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THE QUADRICEPS ANGLE AND ITS RELATION TO FEMORAL TORSION

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In 29 patients with patellofemoral complaints paired values of Q-angle and internal hip rotation were determined. In addition the patellar height index of Insall & Salvati (1971) was calculated from measurements on lateral radiographs of the knees.

Both Q-angle and internal hip rotation were significantly higher in women than in men and there was a statistically significant correlation between these two measurements. There was no significant correlation between Q-angles and patellar height indexes.

As external hip rotation can generally be taken as a measure of internal femoral torsion, these findings favour the hypothesis of a torsional malalignment syndrome of the patellofemoral joint.

Key words: chondromalacia patellae; femur; hip joint; knee joint; patella; tibia

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It has been stated repeatedly that a large quadriceps angle (Q-angle) in the adolescent or mature patient with patellofemoral complaints is often associated with excessive femoral neck anteversion (Insall et al. 1976, James 1976). Staheli (1980) holds that this clinical observation has not yet been documented.

It is generally agreed that the degree of femoral neck anteversion is the main determinant of the proportion of hip internal rotation (HIR) relative to external rotation (Alvik 1962, Staheli 1980), but it is not the only one. Other factors are soft tissue contractures, asymmetrical placement of the femoral head and neck, and acetabular depth, location and rotation (Kleiger 1968). Figures presented by Staheli et al. (1977) show that there is a significant positive correlation between internal rotation of the extended hip and femoral neck anteversion determined radiographically ($n = 19$, Spearman rank correlation coefficient $r_s = 0.46$, $0.01 < P < 0.05$).

The purpose of the present study was to investigate the correlation between internal rotation of the extended hip and the Q-angle in order to contribute to the discussion on the possible existence of a torsional malalignment syndrome of the patellofemoral joint. High riding patella is sometimes claimed to be part of this syndrome and therefore measurements of patellar height were included.

PATIENTS AND METHODS

Twenty-nine patients, 18 women and 11 men with patellofemoral complaints, participated in the study. Their median age was 38 years, range 17 to 60 years. The Q-angles of both knees were determined as the acute angle between lines from the centre of the patella to the anterior superior iliac spine and from the centre of the patella to the centre of the tibial tuberosity. During these measurements the patient was supine with the legs extended, the feet together and the quadriceps muscle relaxed.

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Internal hip rotation was measured with the patient prone and the hips extended. External hip rotation was also noted to ensure that range of rotation was within normal limits. All measurements were done by the authors.

Patellar height was determined according to Insall & Salvati (1971) and expressed as the ratio of patellar tendon length to diagonal patellar length (LT/LP).

Nonparametric statistical methods were used to evaluate the results (Siegel 1954).

RESULTS

Table 1 shows the distribution of Q-angles measured. The difference between the medians of female and male values is statistically significant ($P < 0.01$, Mann-Whitney test). There is no significant difference between right and left knees ($P > 0.10$). The distribution of HIR is shown in Table 2. Again the difference between the sexes is statistically significant, the difference between sides is not ($P < 0.01$ and $P > 0.10$ respectively).

Table 1. Distribution of Q-angles in relation to sex and side

	Total	Women	Men	Right	Left
Number of knees	58	36	22	29	29
Median (degrees)	16	20	12	16	16
Interquartile range	12–20	15–24	6–15	11–21	11–21
Range	0–30	0–30	0–18	0–29	0–30

Table 2. Distribution of HIR (hip internal rotation) in relation to sex and side

	Total	Women	Men	Right	Left
Number of knees	58	36	22	29	29
Median (degrees)	40	45	29	40	40
Interquartile range	32–46	40–54	22–36	34–47	31–47
Range	17–67	35–67	17–40	17–67	17–67

