

A Study of Three-Dimensional (3D) Printed Prosthetic Upper Limb Models in Local Context

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Abstract

Northern Sri Lanka is recovering from a civil war that has left a large number with amputations. The centre for prosthetics initiated the production of four different widely available models of 3D printed prosthetic upper limbs and compared the pros and cons in local context. Flexy, Shira, LimbForge and a simple bionic hand were produced at the centre and they were analysed in this aspect. Manipulations, shape, weight, comfort and cost is accounted for during the selection of prostheses. LimbForge, an aesthetic nonfunctional solution is preferred by economically disadvantaged groups for its low cost and realistic look. But lacking basic requirements of functionality makes it a less effective choice. While a bionic hand opens to a wide range of possibilities for performance enhancement, in contrast with the high cost involved, the Flexy or Shira prosthesis seems to be much more promising as they offer essential functionality at low cost. A set of experiments were carried out with the Shira and Flexy prostheses to compare performance analysing parameters such as the maximum grasp strength, angle of wrist flexion required and types of grips attainable by the prosthesis. Based on these experiments regarding proper manipulation of day to day objects, the 3D printed Flexy showed high grip strength and increased dexterity compared to the Shira hand. Moreover, the 35 degrees angle of flexion required for a proper grip exhibited by the Flexy hand, compared to the 46 degrees of the Shira hand reflects a clear superiority of the former in the context of simplicity of manipulation. This study concludes that the Flexy hand is the most suitable among the four models developed by considering production cost and minimal functionality requirements, for low or middle-income amputees.