E-Appendix

Strain Measurement Reproducibility

Methods

A separate study was performed to evaluate the reproducibility of the labral strain measurements. The repeatability of Maneuver B was assessed in one specimen that was placed in 10° of extension and preconditioned by applying an axial load of 100 lb (445 N) and an external rotation torque of 20 Nm for three periods of thirty seconds, each separated by a rest period of sixty seconds. Following preconditioning, a set of orthogonal radiographs of the unloaded specimen in neutral flexion and rotation was made. The loading maneuver was then repeated with application of an axial load of 100 lb (444 N) and a torque of 20 Nm, and a second set of radiographs was made. Next, the specimen was unloaded for approximately ten minutes and the loading procedure was repeated. This loading and unloading procedure was performed a total of four times, generating four sets of strain measurements, which were calculated by comparing the distance between markers in the strained position and the initial unstrained position.

Results

Strains developed within the anteriormost segment of the labrum were measured four separate times, with an average axial strain of 4.7%, which is consistent with the average axial strain of 5.0% ± 1.7% that we had observed during our testing of that maneuver. The circumferential strain at the anteriormost segment of the labrum was also measured four separate times. The average value obtained was 5.1% ± 0.7%, which is also consistent with the average circumferential strain of 4.7% ± 1.4% that we had observed during our testing of that maneuver.

Principal Strain Equation for the Case of Plane Strain

$$\varepsilon_{1,2} = \frac{\varepsilon_x + \varepsilon_y}{2} \pm \sqrt{\left(\frac{\varepsilon_x - \varepsilon_y}{2}\right)^2 + \varepsilon_{xy}{}^2}$$

where ε_1 = maximum principal strain, ε_2 = minimum principal strain, ε_x = strain in the circumferential direction of the labrum, ε_y = strain in the radial direction of the labrum, and ε_{xy} = shear strain.