The Patellar Tilt Angle: Correlation of MRI Evaluation with Anterior Knee Pain

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Abstract

The purpose of this study was to analyze the degree of patella tilt and its correlation with the symptoms of anterior knee pain. We used magnetic resonance imaging (MRI) to measure the angle of patella tilt. The patients (n = 128) were classified into two groups. Group 1 (n = 78) included patients who had never had symptoms of anterior knee pain but had MRI for evaluation of the menisci and the ligaments. Group 2 (n = 50) included patients who had MRI for evaluation of anterior knee pain syndrome. Patients who had gross deformities like patellar dislocation, tricompartmental osteoarthritis, or inflammatory arthritis were excluded. The average patella tilt angle was 6.3 (SD = 3.9) and 12.8 (SD = 8.4) degrees, respectively, for the two groups of patients. Twenty-three patients in group 2 underwent arthroscopy because of failure of conservative treatment, and the average patella tilt angle in this subgroup was 16.4 degrees. Our study suggests that patella tilt angle is correlated with the symptoms of anterior knee pain, and indicated that the cause of pain came from the tight lateral retinaculum. In addition, MRI was found to be an accurate and reproducible method of measurement of the patellar tilt angle.

Anterior knee pain syndrome is a common orthopaedic problem in outpatient clinics. Gross malalignment and dislocation of the patella are easily diagnosed, but very often, no exact structural diagnosis can be made. The orthopaedic surgeon often has difficulty with regard to diagnosis and treatment. These patients are diagnosed and assigned to various categories, e.g. chondromalacia patellae,[1-3] patellofemoral malalignment,[4-9] lateral patellar compression syndrome,[1,10-12] and excessive lateral pressure syndrome[13]. The pain from the above syndrome can all be the result of

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patellofemoral malalignment[14] or from the periarticular structure such as synovium, capsule, ligaments, bursae and medial plica[15]. Radiological evaluation is necessary to further assess patients, but patellar malalignment and patellar tracking disorders often escape routine detection. Congruence angle has been used by many doctors[3,16-19]. Although it is very specific, it is not sensitive in the detection of minor degrees of malalignment, especially patellar tilting[20-22]. Inoue et al[23] found that only 30 per cent of patients with clinical patellar subluxation had an abnormal congruence angle. Laurin et al[20,21] have developed the measurements on 20 degrees knee flexion skyline view. But many authors[24-28] have cautioned that measurements of patellar tilt may be inaccurate and misleading, because beyond 30 degrees flexion the patella firmly engages in the trochlea and the Merchant view cannot be obtained if the knee is flexed less than 30 degrees. The interpretation of the axial views may also be affected by image distortion and hip rotation, making the measurement inaccurate. Computerized tomography (CT) and magnetic resonance imaging (MRI) may be more reliable in evaluating the patellofemoral joint[27,28]. Both are precise and reproducible. We used MRI to evaluate patients who reported patellofemoral pain, because MRI can provide more information, e.g. access to the articular cartilage, the plica and the soft tissue around the knee joint. However, the cost of CT is high so we could not make a controlled CT study in the normal population.

MATERIAL AND METHOD

We made MRI investigations in 128 patients, aged 13-72 years, who attended the knee clinic, Ramathibodi Hospital, between January 1996 and August 1997. Group 1, the control group, included 78 patients (mean age 35 years) who had never had symptoms of anterior knee pain and had MRI for evaluation of the menisci and ligaments. Group 2, the study group, included 50 patients (mean age 18 years) who came with symptoms of anterior knee pain. Patients who had gross deformities like patellar subluxation or dislocation, tricompartmental osteoarthritis, or inflammatory arthritis were excluded from the study.

