

### **Abstract:**

Knee ankle foot orthoses (KAFOs) are prescribed to paraplegic patients as accommodative and functional device. Three types of KAFOs were used in this work (plastic-metal, metal-metal and composite materials), the composite materials were depended on the number of Perlon layers (13 layers & 9 layers) with one layer of carbon-fiber and (6 layers) without carbon-fiber. The mechanical properties of most of the KAFOs' materials were tested by tensile test and fatigue test.

The data of gait cycle (Ground Reaction Force (GRF), Center of Pressure (COP) and pressure distribution), analysis of acceleration in three dimensions and kinematic analysis were collected from two patients with poliomyelitis (wearing brace type KAFO) and for each study applied for one normal subject.

In this thesis, the FEM (ANSYS) was used to compute the safety factor of fatigue for all types of KAFOs' models and the equivalent stress (Von-Mises). The suggested design of composite material KAFO model was characterized by alternating the position of the Perlon layers in the thigh and shank segment as (13-9) layers model, (13-6) layers model and (9-6) layers model of KAFO. The interface pressure between the patient's leg and the brace was tested by using a piezoelectric sensor.

The obtained results from ANSYS gave the profile of safety factor of fatigue, for metal-metal KAFO (3.69), plastic-metal model (0.88).

While, the (13) layers for composite material was about (1.4), but (1.07) & (0.41) for (9) layers and (6) layers, respectively. The value of safety factor increased with the composite material for the suggested design.

The kinetic analyses (GRF, COP and pressure distribution) were discussed, as well as the kinematic analyses for gait cycle were also studied for normal and pathological subject. The fluctuation reason gave very clear differences for acceleration and both of knee joint and thigh point.