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ORIGINAL STUDY

Evaluation of the posterior cruciate ligament in long standing cruciate retaining total knee arthroplasty

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We evaluated the status of the posterior cruciate ligament in 52 knees with a cruciate retaining total knee arthroplasty 11 years after the index surgery. The evaluation consisted of the Knee Society scores, clinical examination of antero-posterior laxity using the Lachmann test and posterior drawer test. We also used the KT 1000 device, stress radiographs and MRI scan to corroborate this. Three knees were found to be lax clinically and had a posterior tibial shift on radiographs. The MRI scans were able to delineate the posterior cruciate ligament in 86% of the knees. Eleven years after surgery, clinical, radiological and MRI scans when assessed in combination demonstrated the presence of a stable posterior cruciate ligament in 94%.

Keywords : cruciate retaining total knee replacement ; long term evaluation ; posterior cruciate ligament retention.

INTRODUCTION

The results of total knee arthroplasty (TKA) have been consistently improving over the past few decades. Based on the retention or sacrifice of the posterior cruciate ligament (PCL) the TKA is either a PCL retaining or a PCL substituting type. There are points in support and against both options. Proponents of the substituting type believe it to be the option of choice in severely deformed knees, leaving the cruciate retaining option for the mildly deformed ones (*3,11*). Long-term results of both PCL retaining and substituting designs have reported similar results (*3,2,7,11,12*). The functional status of the PCL in long-standing TKA has been the subject of discussion and speculation with reports of late onset PCL deficiency (*8,9*). The present study was undertaken to evaluate radiologically and clinically the functional and anatomic status of the PCL in long-standing cruciate retaining knees.

MATERIALS AND METHODS

A total number of 170 patients (248 knees) underwent posterior cruciate retaining (CR) TKA between Jan 1998 and Dec 31, 1998 and 34 patients (52 knees) fulfilled the inclusion criteria of this study. We included only primary knee replacements for osteoarthritis with a varus/valgus deformity of less than 20°, a fixed flexion deformity/ hyperextension of less than 15°, and an intact PCL at the time of surgery. Revisions and inflammatory disease were excluded. Informed consent and hospital ethics

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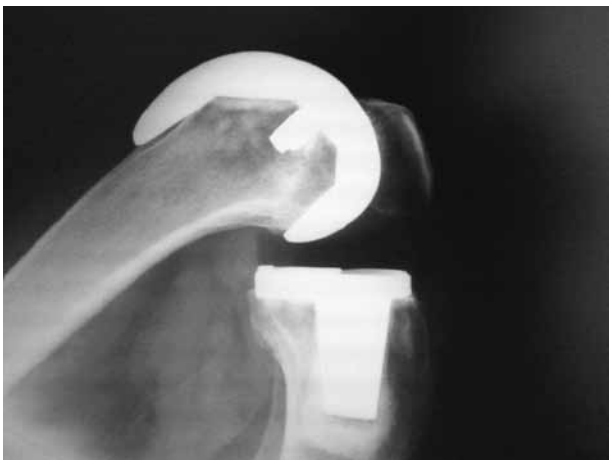

Fig. 1. — Weight bearing lunging forward lateral view

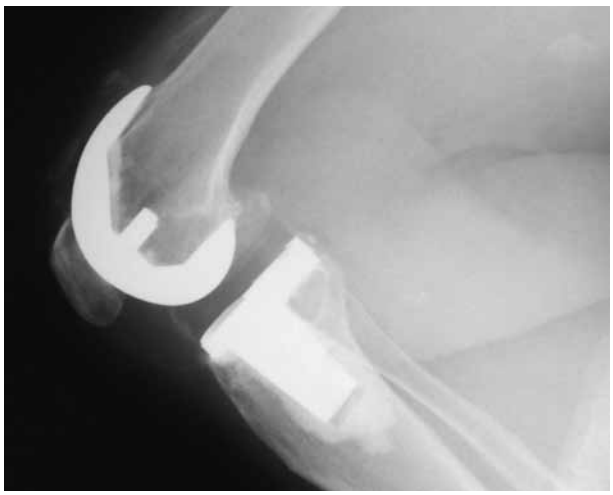

Fig. 2. — Posterior subluxation of tibia on stress view

committee approval were taken for each patient. There were 21 females and 13 males in the study. Eighteen patients underwent bilateral TKA and 16 patients had a unilateral TKA. The average age of the patients was 69 years (range : 54 to 79 years). The average follow-up period at the time of the study was 11 years. The implant used was the Nexgen CR (Zimmer, Warsaw, Ind, USA). The patella was not resurfaced.