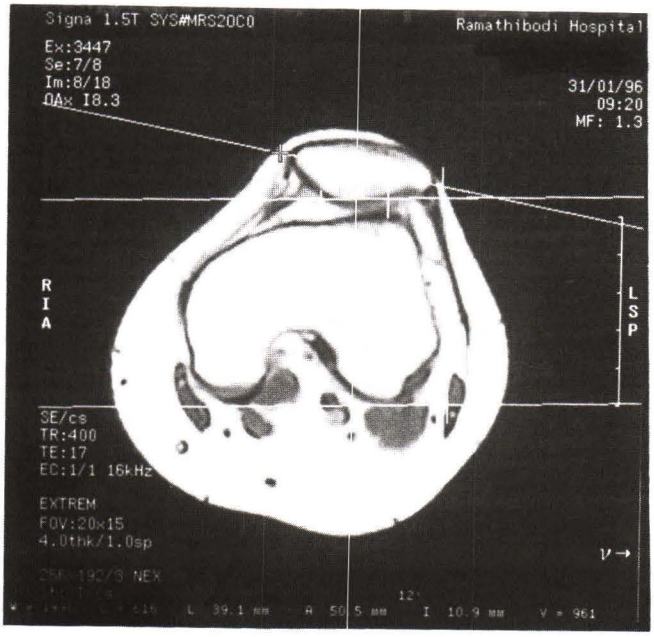

Fig. 1. Measurement of patella tilt angle by the MRI machine.

All MRI were taken with the same machine, 1.5 - tesla Signa superconducting magnet system (GE Medical System, Milwaukee, WI). Transaxial MR imaging of the knee was performed with 3 mm slice thickness and 1 mm gap. An extremity coil was used with 20 x 15 cm. Field of view and a 256 x 192 matrix. Tilt angle was measured by the line extending along the posterior cortex of the femoral condyles intersected with major transverse axis of the patella[28]. The measurement was obtained by the imaging technician and checked by a radiologist (S.J.) in order to minimize interobserver bias (Fig. 1). The patients in group 2 underwent arthroscope if they had persistent anterior knee pain after 3 - months' conservative treatment.

Statistical Analysis

We used the Student *t* - test to compare the two means of patella tilt angles. The sensitivity, specificity, accuracy, and ROC curve (Fig. 2) of the patella tilt angle from MRI in detecting anterior knee pain, relative risk between tilt angle and anterior knee pain with 95 per cent confidence intervals were calculated. Subgroup analysis of group 2 patients who failed conservative treatment and underwent arthroscope was also estimated. We used p - value < 0.05 with two - tailed test. STATA 4.0 was used in statistical analysis.

RESULTS

One-hundred and twenty-eight patients who came to the knee clinic in the Orthopaedic Department, Ramathibodi Hospital, between January 1996 and August 1997, were recruited. Their age range was 13-72 years old. The control group (group 1) who had no anterior knee pain symptoms, were 78 patients with a mean age of 35 years old. While the study group (group 2) who had anterior knee pain symptoms, were 50 patients with a mean age of 18 years. The mean tilt angle for the control group was 6.3 degrees (SD = 3.9) and for the study group was 12.8 degrees (SD = 8.4). There was a significant difference between the means of these two groups with p - value < 0.001. When we used the cut-off point of patellar tilt angle as 7 degrees, there was 70 per cent sensitivity, 73 per cent specificity and 71.9 per cent accuracy in detecting anterior knee pain (Table 1). There were 23 patients (average tilt angle 16.4 degrees) in the study group who underwent arthroscopic examination. The indication for arthroscopy was persistent anterior knee pain despite 3 months of conservative treatment. The arthroscopic findings show normal

