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Functional and radiological outcomes of posteriorly stablised total knee joint arthroplasty

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Abstract:

BACKGROUND: To prevent posterior subluxation of the tibia and to improve both range of motion and stair climbing ability, the TCP was modified to the Insall Burstein Posterior Stabilized Prosthesis (IB I) in 1978. The posterior-stabilized condylar knee was specifically designed to improve stair-climbing ability and range of motion and to prevent posterior tibial subluxation.These goals were certainly achieved with the new"cruciate- substituting" design.

PATIENTS&METHODS: We prospectively studied 30 patients who are randomly selected underwent PS/TKA.The mean age of the patients at operation was 63 years (4975 years) and mean follow-up was 12 months range (3-18 months).The diagnosis of causative disease was OA (24 knees, 3 of them posttraumatic) and the rest 6 knees were RA. All knees were unstable (10 knees in multidirections, 16 in AP. and 24 in mediolat. dierections) and malaligned (23 varus, 7 valgus). The clinical and radiographic results were assessed using the scoring system described by Insall et al.(1989) and the parameters described by the Knee Society Score (Ewald 1989). Preoperatively, anteroposterior weight- bearing radiographs were taken in order to determine lower extremity alignment. Postoperative radiological assessment was performed from weight-bearing anteroposterior and supine lateral radiographs taken at every visit on flow up.

RESULTS: At latest visit, 9 knees (30%) had an excelent result, 18 knees (60%) had a good result and 3 knees (10%) had a fair result. The improvement in the mean Knee Society Score was from 31(OA:49/RA:33.5) points preoperatively (range 25-55 points) to 89 (OA:89/RA:86) points postoperatively (range 77-95). The mean ROM (flexion) preoperatively was 68.5^{o} [OA:70^{o}/RA:45^{o}] (range 45^{o}-100^{o}) was improved to 106^{o} [OA:110^{o}/RA:90^{o}] (range 90^{o}-120^{o}). All were stable in AP direction and in 4 patients (13.3%) a slight instability was noted in the lateral direction. The ideal position for femoral component within (6-10^{o}) valgus was obtained in 24 knees (80%). The femoral prosthesis was within (0-5^{o}) valgus in 6 knees (20%). Ninety three percent (28) of the tibial component were within 2^{o} of varus or valgus, 6.6% (2 knees) was in greater than 2^{o} of varus. Knee function score was improved from a mean 27.5 (OA:26/RA:25) points preoperatively to 58 (OA:59/RA:55) points postoperatively and the patient able to walk more than 5 blocks(1/2km) and less than 10 blocks(1km).

CONCLUSIONS: Posterior stabilized total knee arthroplasty would allow increase range of motion, increase joint stability and improved gait. Because OA and RA are the predominant knee diseases, one could see that both OA and RA patients respond well to treatment with PS/TKA with the same end results. These clinical results on short-term basis are encouraging and justify continuation of its use. We strongly recommend the use of a cemented, posterior stabilized total knee arthroplasty for primary total knee arthroplasty.

Keywords:TKA, Posterior stabilized, IB-II, functional outcome.

Introduction:

The posterior-stabilized condylar knee prosthesis is one of the many successful condylar prostheses developed at the Hospital for Special Surgery.(1) It was introduced as a modification of the total condylar knee prosthesis, which has been called the "gold standard" for total knee arthroplasty longevity(2) (Fig.1.1). In 1978, the posterior-stabilized condylar knee prosthesis was first implanted at the Hospital for Special Surgery. The most recent clinical survivorship studies prove that its durability has surpassed that of the total condylar knee prosthesis.(3) The posterior- stabilized condylar knee prosthesis has since undergone many subtle design changes, with each modification incorporating the merits and eliminating the weaknesses of the preceding design.

The posterior-stabilized condylar knee prosthesis is similar to the total condylar knee prosthesis in that both technically require excision of both cruciate ligaments for prosthesis implantation, however, the posterior- stabilized condylar knee prosthesis is radically different. It is a "posterior cruciate ligament-substituting" prosthesis, which has a tibial and femoral component articulation, that allows for femoral rollback during knee flexion.