The patients were clinically evaluated using the Knee Society scoring system (*4*). The scores obtained at the time of the study were compared with the pre-operative scores. KT 1000 arthrometer was used in all patients post operatively to assess posterior tibial translation (*6*) in quadriceps neutral angle of 70°-80°. The posterior laxity was measured by applying a 20 lbs push.

Radiological evaluation consisted of a standing antero-posterior view, a supine lateral view, a weight bearing lunging forward lateral view (Fig. 1) (*14*) and a stress view : with the patient supine a posteriorly directed force was applied to the proximal third of the tibia with the knee in 60° of flexion (Fig. 2). The radiographs were evaluated for alignment, evidence of loosening and radiolucencies. The weight bearing lunging forward view and the stress views were evaluated to assess the tibio-femoral contact point and any evidence of posterior tibial translation.

MRI studies were performed using a 1.5 tesla MRI unit (Phillips Gyroscan) with a dedicated knee coil. The Hospital for Special Surgery recommended protocol for MRI of total knee arthroplasty was followed (Table I) (*10*). The radiographs and MRI images were reviewed by the two senior radiologists to localise and assess the integrity of the PCL. They were not provided with the clinical details to remove bias.

RESULTS

The average pre-operative Knee Society score of 46 points (range : 38 to 65) increased to an average of 88 points (range : 78 to 95) at the time of the study. Forty five knees had an excellent knee score, 4 had a good score and 3 had a fair score. These scores were maintained throughout the period of follow-up. The average range of motion was 118° (range : 85° to 135°) at the time of study. None of the knees demonstrated any appreciable mediolateral instability during clinical examination. In 3 knees there was a posterior laxity of more than 10 mm when they were subjected to the KT 1000 arthrometer. The average posterior laxity was 3.7 mm (0 to 3 mm : 35 knees, 3-5 mm : 16 knees, 5-7 mm : 2 knees, > 10 mm : 3 knees).

The alignment was measured to be 5° of valgus in 46 knees, 4° valgus in 3 knees and 3° valgus in 3 knees. Six knees showed evidence of non-progressive radiolucencies. There was no evidence of any implant loosening. Three knees demonstrated posterior tibial translation on the weight bearing lunging forward lateral view and the stress views. These were the same knees that were found to be > 10 mm lax when using the KT 1000.

Table I. — The Hospital for Special Surgery recommended protocol for MRI of total knee arthroplasty, as used in this study

Coil	Phased array extremity
Position	Feet first supine
Series I	Sagittal fast inversion recovery TR/TE/TI 6000/17/150 ; ETL 7 ; FOV 18 cm ; phase correct ; RBW 62.5 ; slice 4/0 gap ; tailored RF ; matrix 256 _ 192 ; NEX 2
Series II	Sagittal FSE-XL TR/TE 5000/30 ; ETL 15–22 ; FOV 20 ; phase correct ; RBW 83.3 (100 kHz preferred) ; slice 3.5/0 gap ; tailored RF ; matrix 512 _ 320–352 ; NEX 4–5
Series III	Coronal FSE-XL TR/TE 5000–6000/30 ; ETL 20 ; FOV 15 ; phase correct ; RBW 62.5–100 (preferred) ; slice 3.5/0 gap ; tailored RF ; matrix 512 _ 256–288 ; NEX 4
Series IV	Axial FSE-XL TR/TE 6000–7500/30 ; ETL 20 ; FOV 16 ; phase correct ; RBW 62.5–100 (preferred) ; slice 3/0 gap ; tailored RF ; matrix 512 _ 256 ; NEX 4

MRI scans were able to delineate an intact PCL in 45 knees (Figs. 3-5). In the remaining 7 knees the PCL could not be visualised on account of metal artefacts.

