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The Result of PFC (press-fit condylar) Total Knee Replacement Arthroplasty*

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=Abstract=Total knee replacement arthroplasty (TKA) has given the opportunity for relief of pain and for improvement of function to patients with knees disabled by osteoarthritis and rheumatoid arthritis. The purpose of this study was to evaluate the interim result of press-fit condylar (PFC) total knee replacement arthroplasty performed on 44 knees in 29 patients at Seoul National University Hospital from Jan 1988 to Oct 1989. There were three males and twenty-six females with the mean age at surgery 61.0 years. The mean follow-up period was 1 year 5 months. Twelve of twenty four patients who had osteoarthritis underwent bilateral TKA. Three of four patients who had rheumatoid arthritis underwent bilateral TKA. One patient had ankylosis of the knee following pyogenic arthritis.

Good or excellent results were obtained in 39 (88%) knees. Pain relief was remarkable. But, the increase of the range of motion was not signigficant although the flexion contractures were corrected successively. Complications included mild to moderate joint effusion in 6 knees and superficial infection in 2 knees.

Key Words: *Press-fit condylar, Knee, Arthroplasty*

INTRODUCTION

Total knee replacement arthroplasty (TKA) has contributed to the pain relief and restoration of joint function for the knees destroyed in the disease processes of osteoarthritis, rheumatoid arthritis, and others. Many surgeons tend to prefer less constrained designs to constrained types these days, and cementless TKA has also been tried recently for younger patients.

Press-fit condylar (PFC) TKA is a model of cruciate-retaining artificial joint capable of cementless application with advanced material and design (Scott, 1989). The authors report the interim results of PFC total knee replacement arthroplasty performed on 44 knee joints in 29 patients.

MATERIALS AND METHODS

During the period of January 1988 to October 1989, PFC total knee joint replacement arthroplasty was performed on 44 knees in 29 patients at the Department of Orthopedic Surgery of Seoul National University Hospital, Seoul, Korea. The mean age at surgery was 61.0 years, ranging from 32 years to 72 years. There were 26 females and 3 males, and the mean follow-up period was 17 months, ranging from 13 months to 29 months. Thirty-six joints in twenty-four patients were affected

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by osteoarthritis, seven joints in four patients by rheumatoid arthritis, and one joint had ankylosis following pyogenic arthritis (Table 1).

Table 1. Diagnosis of Patients

Diagnosis	No. of patients		No.
	bilateral	unilateral	of knees
DA	12	12	36
RA	3	1	7
Other	0	1	1
Total	15	14	44

The authors used the knee rating score of Hospital for Special Surgery for the preoperative and postoperative evaluation of the knee joint function. The full score of the system is 100 points: pain, 30 points; function, 22 points; range of motion, 18 points; muscle strength, 10 points; flexion deformity, 10 points; and instability, 10 points. Subtractions are made when the patient uses cane or crutch, or when he has extension lag, varus, or valgus deformity. We considered the joint excellent when the total score ranged from 85 to 100 points, good from 70 to 84, fair 60 to 69, poor under 60 points (Table 2).

Table 2. Clinical Evaluation: Hospital for Special Surgery Scoring (1976)

	Pain at walking, rest	30	points
	Function	22	
	Range of motion	18	
	Quadriceps power	10	
	Flexion deformity	10	
	Instability	10	
Result	Excellent	85-100	points
	Good	70-80	
	Fair	60-69	
	Poor	0-59	

Detailed history taking and physical examination were carried out preoperatively and at postoperative follow-up. The range of motion and the degree of both flexion contracture and varus or valgus deformity were measured by goniometer. For radiographic evaluation, the tibiofemoral angle was measured using the standing anteroposterior radiograph by the method of Bauer or using the supine radiographs if the patient was unable to walk or had severe flexion contracture. The position of components of artificial joints and changes during the interval were evaluated with both anteroposterior and lateral radiographs.

Appropriate size of components was determined using the plastic templates. Skin traction of four to five pounds in weight was applied to 7 joints with flexion contracture above 30 degrees for three or four days prior to surgery. Broad spectrum antibiotics were administered parenterally from 8 hours preoperatively to 72 hours postoperatively.