This "posterior cruciate ligament-substituting" mechanism makes the posterior-stabilized condylar knee prosthesis both clinically and mechanically a better prosthesis choice for patients requiring a total knee arthroplasty. The Insall-Burstein I was the original posterior-stabilized condylar prosthesis developed at the Hospital for Special Surgery and was the successor of the total condylar prosthesis (Fig.1.2). It was introduced as a modification of the total condylar prosthesis to specifically improve joint stability, range of motion, and ability to climb stairs. These goals were to be achieved with the use of a "posterior cruciate ligament-substituting mechanism." A transverse cam on the femoral component articulating with a central polyethylene post on the tibial component combined with a change in the center of curvature of the femoral condyles allowed for femoral rollback during flexion to improve motion and knee stability. In the original reports on the performance of the posterior-stabilized condylar prosthesis, these goals were indeed achieved.(5)

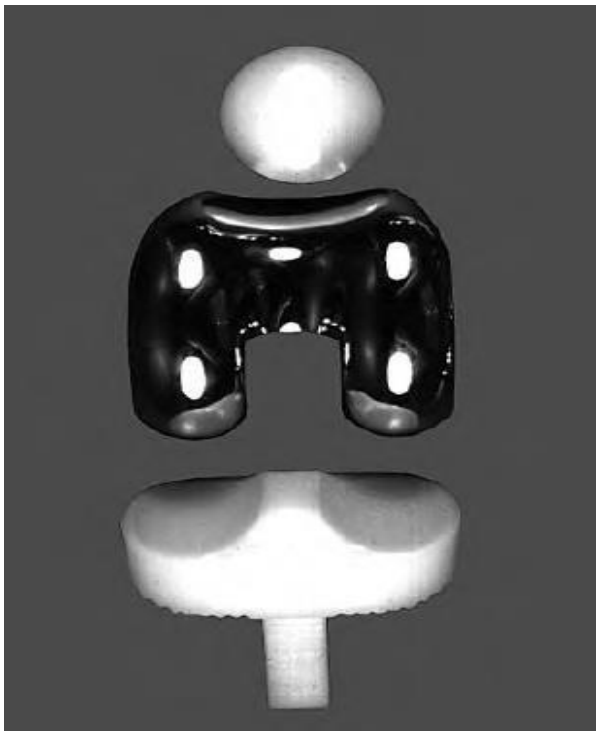


Figure 1.1. Total condylar prosthesis(Scuderi GR,and Tria AT:Surgical techniques in total knee arthroplasty;2002 springer-verlag.New York.P.68).

A major change to the posterior-stabilized condylar knee prosthesis came about in November 1980[6] , when a posterior-stabilized prosthesis with a metalbacked tibial component was first implanted at the Hospital for Special Surgery. It was determined that in the revision setting, the primary mode of failure had been the loosening of the tibial component due to poor cancellous osseous support of the tibial tray.[7]

As a result, metal backing was introduced into the tibial component to evenly distribute proximal tibial load to the tibial cortical shell rather than the proximal cancellous bed. Even in primary total knee arthroplasty with an allpolyethylene tibial component, the most frequent cause of failure is tibial loosening.[9] In one of the original series of total condylar knees with an all polyethylene tibia, Hood reported that two of the three failures that occurred were due to aseptic tibial component loosening.[12] In Stern's 9- to 12-year follow-up study posterior-stabilized condylar knee prosthesis with an all- polyethylene tibial component,[13] there were twice as many aseptic failures on the tibial side as compared to the femoral side. Additionally, fewer radiographic lucencies have been reported around metal-backed tibial components compared to all-polyethylene tibial components.

