

## Comparison of Photoelastic and Strain Gage Evaluation Techniques of Tibial Strain in an Orthopaedic Model

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Several studies have used the photoelastic strain method to determine locations of peak strains in the tibia after total knee arthroplasty. While this method is a full-field technique, it cannot readily quantify principle strain magnitudes and directions on test specimens. The purpose of this study is to compare measurements collected by rosette strain gages to the photoelastic strain method on an orthopaedic model. Comparisons will be made from data gathered at predetermined regions on the cortex of a set of composite tibias during axial and three-point bending loading conditions. A preliminary trial was conducted on aluminum beams to determine the relationship between strain gages and the photoelastic method with beam theory calculations. Cantilever tests were conducted using eight, twelve inch long aluminum bars and loaded incrementally at 215mm from the strain measurement site. The results showed that the photoelastic strains were on average 30.0% below the theoretical value with a 16.6% uncertainty, while the strain gages were 3.1% above the theoretical value with a 0.7% uncertainty. Based on this preliminary data, the photoelastic method is a useful means of finding areas of high strain; however, strain gages are ideal for more precisely quantifying the strains at a specific location.