An investigation of mechanical properties of Joshi External Stabilising System (JESS)

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Introduction: Joshi External Stabilising System (JESS) has been used for more than 20 years in clinics for treatment of variety of musculoskeletal disorders. However, despite its popular use in India, to the best of our knowledge, there is little information about its mechanical performance in the literature. Therefore, aim of the present study was to investigate the mechanical properties of JESS and compare it with other fixation devices.

Materials and Method: The mechanical properties of a JESS (previously used to treat a tibial fracture) were investigated in two parts. In the first part, its load –deformation curve was plotted under compression testing by gradually applying 0 to 400N. In the second part a Finite Element Model (FEM) of JESS and tibia was developed on a computer. The FE model was also applied 0-400N loading to compare its results with experiment. After validating computer models its stiffness and interfragmentary displacements were calculated.

Results: The load-deformation curve for JESS is a linear curve having the stiffness of 60N/mm. The maximum interfragmentary displacement of 6.8 mm under load of 400N was recorded experimentally. The computer model showed maximum displacement of 6.47 mm which is a good agreement with the experimental value. The validated computer can be used to predict its other mechanical properties.

Discussion and Conclusion: As the selected configuration of JESS is not used for full weight bearing therefore in clinical situation one can expect much lower value of loading (less than 100N) hence interfragmetary displacements are expected to be in the range of 0 to 1mm similar to other External fixators. JESS axial stiffness is approximately half of a standard Ilizarov circular external fixator [stiffness = 123.39N/mm;Yilmaz in clinical Biomechanics 2003]. Furthermore, changes in the design to improve the mechanical performance of JESS have also been proposed.