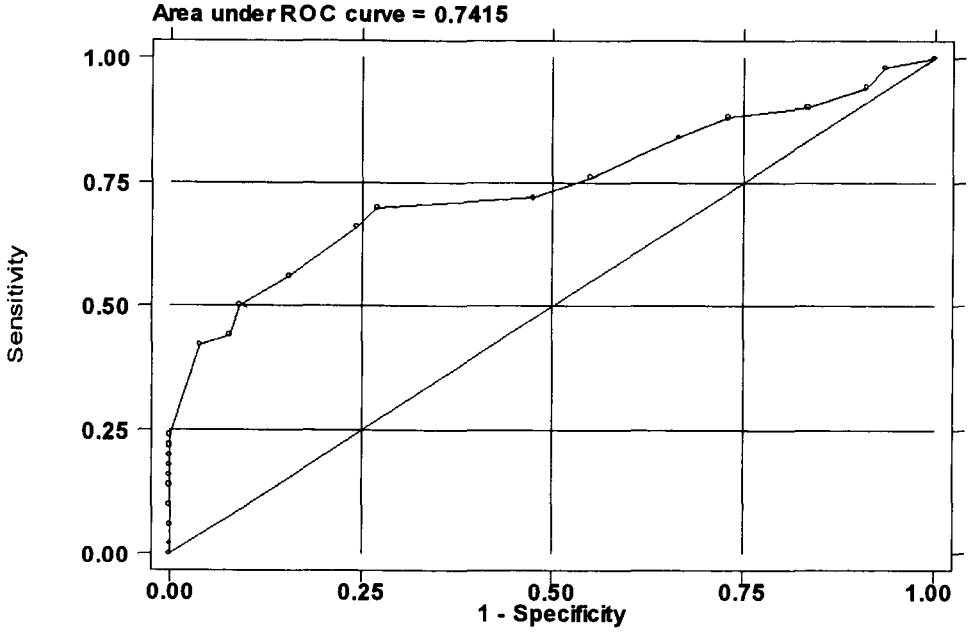

Fig 2. Show ROC curve of the patella tilt angle.

Table 1. Sensitivity, specificity, and accuracy of the tilt angle to predict the cutoff point of patellar tilt angle.

Tilt angle	Sensitivity %	Specificity %	Accuracy %	Relative risk estimate 95% confidence bounds
5	84	53.3	53.0	2.6 (1.0 to 6.4)
7	70	73.0	71.9	3.0 (1.8 to 4.9)
10	66	75.6	71.9	6.0 (2.8 to 13.2)

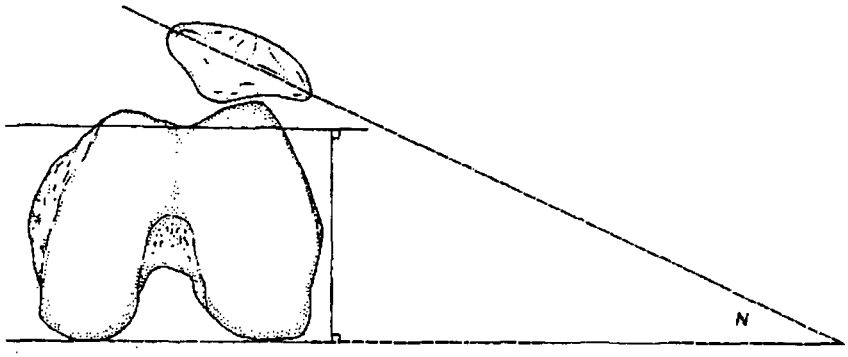

Fig. 3. The diagram of reference lines.

arthroscopic findings except for synnovial plica in four patients (average tilt angle = 6.3 degrees). Seven patients (average tilt angle = 25 degree) had patella tilt with subluxation, and cartilage lesion ranged from chondromalacia patella to chondral defect. Twelve patients (average tilt angle = 13.3 degree) had normal findings except for early chondromalacia of patella.

DISCUSSION

The anterior knee pain syndrome is a challenging problem in orthopaedic out-patient clinics. Occasionally, no cause can be found. The diagnosis could be made easy from the history and symptoms, but difficulties in proper evaluation of the alignment on clinical examination[6,30-33] have led to the development of various methods in radiologic examination. The lack of standardization and reproducibility of axial radiography (Merchant's and Laurin's) has limited its usefulness. CT scan is a reproducible method that can make a standard posterior condylar reference line and the transverse patellar axis[14]. Because of the high cost of CT and the limited number of patients, we could not use CT in this study. Mostly, orthopedists will request MRI for evaluation of problems of the knee. MRI provides information similar to CT, but it also can be used to assess the articular cartilage, quadriceps muscle and peripatellar tissue. MRI has no exposure to radiation but costs significantly more. From our study, only 10 of 50 patients in the study group had MRI documentation of the cartilage (chondromalacia patella). Therefore, the information received was helpful for therapeutic decision making.