In Colizza's 10-year follow-up of posterior-stabilized condylar knee prosthesis with a metal-backed tibial component,[10] nonprogressive lucencies were reported in only 10% of cases. Contrast this with the 49% incidence of radiolucencies in Stern's 9- to 12-year

follow-up of posterior- stabilized condylar knees with an all-polyethylene tibial component. The tibial polyethylene insert was also significantly changed to enhance knee flexion by shortening the tibial post by 2 mm and translating it posteriorly 2 mm.(11)

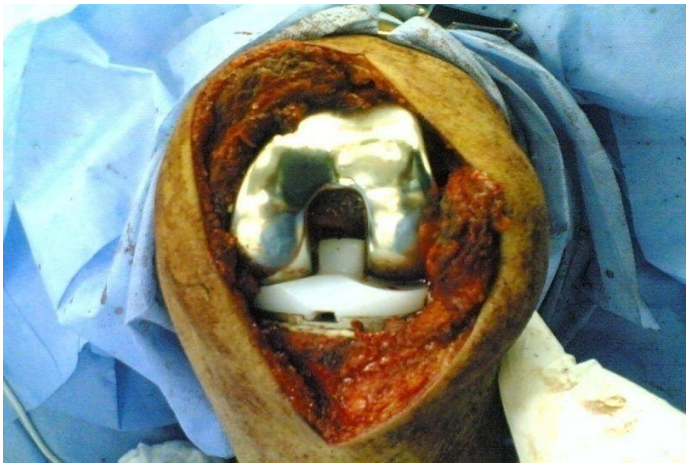
1. Patients&Method

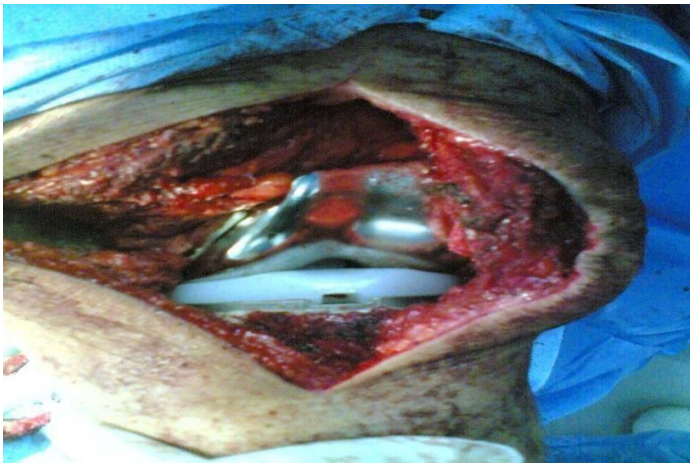
A prospective study from January-2010 to June-2011 of 30 patients who are randomly selected underwent PS/TKAs at nursing home hospital. There were 12 (40%) males and 18 (60%) females, the mean age of the patients at operation was 63 years (range 49-75 years) and mean follow-up was 12 months range (3-18 months). The causative disease was OA in 24 knees (3 of them posttraumatic) and the rest 6 knees were RA. All (30) knees were unstable, 16 in anteroposterior direction (assessted clinically by allowing the examiner to place a posterior force on the tibia in different positions) and 24 in mediolateral direction (is measured by the maximum degree of alignment change to varus/valgus stress) and 10 knees unstable in multidirections.

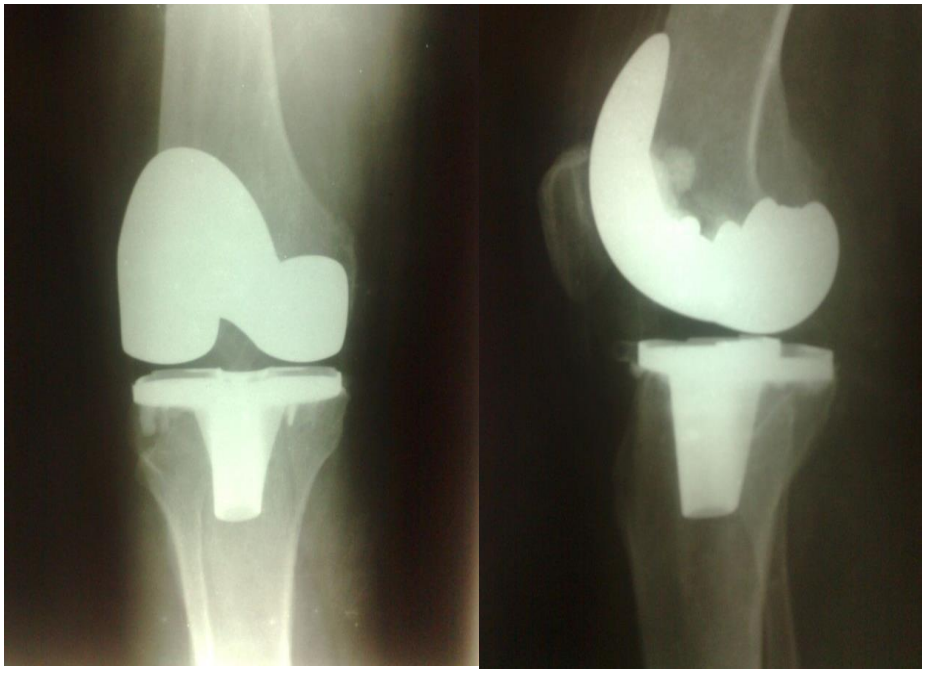
Malalignment deformities were 23 knees varus and 7 knees valgus. The mean ROM (flexion) preoperatively 68.5^{o}(range 45^{o}-100^{o}) and extention lag (5-15^{o}) mean 8^{o} preoperatively.

