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Comparison of Standing versus Supine Alignment Capture Methods for Monolimb Fabrication

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Introduction: In response to a global need for prosthetic devices in developing regions, systems have been designed to create simplified prosthetics such as the monolimb. Key to the monolimb's functionality is the capture of alignment. Initial alignment capture attempts were performed in the supine position and focused on the position of the knee and heel.[1] After refinement, both a standing and a supine system evolved to incorporate an alternate alignment theory. This theory, embedded in both systems, bases the alignment of the monolimb upon the location of the three lower-limb joint centers. Each system guides the technician to locate the hip and knee centers as two points in space which define a mechanical axis. A sound limb length measurement and selection of prosthetic foot positions the ankle center upon this axis and captures the prosthetic alignment. The purpose of this research was to compare the alignment of transtibial monolimbs fabricated through both standing and supine alignment capture methods.

Methodology: Eight unilateral transtibial amputees were fit with two monolimbs – one fabricated from the standing system and one from the supine system. The alignments of these monolimbs were compared to each other, and to the subjects' personal prostheses using static and dynamic alignment evaluation performed by trained prosthetists, an Otto Bock LASAR Posture device, and a laser jig to evaluate socket angulation and translation in reference to the foot bolt. At the trial conclusion, study subjects, who were not told which limb matched which system, were asked to indicate their preferred monolimb and method of alignment capture.

Results: For each amputee, static analysis of socket translation and flexion revealed similarities between the system specific monolimbs and between each monolimb and the amputee's personal prosthesis. On average, all medial/lateral and anterior/posterior translational differences between monolimbs were under 1.5mm. Additionally, socket flexion angles were all within an average of one degree. When compared with the personal prostheses, the medial/lateral and anterior/posterior measurement differences of the monolimbs were all within an average of 9.5mm.

Comparison of the limbs using the technique described by Lin and Wu[2] showed that the majority of the monolimb vertical projections lay between the reported zone of proper alignment and the vertical projections of the personal prostheses. Within this scale, the vertical projections of the standing and supine monolimbs were quite similar.

Participant preference indicated the following:

	Standing	Supine	No Pref.
Method	1	4	3
Limb	2	6	

Conclusions: The standing requirement, necessitated by the standing alignment capture method, was seen as both physically demanding and a possible source of error during alignment. Due to fatigue, it became difficult for several patients to maintain the stance needed for proper alignment. The supine method was seen as advantageous as it gathered alignment information from a relaxed position, thus eliminating possible error associated with fatigue. Furthermore, the bulk and size of the standing system's patient support requirements preclude it from being as portable as the supine system.

In this study, two proposed methods of alignment capture for the fabrication of monolimbs are explored and tested. Preliminary data show that both methods may provide equally suitable prostheses. While there is no universally-accepted "gold standard" to obtain or measure optimal alignment, these pilot data, based on multiple evaluation techniques, provide sufficient evidence to warrant continued exploration of both methods. Ultimately, the comfort, simplicity, and portability afforded by the supine alignment method show promise not only for developing regions but also for any situation where an amputee's mobility or strength is compromised.

References:

1. Beck, Boone, Casanova: A Simple Prosthetic Alignment Method for Trans-Tibial Amputees. ISPO 10th World Congress, Glasgow T09.1, 2001
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