Ten arthroplasties had cement fixation for femoral, tibial, patellar component, while thirty-two arthroplasties had cement fixation for tibial and patellar component. Totally cementless arthroplaties were performed in two joints that had good quality of subchondral bone.

Compression dressing and long-leg splint were applied postoperatively. Patients started active range of motion exercise from the 5th postoperative day followed by passive range of motion as soon as further flexion increased beyond 70 degrees. Partial weight bearing was encouraged when active straight leg raising was possible.

RESULTS

There were not any knees which had excellent or good function according to the scoring system preoperatively. 19 knees (44%) had fair function, 25 knees (56%) poor. But, 19 knees (44%) had excellent function, 20 knees good (45%) postoperatively. 5 knees (11%) had fair result. The average score improved from 47.2 preoperatively to 83.1 postoperatively (Figure 1). The improvement was greater in rheumatoid knees (from 34.8 preoperatively to 76.2 postoperatively) than in osteoarthritic knees (from 50.1 preoperatively to 85.0 postoperatively). In 19 younger patients, below the age of 60, the average knee score was from 43.7 preoperatively to 80.5 postoperatively, and in 25 patients over the age of 60, the average knee score was 49.9 preoperatively to 85.3 postoperatively.

The mean flexion contracture was decreas-

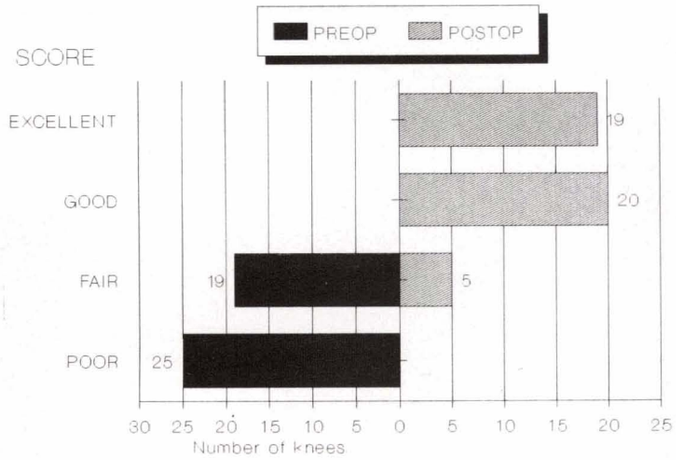
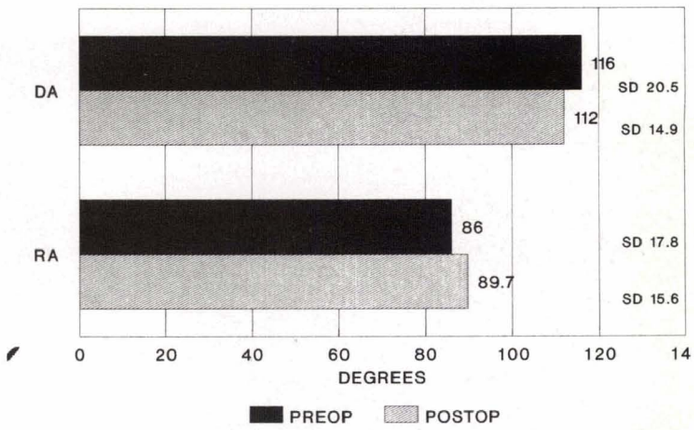
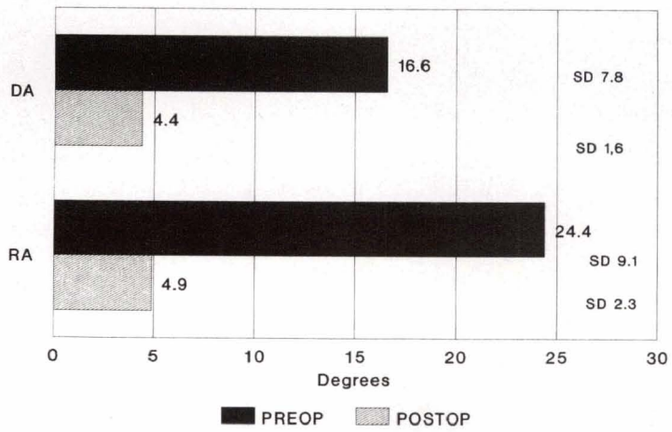


Fig. 1. In the overall result, all the patient showed fair or poor function preoperatively. Postoperatively 39 knees showed excellent or good function.



