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No stabilizing effect of the elbow joint capsule

A kinematic study

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We dissected 7 cadaveric elbow specimens, leaving the collateral ligaments and the joint capsule intact. The anterior and the posterior capsule were sequentially transected, followed by kinematic testings. We found no change in joint laxity after total transection of the capsule.

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Morrey and An (1983) showed that the elbow joint capsule contributed substantially to the stability of the elbow joint. They used a material testing machine, not a three-dimensional kinematic test apparatus. King et al. (1993) stated that "the anterior capsule has transverse and obliquely directed bands and provides an important stabilizing effect when taut in extension."

Other authors have stressed that the lateral and medial ligament complexes are the primary constraints on the elbow capsule (Regan et al. 1991, O'Driscoll 1994). In our opinion, the structure and elasticity of the joint capsule show no major effect on the stability of the elbow. Therefore we investigated the basic kinematics of the elbow before and after transection of the joint capsule.

Material and methods

We tested 7 fresh-frozen cadaveric elbow specimens. The specimens were right-sided and obtained from male cadavers, with a mean age of 69 (58–85) years. The specimens were dissected leaving the ligaments and joint capsule intact. They were then tested in an experimental kinematic test apparatus. In this apparatus, 3 strain gauges and 3 potentiometers, enabled simultaneous recordings of movement and force applied to the forearm of the specimens in the 3 axes describing flexion/extension, valgus/varus and rotation around the forearm axis. The humerus was mounted horizontally in the test apparatus and the lever arm was connected to the forearm (Figure 1). The test apparatus and technique have been described in detail (Olsen et al. 1996). The specimens were tested in a cycle first without any applied force. Then a load of 0.75 Nm was applied to the forearm in the valgus direction during flexion and a load of 0.75 Nm in the varus direction during extension. Then a load of 0.75 Nm in external rotation was applied during flexion and a load of 0.75 Nm in internal rotation was applied during extension. Finally, a pivot shift test was performed with a simultaneous force of 0.75 Nm applied in external rotation and valgus direction.The first measurements were made on the intact joint.

Then measurements were performed after the capsule was punctured, then after total transection of the anterior capsule and, finally, after total transection of the posterior capsule. In 3 of the specimens, the transection of the capsule was reversed, with the first transection made posteriorly.

The medial and lateral ligament complexes were defined visually and by digital palpation and their borders marked with needles, to ensure that transection of the capsule was performed without damaging the margins of the ligament complexes.

Results

From full extension to full flexion, we found no increase in laxity on the varus-stressed elbow, even after total transection of both the anterior and the posterior joint capsules (Figure 2). In the same way, we found no change in laxity or movement pattern on the valgus-stressed elbow, even after total transection of the capsule (Figure 3).

When tests were made with internal or external rotational force applied to the elbow, there were still no changes in stability and movement pattern. The tests made with combined supination and valgus force (lateral pivot shift test) confirmed the above-mentioned findings (Figure 4).

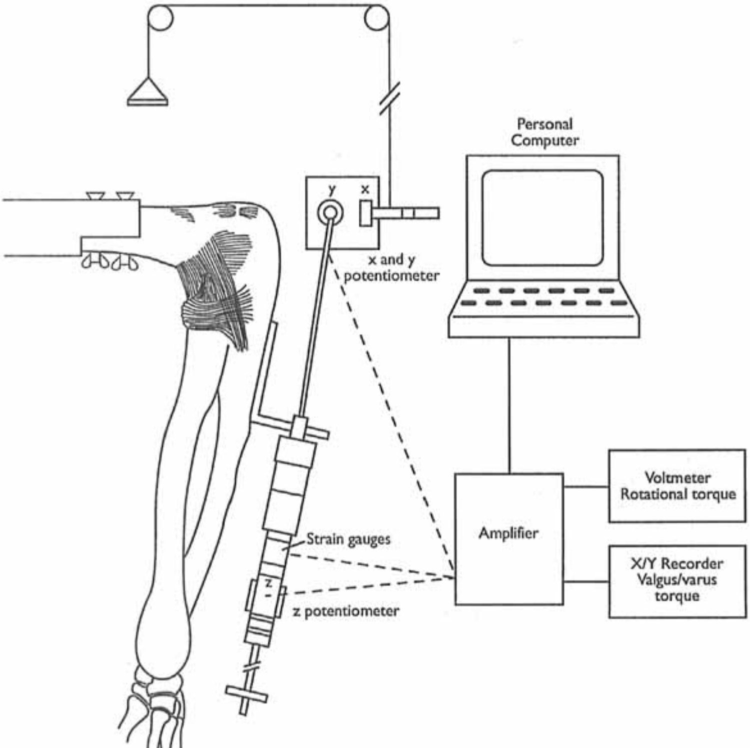

Figure 1. The experimental 3D-kinematic testing apparatus.

