REDUCING THE RISK OF RING BREAKAGE IN TAYLOR SPATIAL FRAMES: THE EFFECT OF FRAME CONFIGURATION ON STRAIN AT THE HALF RING JUNCTION

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Introduction

Ring breakage is a rare but significant complication requiring revision surgery and prolonging the course of treatment. We have encountered three cases with Taylor Spatial Frames (TSF) with breakage at the half ring junction of the distal ring. This experimental study examines the strains produced at different locations on the distal ring during loading and the effects of altering the construct in order to develop techniques to minimise the risk of breakage.

Materials and Methods

We mounted different TSF constructs on tibia sawbone models. Construct 1 reproducing the configuration of cases where failure was seen, Construct 2 with different wire and half pin configuration and construct 3 with the distal ring rotated 60 degrees. Strain Gauges were attached to different locations and measurements were collected during loading. Statistical analysis was subsequently performed.

Results

The highest strain values were recorded at the half ring junction of constructs 1,2 (>600 microstrains in tension). Rotating the ring 60 degrees significantly reduces the strain observed at the half ring junction (300 microstrains) ($p=.000$). Strain is increased in areas close to where a half pin attaches to the ring.

Conclusions

The highest strains are observed in the half ring junction as the two half rings are subjected to different modes of loading. This area is at higher risk of failure as the thickness of the half rings is halved and their second moment of area significantly reduced. Positioning this junction close to the half pin frame interface increases the strain produced. This interface is dictated by the safe zone in the mid-distal diaphysis of the tibia. Rotating the distal ring 60 degrees has a protective effect by significantly reducing the strain. This simple technical tips should be taken into consideration in order to reduce the risk of breakage at the half ring junction