Study of the patella tilt angle has demonstrated the advantage of using reference lines. The posterior intercondylar line is a reliable reference because there is less variation in bone anatomy, and it offers a reproducible plane of reference[34] (Fig. 3). The use of the line connecting the corner of the patella at midpatellar transverse image has a number of advantages, e.g. it is easy, and it is independent of patella morphology[22]. When this is difficult to measure, we can use the line parallel to the subchondral bone of the anterior patella to represent this line.

Following the study of Schutzer[27,28] about patellofemoral malalignment pattern, we

found 43 of 50 patients (86%) had tilt without subluxation, and 7 of 50 patients (14%) had tilt with subluxation. We did not see patella subluxation without tilt. From this, we postulate that the physical examination of anterior knee pain patients cannot differentiate the patients. But based on studies showing a high degree of patellar tilt (16.4 degree) in operated patients, we reasoned that the patellar tilt angle may be a useful criterion for differentiating anterior knee pain patients, and hence it is useful as an indication for surgery. Shea and Fulkerson[35] did not recommend lateral release in patients with anterior pain and a normally aligned patella.

From this study, the use of the patella tilt angle from the axial view provides more information and may be used in the routine investigation of anterior knee pain patients. Also, in another case of MRI evaluation of the knee joint, with negative routine MRI study, the patella tilt angle revealed the cause of symptoms especially in cases of patellar tilt of more than 7 degrees.

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การเอียงตัวของกระดูกสะบ้าข้อเข่า : ความสัมพันธ์ระหว่างอาการปวดเข่าทางด้านหน้ากับค่าการเอียงตัวของกระดูกสะบ้าข้อเข่าจากภาพถ่ายคลื่นแม่เหล็กไฟฟ้า

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ได้ทำการศึกษา เพื่อหาค่าความสัมพันธ์ระหว่าง การเอียงตัวของกระดูกสะบ้าข้อเข่า กับอาการปวดเข่าทางด้านหน้า (anterior knee pain syndrome) ในผู้ป่วยกลุ่มควบคุม และกลุ่มผู้ป่วยที่มีอาการปวดเข่าทางด้านหน้า ในการศึกษาได้ทำการถ่ายภาพคลื่นแม่เหล็กไฟฟ้า ในผู้ป่วยกลุ่มควบคุม (78 ราย) ได้แก่ผู้ป่วยที่ไม่เคยมีประวัติปวดเข่าทางด้านหน้ามาก่อน และได้เข้ารับการถ่ายภาพคลื่นแม่เหล็กไฟฟ้าของข้อเข่า เพื่อช่วยในการวินิจฉัยการบาดเจ็บจากหมอนรองกระดูกเข่า หรือเส้นเอ็นภายในข้อเข่าฉีกขาด กลุ่มผู้ป่วยที่ทำการศึกษา (50 ราย) เป็นกลุ่มผู้ป่วยที่มีอาการปวดเข่าทางด้านหน้า โดยไม่มีอาการแสดงทางคลินิกที่ชัดเจน เช่น ภาวะสะบ้าเคลื่อนหลุด ข้อเข่าเสื่อมระยะรุนแรง หรือมีอาการอักเสบของข้อเข่าต่าง ๆ ค่ามุมการเอียงตัวของกระดูกสะบ้าได้เท่ากับ 6.3 (SD = 3.9) ในกลุ่มควบคุม และ 12.8 (SD = 8.4) ในกลุ่มที่ทำการศึกษาตามลำดับ ในการศึกษาครั้งนี้พบว่ามีผู้ป่วย 23 ราย ในกลุ่มที่ทำการศึกษาไม่ตอบสนองต่อการรักษาแบบอนุรักษ์ และได้รับการตรวจโดยวิธีการส่องกล้องในข้อเข่า ค่ามุมการเอียงตัวของกระดูกสะบ้าในกลุ่มนี้มีค่าเท่ากับ 16.4 จากการศึกษาพบว่าค่ามุมการเอียงตัวของกระดูกสะบ้ามีความสัมพันธ์กับอาการปวดเข่าทางด้านหน้า และอาจจะนำมาใช้เป็นข้อบ่งชี้เพื่อทำการผ่าตัดในผู้ป่วยกลุ่มนี้ได้

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