Discussion

We could not confirm the previously postulated function of the elbow joint capsule, as an important stabilizer in forced valgus or varus in the fully extended elbow, or in any degree of flexion (Morrey and An 1983, King et al. 1993). However, the capsule might have some importance as secondary constraint after rupture of the collateral ligaments. Our experimental kinematic test results confirm reports (O'Driscoll 1994) stating that an elbow with intact joint surfaces requires only the medial and lateral collateral ligament complexes for functional stability.

Closure of the posterior capsule with strong non-absorbable sutures has been specifically recommended to restore joint stability (Wadsworth 1982, Crenshaw 1992). Our findings indicate that reconstruction of the joint capsule for stability reasons, after rupture or surgical transection, is not necessary, and because of the risk of inducing capsular contractures, perhaps should be avoided so long as the collateral ligament complexes are left intact or are properly reconstructed. Furthermore, there seems to be no reason to avoid capsulotomy for treatment of posttraumatic contractures (Urbaniac et al. 1985, Husband and Hastings 1990, Mih and Wolf 1994, Nowicki and Shall 1992, Søjbjerg 1996, Hertel et al. 1997).

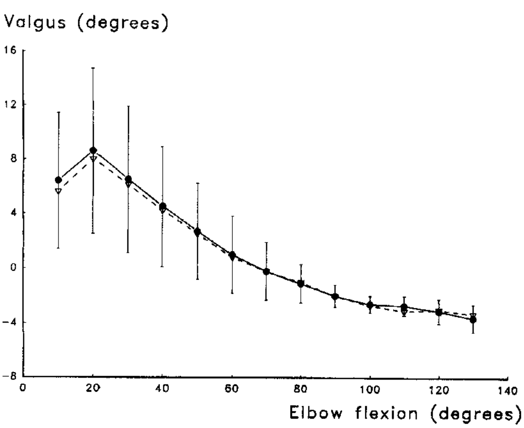

Figure 2. Movement curve during varus load. Negative values express varus.The shape of the curve expresses the carrying angle of the elbow in the full range of elbow flexion. Values expressed in mean ± SEM, ● intact, ▽ total capsule, *p < 0.05.

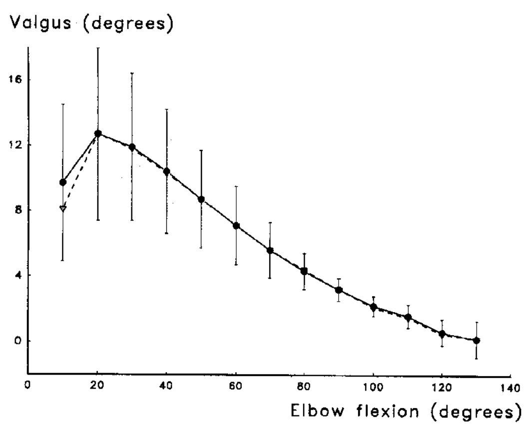

Figure 3. Movement curve during valgus load. Negative values express varus.Values expressed in mean ± SEM, ● intact, ▽ total capsule, *p < 0.05.

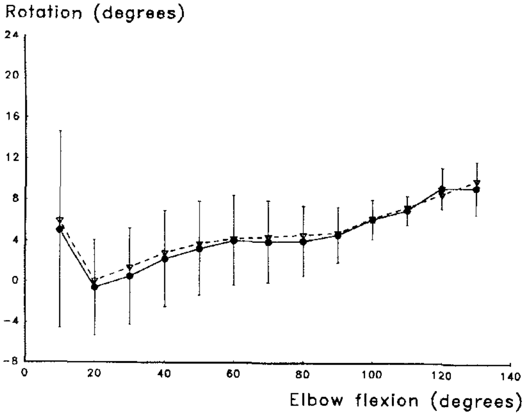

Figure 4. Movement curve during combined supination and valgus load (pivot shift test).Positive values express external rotation.Values expressed in mean ± SEM, ● intact, ▽ total capsule, *p < 0.05.

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