THE DEVELOPMENT OF NEWLY HINGED ANKLE EXTERNAL FIXATOR AND ITS BIOMECHANICAL STABILITY OUTCOME

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Introduction: Ankle joint stiffness is a well-known complication after treatment with conventional ankle spanning external fixator. An ideal ankle specific external fixator should be able to provide adequate stability to treat ankle joint problems and allow protected movement at the ankle joint to prevent joint stiffness. We design an ankle external fixator with these features in this study. The design process uses the finite element analysis (FEA) as a faster and reliable method for testing the stability of the prototypes.

Methodology: Multiple external fixator prototypes based on unilateral hinge external fixator for ankle specific usage was designed using computer assisted design software. The stability of each prototype was tested by simulating axial loading equivalent to an adult of 70kg. The deformation and stress to the design constructs were evaluated with finite element analysis. The 3D model design with the best stability was used to produce plastic and metal prototypes for assessment of their functionality.

Discussion: The FEA showed the final model (Prototype B) was able to withstand an axial load equivalent to 70kg with minimal displacement of construct. The hinge allowed 15 degree upward and downward movement at the tibiotalar joint.

Conclusion: The external fixator design incorporates the circular and linear form of construct. The components of the external fixator occupy anterior and lateral aspect of the leg and foot thus avoiding restriction of movement of both lower limbs as compared to medially placed external fixator. The newly designed ankle external fixator can provide early stability for tissue and bone healing and later allows early protected range of motion to prevent ankle joint stiffness post treatment.