DISCUSSION

The posterior cruciate ligament (PCL) is one of the strongest ligaments in the body. It acts as a primary restraint against posterior translation of the tibia on the femur (*1*). It has been suggested that the PCL can produce femoral roll back, which increases knee flexion and prevents posterior translation reducing loosening and excessive poly wear by decreasing the shear stresses on the fixation surfaces (*5*). There has been no conclusive evidence that the PCL is involved in the degenerative process when the whole knee joint is affected by osteoarthritis. In this article we have tried to evaluate the functioning of the PCL in long standing cruciate retaining TKA radiologically and clinically. Montgomery *et al* (*8*) and Pagnano *et al* (*9*) have reported on late onset instability of the PCL in long-standing cruciate retaining TKA.

Various methods of clinically assessing the PCL have been described. The very fact that in our group of patients the knee scores improved after surgery and stayed consistently at those levels throughout the period of follow-up points to the fact the PCL was functioning years after surgery. The posterior drawer test and Lachmann test are reliable tests though subject to individual bias. We added the KT 1000 to check for posterior instability and found that 3 knees were showing laxity of more than 10 mm. Jones *et al* (*6*) in 2006 had evaluated their cruciate retaining knees with a KT 1000 and found that a posterior laxity of between 5 and 10 mm had no adverse effect on the functioning of the knee joint and did not affect the knee scores. Our experience with this study group supports this finding.

Fig. 3. — Sagittal T2 MRI image delineating an intact PCL (white arrow) (case 3, left knee).

Fig. 4. — Sagittal T2 MRI image delineating an intact PCL (white arrow) (case 11 right knee).

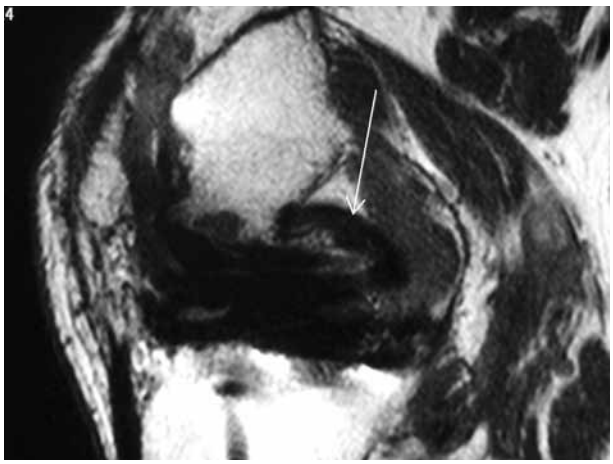

Fig. 5. — Sagittal T2 MRI image delineating an intact PCL (white arrow) (case 11 left knee).

Victor *et al* (*14*) studied the kinematics of the cruciate retaining knee and proposed a radiographic lateral view of the knee during lunge (with the knee subjected to forward flexion with full weight bearing). They measured the contact point of the femoral component on the tibial insert in relation to the midline of the tibial insert. If the contact point was anterior in relation to the midline then the PCL was thought to be lax. Our three patients who were lax on the KT 1000 also showed anterior contact points on the above radiographic image. In a supine lateral view of these three knees with a posteriorly directed force on the proximal tibia there was an appreciable anterior shift of the contact point between 10 mm and 12 mm (average 11 mm).

In the presence of a total knee arthroplasty, MRI can efficiently evaluate the quadriceps and patellar tendons, collateral ligaments and structures of the posterolateral corner (*10,13*). A PCL was clearly delineated in 45 knees subjected to MRI scan using the above mentioned protocol. In 7 knees the PCL was not delineated probably due to metal artefacts. Of these 7 knees, 3 knees were those which were lax in the KT 1000 test and showed posterior femoro-insert contact points on the lunging forward and stress views.

This study demonstrates that the PCL functions clinically well in the long term as evidenced by the sustained consistency in Knee Society scores, absence of clinically appreciable laxity in the sagittal plane (94%) as shown by the use of the KT 1000 arthrometer and stress radiographs. The MRI scans have further demonstrated the presence of the PCL in 86% of the knees. These findings put forward an important case for retaining the PCL rather than sacrificing one of the strongest ligaments in the body to achieve a near normal knee.

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