



Cost-effective, Robust Prosthetic Knee Joint Designed for Active Trans-femoral Amputees

Nuwan Chanaka Gunarathne

Faculty of Allied Health Sciences, University of Ruhuna

Corresponding author: <mailto:mailtosrinuwan@yahoo.com>

ABSTRACT

The most effective way to improve mobility and life quality following an amputation is by the use of a properly designed prosthetic system. However, many amputees are priced out to receive customized modern prosthetic services in Sri Lanka. This study is focused on developing a resilient, homemade four-bar prosthetic knee with readily available two types of Nylon material, Hard Nylon and Oil Impregnated Nylon, which are very affordable costing approximately £29 per unit, and sustainable. Our four-bar linkage polycentric knee design has several new advancements, to address the shortfalls of previous versions. Following the biomechanics of the polycentric knee joints with 4 bar mechanisms, the link dimensions of this model were designed specifically by, shortening the top linkage (25mm) and extending the bottom linkage (40mm) subsequently raising the Instantaneous Center of Rotation and moving it posterior to the weight line offering natural stability. These link dimensions were offered 18mm ground clearance. The geometric angle between the top linkage and the horizontal line is optimized to 330 to enable effortless push-off without disturbing the stability. Adjustable top and bottom attachments facilitate modifications to individual requirements. This model knee autonomously depends on the muscle action of the residual limb to swing through during the swing phase thus, avoiding inconsistency and unreliability of the braking action. In conclusion, we have shown that there is scope for improvement in currently existing knees in terms of their functionality and cost-effective production for developing countries and have designed a knee that provides greater stability and toe clearance to better navigate uneven terrain. It is expected to transfer the lesson learned from this study to future work including gait studies with prosthetic users to evaluate kinematics, kinetics, and energy consumption, along with other gait parameters through full-scale clinical trials to validate the results of this knee.

Keywords: *Four-bar knee, Prosthetic knee, Transfemoral prosthesis.*