TROCHLEAR PRESSURE PATTERNS OF THE PATELLOFEMORAL JOINT: EFFECTS OF SURGICAL REALIGNMENT PROCEDURES

Introduction- Lateral retinacular release, tubial tuberosity elevation, and tubial tuberosity elevation with medial transposition are commonly done at our institution in patients who have failed conservative therapy for patellofemoral pain syndrome. Our clinical results reflect the findings of multiple authors and are not always satisfactory. Usually, the retropatellar surface is referenced in biomechanical investigations. The role of femoral trochlear chondrosis has been only minimally investigated.

The objectives of our study were twofold. First, we wanted to demonstrate the effects of lateral retinacular release, tubial tubercle elevation, and tubial tubercule elevation with medialization on trochlear groove contact pressures as potential treatments specifically aimed at trochlear lesions. Second, we wanted to examine the role of “pressure migration” with regards to the trochlea as a potential cause of inconsistent results following these same surgical procedures when performed for more conventional indications.

Methods- Eight fresh frozen cadaver legs from the proximal femur to the foot were harvested. The extensor mechanism and knee capsule were retained. Through medial and lateral arthroscopy, a guide wire and specially designed cannulated drill system was used to place fiber optic transducers (Photonetics, Wakefield, Mass) flush with the femoral articular surface at four predetermined points along the trochlea: midline/proximal third, midline/distal third, 3 millimeters medial to midline/ middle third, and 3 millimeters lateral to midline/middle third.

The knee was secured with an intramedullary femoral rod and coupled to a fixed velocity electric motor, which ranged the knee joint from 90 degrees flexion to full extension. Gravity returned the foot to a dependent position at 90 degrees flexion. Data from an electromagnetic position sensor (Fast-Trak, Polhemus, Inc., Colchester, VT) and from the fiberoptic transducer system was interfaced with a Power Macintosh personal computer (Apple Computer, Inc. Cupertino, CA) and collected through an entire arc of motion for one baseline and three altered conditions: lateral retinacular release, tubial tubercle elevation (using 1.5cm block), and tubial tubercle elevation with medialization (using 1.5cm block). Measurements were summated to calculate the total cumulative pressure each transducer was exposed to through an entire arc of motion for each condition. This “total cumulative pressure” was the final measurement used for Student T-test statistical analysis to compare the four conditions.

Results- Lateral retinacular release inconsistently affected the cumulative pressure measurements at all four transducers. No statistical difference was found comparing this condition with the baseline measurements at any of the transducers.

Elevating and medializing the tubial tubercle tended to decrease the cumulative pressure loads at all four transducers. Changes ranged from +1.67% to -17.3% at the lateral transducer, +2.1% to -50.2% at the distal transducer, -2.8% to -18.1% at the medial transducer, and +2.7% to -25.8% at the proximal transducer. A statistical difference was found comparing the baseline with the lateral transducer (p<0.01), distal (p<0.05), medial (p<0.01), and proximal (p<0.05).

Elevating the tubial tubercle without medialization also tended to decrease the cumulative pressure loads. Changes ranged from +2.4% to -13.2% at the lateral transducer, +2.2% to -43.2% at the distal transducer, +4.1% to -23.6% at the medial transducer, and +16.4% to -11.3% at the proximal transducer. A statistical difference was found comparing the baseline with the lateral transducer (p<0.03), the distal transducer (p<0.05), and the medial transducer (p<0.01). No statistical difference was found at the proximal transducer.

Discussion- The fiberoptic pressure transducer system offered several unique advantages. Extrinsic interference with tracking and glide was minimized and measurements could be obtained in a dynamic fashion. While previous static techniques primarily measured peak pressures, we were able to measure the total amount of pressure a single point was exposed to during a range of motion. We referred to this value as the “cumulative total pressure.”

We did not find lateral release to have any significant altering of femoral trochlea pressure and would suggest poor predictability in the use of this procedure alone in the treatment of femoral trochlear lesions. Van Kampen and Heegaard and colleagues also failed to demonstrate changes in patellar tracking after lateral release. Huberti and Hayes, using cadaver knees and Fuji pressure sensitive film found lateral release procedures “exhibited unpredictable and inconsistent results.”

Our results did reveal statistically significant reduction in pressure at the lateral, distal, and medial transducers following straight elevation of the tubial tubercle. The literature offers a wide range of opinions regarding this procedure. Clinical results vary from 50% good results to 90% good results.

Biomechanical conclusions also differ. While definite decreases in contact pressures were found in one study, Lewallen and colleagues concluded “tibial tubercle elevation... failed to cause a consistent change in contact pressure” and “caused a migration of the joint contact area superolaterally on the retropatellar surface.” Our results did not support a similar conclusion with regards to the femoral trochlea but found that this procedure predictably decreased pressure along the trochlea and would be a viable surgical option in treating chondrosis in these areas.

Anteromedialization of the tubial tubercle as described by Fulkerson was found to significantly reduce pressures at all four points along the trochlea in our study. Our findings would suggest that anteromedialization may be helpful in cases of trochlear chondrosis. Fulkerson reported 89-93% good/excellent outcome following his procedure. Our findings are not able to offer any insight into less favorable results, such as one report of 60% satisfactory outcome, other than to help eliminate trochlear lesions as an unforeseen factor.

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References-

Additional Affiliation- Orthopaedic Research Laboratory, Department of Biomechanical Engineering and Orthopaedic Surgery, Virginia Commonwealth University, Richmond, VA.