

## **FUNCTIONAL COMPARISON OF THE LEGS M1 KNEE TO COMMONLY AVAILABLE DEVELOPING WORLD ALTERNATIVES**

Rispin, K., Husk, C., Lew, S., Schufeldt, T., Gonzalez, R..

### **SUMMARY**

Gait and functional characteristics were collected to compare the LEGS M1 knee a locked knee condition and a first-world polycentric knee. The LEGS M1 knee showed few gait penalties from a lower stability and amputees self reported a more satisfactory gait.

### **INTRODUCTION**

In many developing world nations the primary prosthetic knees available to lower income transfemoral amputees are often used as semiautomatic knees kept locked in gait (Jensen and Raab 2004 and 2006). LeTourneau Empowering Global Solutions (LEGS) Prosthetic Project has developed a stable polycentric knee that can be manufactured on site in developing nations using simple tools and available materials. The purpose of this study was to quantify functional characteristics of active transfemoral amputees using the LEGS knee compared to the most commonly available alternative, a prosthetic leg with a knee kept locked in gait. Scant literature indicates that a locked knee may be more energetically efficient (Isackov et al 1986). Running legs without knees are now more commonly being proscribed in the developed world making the comparison of locked to articulating knee conditions of global interest (Menetrez and King 2007).

### **METHOD**

Subjects were nineteen transfemoral amputees from Kenya and Bangladesh ( $27 \pm 5.3$  years 16 M, 2 F) who had worn the LEGS knee for a year or more (LEGS) ; all but four had previously worn locked knee (Locked). Each subject was tested with the LEGS knee, the LEGS knee locked with a locking jig, and eleven were tested with the OrthoEurope 4bar (OE) knee utilizing the same socket and foot. Temporal and spatial gait data were collected with GAITRite computerized gait mat. Energy cost data were collected with timed walk test (TWT) and Physiological Cost Index (PCI). Amputee input on functional parameters was collected with thirteen questions modified from the Prosthetic Evaluation Questionnaire and seven trial questions. Amputees estimated average daily time wearing the knee and distance walked. Gait spatial data was standardized to biological leg length. Gait temporal data was standardized to percent of gait cycle. Questionnaire data was normalized by standard deviation from amputee median.

### **RESULTS**

Paired T-tests revealed the following significant differences. LEGS was perceived to have a higher ease of swing through, more normal looking gait, less energy cost, less effort, more ease sitting down and standing up, more noise, and less standing balance than Locked. Spatial gait parameters showed a narrower heel-to-heel base of support, and greater prosthetic step length for LEGS than Locked. There were no significant differences in temporal parameters. Neither PCI nor the TWT showed significant differences between LEGS and Locked; however, correlation analysis showed that amputee perception of lower energy cost correlated with lower PCI results.

For OE, there was no significant difference in PCI from the other knee conditions. However, TWT and prosthetic single support time were lower and double support time higher for OE than LEGS or Locked. Heel-to-heel base of support was wider for OE than LEGS, but not significantly different than Locked. For OE, like LEGS, amputees reported a higher ease of swing through, more ease sitting down, and more satisfaction with gait than for Locked. However, there was no significant difference in perceived effort or normalcy of gait between OE and Locked as there had been between LEGS and Locked, and amputees reported less walking balance for OE than either Locked or LEGS.

## **DISCUSSION**

In the developing world, the appearance of disability is an extreme social and economic liability (Mitra and Sambamoothi 2008). The narrower and self perceived more normal gait enabled by the LEGS knee is of significant social value. Amputees' self reported increase in ease in swing through and ease in sitting were expected for a comparison of polycentric knees to a locked knee. A locked knee which can neither bend nor buckle was as expected quieter and more stable in stance. Currently available developing world prosthetic knees which are often worn locked can also be used unlocked by amputees able to deal with their instability. Short biological stance time and extended double stance time are known to reflect a lack of stability (Lusardi et al 2007). For these measurements, LEGS behaves more like the stable locked knee. With an approximate cost of \$20 a knee, the LEGS M1 knee provides an affordable and stable articulating knee option to prosthetic clinics in low income nations.

## **REFERENCES**

- Isakov E., Suzak B. Becker E. Scand. J. Rehab. Med. Suppl. 12, 108-111. 1985  
Jensen J. S., Raab W., 2006 VIETCOT presentation. Author, C. Clin. Biomech. 33, 1013-1014, 1990.  
Jensen, J. S. and W. Rabb Prosthetics Orthotics International, 28, 142-151, 2004  
Menetrez J., King J. 2007 J Trauma Injury Infection Critical Care. 62, S3-S5  
Mitra S., Sambamoothi U., 2008. World Development. 36, 934-952  
Lusardi M., Nielson C. Orthotics and Prosthetics in Rehabilitation. Elsevier. 35-69, 2007