Gunterberg, and R. Brånemark, Osseointegration in transfemoral amputees: the gothenburg experience. Journal of Bone & Joint Surgery, British Volume, 2012. 94-B(SUPP XIV): p. 55.
14. Hagberg, K., R. Branemark, B. Gunterberg, and B. Rydevik, Osseointegrated trans-femoral amputation prostheses: Prospective results of general and condition-specific quality of life in 18 patients at 2-year follow-up. Prosthetics and Orthotics International, 2008. 32(1): p. 29 - 41.
15. Hagberg, K. and R. Branemark, One hundred patients treated with osseointegrated transfemoral amputation prostheses-rehabilitation perspective. J Rehabil Res Dev, 2009. 46(3): p. 331-44.
16. Dumas, R., L. Cheze, and L. Frossard, Loading applied on prosthetic knee of transfemoral amputee: comparison of inverse dynamics and direct measurements. Gait Posture, 2009. 30(4): p. 560-2.
17. Frossard, L., J. Beck, M. Dillon, M. Chappell, and J.H. Evans, Development and preliminary testing of a device for the direct measurement of forces and moments in the prosthetic limb of transfemoral amputees during activities of daily living. Journal of Prosthetics and Orthotics, 2003. 15(4): p. 135-142.
18. Dumas, R., L. Cheze, and L. Frossard, Load during prosthetic gait: Is direct measurement better than inverse dynamics? Gait & Posture, 2009. 30(Supplement 2): p. S86-S87.
19. Frossard, L., E. Haggstrom, K. Hagberg, and P. Branemark, Load applied on a bone-anchored transfemoral prosthesis: characterisation of prosthetic components – A case study Journal of Rehabilitation Research & Development, 2013. 50(5): p. 619–634.
20. Frossard, L., L. Cheze, and R. Dumas, Dynamic input to determine hip joint moments, power and work on the prosthetic limb of transfemoral amputees: ground reaction vs knee reaction. Prosthet Orthot Int, 2011. 35(2): p. 140-9.
21. Frossard, L., N. Stevenson, J. Sullivan, M. Uden, and M. Pearcy, Categorization of Activities of Daily Living of Lower Limb Amputees During Short-Term Use of a Portable Kinetic Recording System: A Preliminary Study. JPO Journal of Prosthetics and Orthotics, 2011. 23(1): p. 2-11.
22. Frossard, L.A., Load on osseointegrated fixation of a transfemoral amputee during a fall: Determination of the time and duration of descent. Prosthet Orthot Int, 2010. 34(4): p. 472-87.