Chapter 7
Lower Body Orthotic Calipers With Composite Braces

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ABSTRACT

Composite based materials are finding application in a large number of research and engineering spectrum due to its better mechanical properties (strength and stiffness), inherent surface finish, easiness in fabrication and installation and corrosion resistant. They are very strong and firm, yet very light in weight due to which lower weight-to-volume ratio can be achieved and stiffness to weight is 1.5 times greater than the non-ferrous materials like Aluminum. The work is undertaken in two parts. First and foremost being modeling and virtual estimation of mechanical properties using CREO and ANSYS for currently used aluminum based calipers and fabrication of the composites and testing of the same. A comparison is performed between the virtual and experimental results and also the effectiveness of composite based calipers over Aluminum ones is studied. Here two polymeric based composites are proposed for fabrication which are thermoplastic and thermoset based composites respectively. The braces are modeled using a solid modeling software, CREO and the same is tested using ANSYS.

INTRODUCTION

Disability related to locomotion has affected many individuals and one such locomotor disability is poliomyelitis which is spread due to polio virus. Due to polio virus they suffer from different joint problems, sitting cross-legged, walking and running. Few decades ago, a brace or caliper came into existence which is used to support the feeble joints which require support for any kind of movement in different and transverse positions. Calipers or braces also known as Orthotic device are appliances which are being referred by the orthopedist considering amputees problem (Figure 1). Calipers are categorized into lower body extremity, upper body extremity and spinal. Calipers for lower body extremity restore weight bearing capabilities to the affected leg and hence allow the patients to walk and move from one place

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to another without any risk of falling and contracture of joints. It also prevents further disfigurement of the joints and makes walking more effective by correct positioning of the braces/calipers. But not every different type of brace/calipers suites the affected handicapped survivor. Calipers are designed by keeping in mind the problems being faced by the handicapped patients. Patients who suffer from knee pain are advised to have Knee supporting braces. Those who are suffering from ankle and knee related injuries they are given Ankle-Knee-Orthotic calipers also known as (AKO) and KAFO also known as Knee-Ankle-Foot-Orthosis are worn by the patients having weak knee, ankle and foot so that the braces given to them provide strength to their joints and they are able to move and walk without any issues. Underbracing and overbracing can be done considering the patient’s height, weight, occupation and their problems related to the joints. Calipers are made as lighter as possible for the handicapped patients and are made available to them at the nearest hospitals and rehabilitation centers.

Lower extremity or lower body here is meant by the part which stops functioning properly after the muscular dysfunction. Due to muscular dysfunction paralysis of one side of body part or paralysis of both sides, poliomyelitis occurs and then requirement of braces becomes essential to lead a normal life. For lower part of the body foot orthotics are available, ankle braces and knee braces are designed to provide support the joints which are not able to function and are weakened. All the calipers/Braces designed for amputees consist of an adjustable lock which helps them in standing and sitting by adjusting it. Leather straps are present at calf and knee to make it more efficient for the affected survivors. For the fabrication of orthotic calipers researchers chose material which is lighter in weight, cost-effective, environment friendly and provides higher strength, stiffness and lower weight to volume ratio.

Figure 1. Commercially available orthotic braces/calipers
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