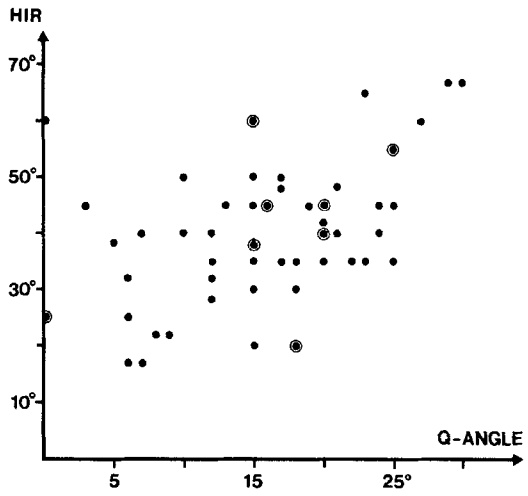

Figure 1. Correlation between Q-angle and HIR (hip internal rotation). ◉ = two sets of paired observations.

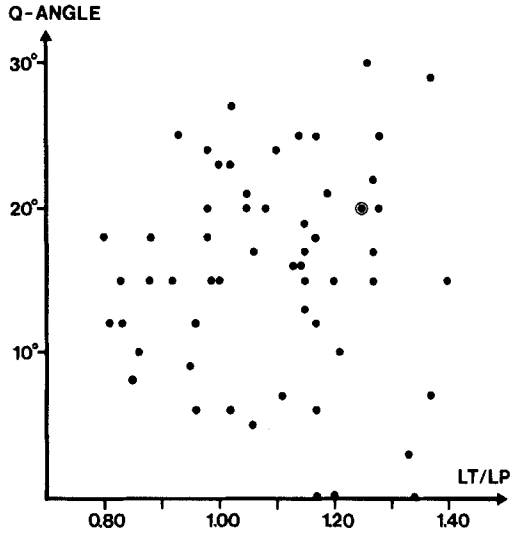

Figure 2. Correlation between Q-angle and the patellar height index LT/LP. ◉ = two sets of paired observations.

The paired values of Q-angles and HIR are shown graphically in Figure 1. The Spearman rank correlation coefficient, corrected for tied observations, was calculated to be $r_s = 0.428$. For $n = 58$ this correlation is statistically significant ($0.001 < P < 0.01$).

In Figure 2 patellar height and Q-angle values are shown. There is no significant correlation between the two ($P > 0.10$).

DISCUSSION

The frequent finding of a high Q-angle among patients with chondromalacia patellae is well recognized in clinical work (Insall et al. 1976, James 1979, Hvid et al. 1981). Stress analysis of the patella confirms that a high Q-angle induces compressive and tensile stress to a point where pathological cartilage change is likely to occur (Minns et al. 1979).

It has been suggested that the more widely spaced hips in women explain the finding of higher Q-angles (Outerbridge 1964). It is true that widely spaced hips result in larger Q-angles, but only to the extent that the valgus angles of the knees are affected. On an average the difference between physiologic valgus angles in females and males is less than 3° (Andersen 1958) and thus cannot account for the 8° discrepancy found in this study. The difference in femoral torsion, as measured by internal hip rotation, offers an explanation for the difference between Q-angles not accounted for by the higher valgus angle in women.

The demonstration of a significant positive correlation between Q-angle and HIR favours the hypothesis that excess femoral neck anteversion leads to compensatory external tibial torsion resulting in a high Q-angle. Herold & Marcovich (1976) found an increasing external tibial torsion during early childhood in normal subjects. Therefore it is likely that an increase in Q-angle during childhood may explain the fact that the clinical syndrome of chondromalacia patellae usually does not present itself before adolescence.

Patella alta is sometimes included as part of the torsional malalignment syndrome. Patellar position is known to be higher in women than in men as measured by the method of Insall & Salvati (Marks & Bentley 1978). Our findings show that the Q-angle and patellar height are unrelated. It might be argued that the presence of patella alta compromises Q-angle measurement as the patella may drift laterally when the knee is extended. However the exclusion of patellar height indexes higher than 1.20 does not affect the conclusion and thus patella alta should not be regarded as part of the syndrome. It is obvious that the two conditions relatively often coexist since patella alta is a frequent finding among patients with patellofemoral symptoms.

It should be stressed that the figures presented in this study are not normal values.

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