The operation which was performed by two different surgeons, under general anaesthesia and supine position and applying pneumatic torniquet to the upper thigh with flexion of knee to allow lengthening of quadriceps muscle, preparing and draping the limb, through anterior midline skin incision and then a medial parapatellar arthrotomy, aimed to achieve correct limb alignment, good stability, normal patellar tracking and a good range of movement. A third generation cephalosporine was given to all patients, starting at the induction of anaesthesia and continuing into the postoperative period for 5 days. Anticoagulation with low molecular heparin began 6 hours after the operation and continued for two weeks postoperatively. Every knee was supported with Robert Jonse dressing in extension for 48

hours, but static quadriceps exercises were started without delay in bed, next day postoperative patient encouraged to walk with aid of walker with partial weight-bearing.The mean length of hospital stay was 5 days.







Figer 1-2 A&B peroperative photos show PS prosthesis in flexion A,and B,in extention and C,postoperative X-Ray for 58yrs old male with OA underwent PS/TKA.

RESULTS

1. Results of Knee joint score

Preoperatively: the mean knee joint score was 31 points[OA 49 points, RA 33.5 points] (range 25-55 points).The mean preoperative knee flexion was 68.5^{o} [OA 70^{o},RA 45^{o}] (range 45^{o}-100^{o}). All patients had painful deformed knee that failed to respond to conservative measures.

Preoperatively, 54% of the knees were unstable in anteroposterior (AP) direction (16 knees). In the lateral direction, the figures were preoperatively 80% (24 knees) and 10 knees (33%) unstable in multidirections.

Postoperatively: The mean postoperative knee joint score was 89 points [OA 89, RA 86] (range 77-95 points). Nine knees (30%) had an excelent result, 18 knees (60%) had a good result and 3 knees (10%) had a fair result table (4).

Pain was markedly relieved by the endoprosthesis operation. The mean postoperative knee flexion was 106^{o} [OA 110^{o}, RA 90^{o}] (range 90^{o}-120^{o}). Extension lag was reduced from a mean of 8^{o} to 3^{o} . At the latest visit all were stable in AP direction by merit of the constrained (posterior) design of the implant. In 4 patients (13.3%) a slight instability was noted in the lateral direction.(table.3)

Table-3:Clinical and radiological results of 30 knees replacement using PS/TKAs.

		PREOPERATIVELY	POSTOPERATIVELY	
Mean Knee joint score		31	89 points	
MeanKnee function score		27.5	58 points	
Mean knee flexion		68.5^{o}	106^{o}	
Mean Extension lag		8o	3o	
Instability	AP	16	_	
	Multidirec.	10	_	
	lateral	24	4	
alignment	varus	23	4(13%) (3-5) degrees varus.	
	valgus	7	26(87%) (3-7) degrees valgus	
component position	femoral component		6-10^{o} valgus	24
			0-5^{o} valgus	6
	tibial component		over 2^{o} varus	2
			2^{o} varus to 2^{o} valgus	28
			over 2^{o} valgus	_

1. Results of Knee function score

Knee function scores did not improve as clearly as joint scores; some improvement in function was recorded. (table 3)

Preoperatively : the mean knee function score was 27.5 points [OA:26 points/ RA:25 points] (range 5-60 points). 80% of the patients were preoperatively required walking aids.