DA = Degenerative arthritis RA = Rheumatoid arthritis

Fig. 2. The mean range of motion did not show significant change postoperatively.



DA = Degenerative arthritis RA = Rheumatoid arthritis

Fig. 3. The mean flexion contracture improved markedly postoperatively.

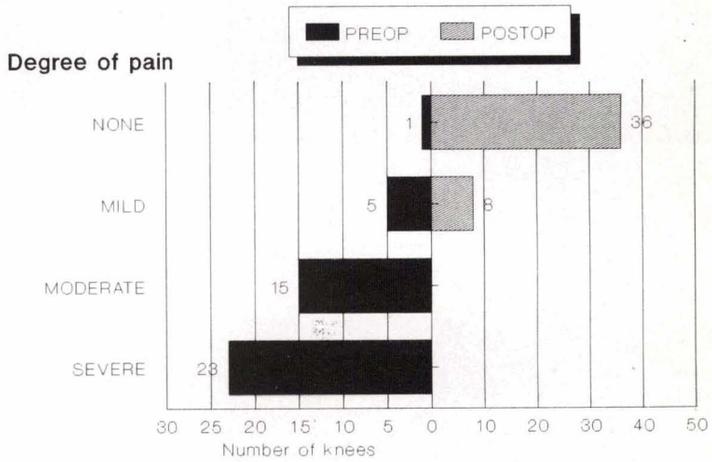


Fig. 4. The pain at walking improved markedly.

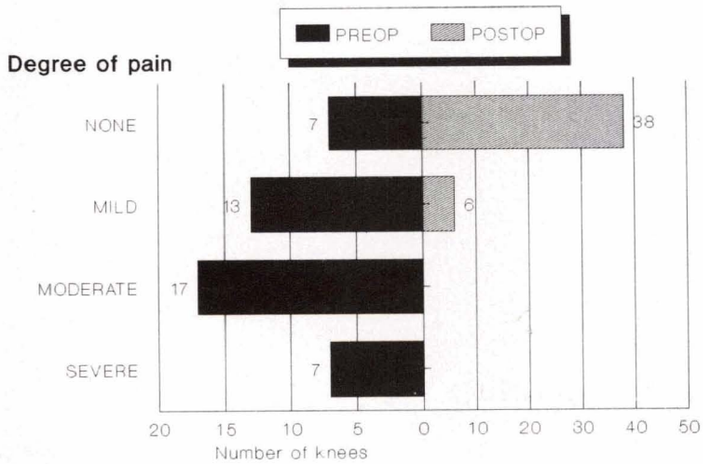


Fig. 5. The pain at rest improved markedly postoperatively.

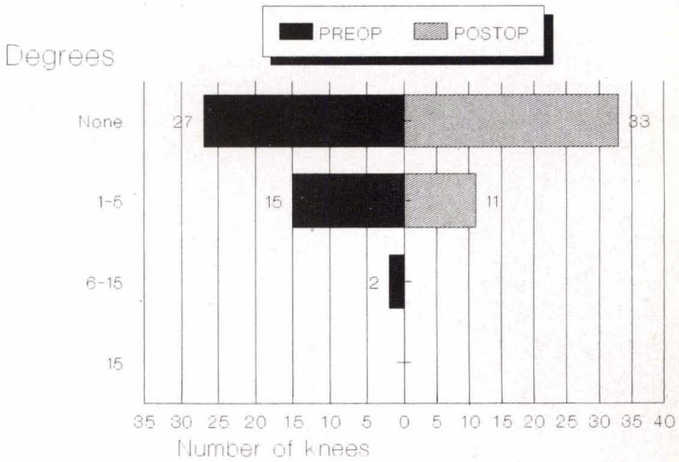


Fig. 6. The instability improved postoperatively.

