Collection of Amputee Gait Data for Validation of LEGS M1 Knee Design

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INTRODUCTION

The LEGS (LeTourneau University Empowering Global Solutions) project has developed a low-cost, sustainable, and easily manufactured articulating prosthetic knee for use by trans-femoral amputees in developing countries. Currently, non-articulating prosthetics such as the Jaipur limb are the primary option for amputees in developing countries [1]. Collecting comparative gait data allows for the evaluation of the functional effectiveness of the LEGS M1 knee design. However this cannot be done on-site using a traditional gait lab. We expect that the portable GAITRite® walkway, which collects footfall data though a sensor-laden mat interfaced with a computer, will be an effective way to measure temporal and spatial gait parameters in trans-femoral amputees in field settings [2].

METHODS

Preliminary data has been collected for two comparative studies. With nine Kenyan amputees, gait with the LEGS M1 knee has been compared to gait with the LEGS M1 knee locked (to simulate a locking knee like the Jaipur limb). With one local US amputee, gait with the LEGS M1 knee has been compared to gait with the Ortho Europe 4-bar knee (OE4bar), an mechanically similar first-world knee. In both studies, amputees walked at a self-selected pace across the GAITRite® mat with each of the comparative-knee configurations for a minimum of 50 steps. A locking jig was used to lock the LEGS M1 knee for the locked versus LEGS M1 knee comparison.

Comparative gait data was analyzed for statistical significance between knee conformations. Both temporal and spatial parameters were analyzed, including stride length, stride width, and step time. A symmetry index formula [3] was used to compare temporal and spatial gait symmetry.

RESULTS

Preliminary results from the LEGS M1 versus locked knee comparison do not reveal a clear trend in stride length or gait symmetry. Roughly half of the patients display a longer stride length and a more symmetrical gait with the LEGS M1 knee. However, the LEGS M1 knee allowed for a significantly narrower distance between the feet during gait (stride width) (fig.1). This narrower distance more closely resembles normal biological gait [4].

Preliminary results from the LEGS M1 vs. OE4bar knee comparison revealed no statistically significance between gait parameters for the two configurations. The LEGS M1 knee allowed for gait similar to gait with the first-world OE4bar knee (fig. 2).

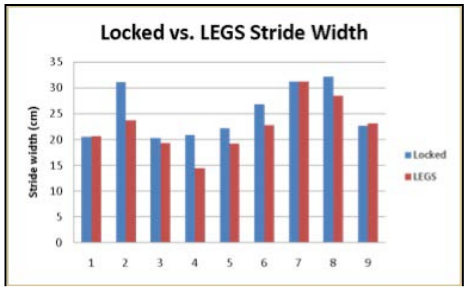

Figure 1. Patient stride width for Locked and LEGS knee conformations.

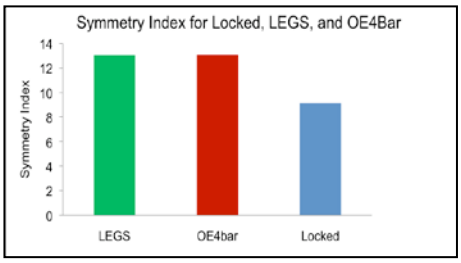

Figure 2. Patient gait symmetry for LEGS, Locked, and OE4bar knees

DISCUSSION

Human variability and small sample size are limiting factors of these studies. Data collection with more patients is currently underway. Because the GAITRite® system only collects footfall data, it is not possible to analysis body trunk symmetry and gait deviations during swing phase, which would provide a more complete picture of gait symmetry. However, preliminary data indicate that GAITRite® system provides a usable method for collecting comparative gait data for our study.

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