Eight of the patients (26%) were preoperatively able to climb up stairs, but were unable to descend.

Postoperatively: the mean function score was 58 points [OA:59 points/ RA:55 points] (range 45-60 points). Twelve patients used a cane or crutches for walking at the latest review. In both OA and RA patients were able to wallk 5-10 blocks (500-1000 metres).

2. Radiographic results

Preoperatively: most knees were in gross (over 14 degrees) deformity, 77% varus(23/30) & 23% valgus (7/30).

Postoperatively: most (26/30) were in (3-7 degrees) valgus, and (4/30) were in (3-5) degrees varus.

The ideal position for femoral component within 6^o-10^o valgus was obtained in 24 knees (80%). The femoral prosthesis was within 0^o-5^o valgus in 6 knees (20%).

Nintey three percent (28 knees) of the tibial component were within 2^o of varus or valgus, 6.6% (2 knees) were in greater than 2^o of varus.(table.3)

There were no evidence of any radiolucent lines around the femoral component. There were no radiolucent lines beneath the tibial prosthesis in 21 knees (70%), in another 9 knees (30%) there were incomplete, non progressive less than 1mm in thickness limited to intereface beneath the medial tibial plateau.

Discussion:

Arguments which suggested that retention of the posterior cruciate ligament during total knee arthroplasty would allow better range of motion, better joint stability, more normal gait, and enhanced prosthetic longevity have not been supported by the latest clinical and basic science research. In the United States there has been a marked increase recently in the use of posterior stabilized prostheses for primary total knee arthroplasty. That shift toward the posterior stabilized knee is reflected in the experience of one of the largest orthopedic centers, the Mayo Clinic. In 1990 less than 10% of all primary total knees at the Mayo Clinic were of a posterior stabilized design. By 1997 the posterior stabilized design was used in 75% of all primary total knee replacements.[14]

The posterior-stabilized condylar knee was specifically designed as a modification of the total condylar prosthesis to improve stair-climbing ability and range of motion and to prevent posterior tibial subluxation.

The posterior sloping of the tibial plateau and the cam-like action of the central build up on the tibial component enhances the anteroposterior stability and provides an increased range of knee motion.[15-18]

In our study, most patients are old age (mean 63 years) with low knee and function scores, instability (AP. and medoilat.) and malalignment (varus or valgus) and flexion contracture.

The use of Poserior-Stabilized prosthesis in TKA in treatment of those patients whoe are having real limitations because of advanced OA, deformity and instability gave us more flexibility in treatment and correction of these problems and deformities and encouraged us and the patients to treat the other limb.

We can discuss our findings according to different parameters as follows;

Knee Society Score:

In our study 90% excellent or good and 10% fair results were obtained at a mean follow up of 1 year, patients were completely relieved from pain with good range of motion and stable functioning knee joint. These results are comparable (despite our shorter follow up period) with Insall-1992 et al. reported 88% excellent and 9% good results using the posterior stabilized (PS) prosthesis at 2-4 years follow up[19] and Colizza, et.al. 1995, reported 74% excellent , 22% good results, zero fair and 4% poor results using Insall Burstein posterior-stabilized knee at average 10 years follow up.[19]

On the rating system of the Knee Society, our mean knee score at a mean of one year was 89 points compared with 92 points for the series of Colizza- 1995. et al,[20] while the corresponding mean functional scores were 58 and 71, reflecting the increasing age and frailty of our patients.

Conclusion:

The posterior-stabilized condylar knee prosthesis is one of the many successful condylar prostheses developed .Excellent and good results are achieved in knee score. Increase in flexion and range of motion is obtained and enhancement in walking distance and climbing stairs and pain relief are maintained. The enhanced stability provided by posterior stabilized prosthesis is useful for correction of severe deformities.

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