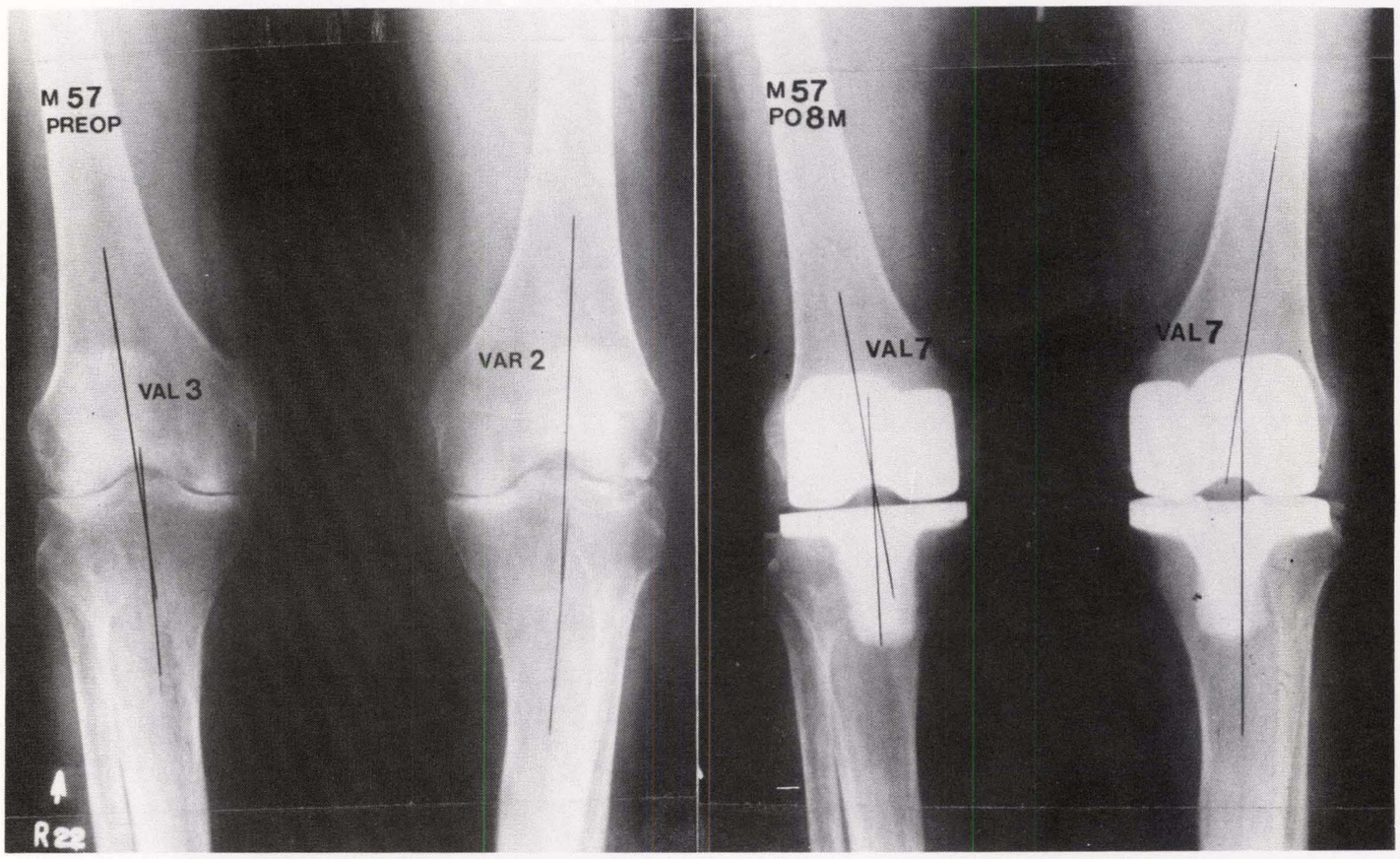


Fig. 7. Preoperative X-ray shows joint space narrowing and diffuse osteoporosis. At 8 months after surgery, X-ray shows good alignment.

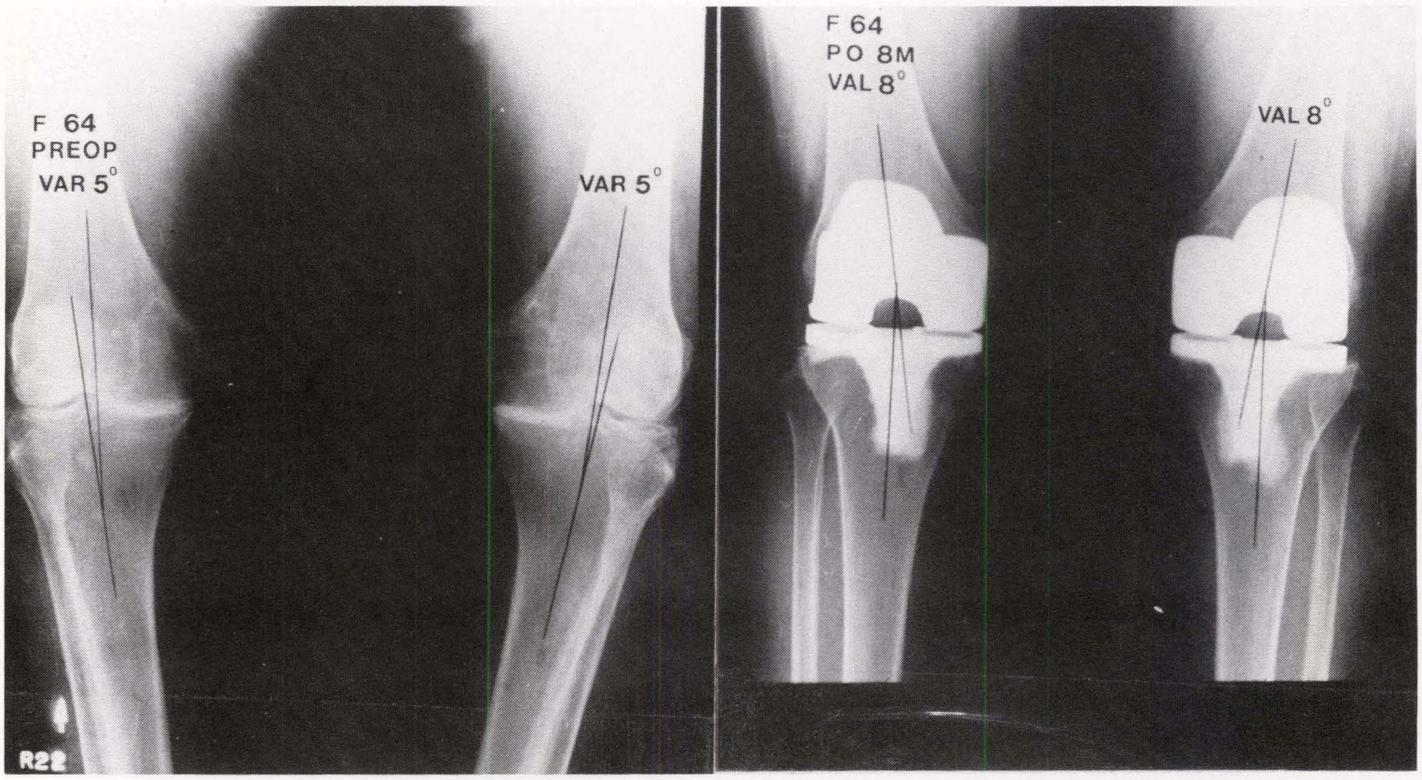


Fig. 8. Preoperative X-ray shows degenerative changes and varus deformity. At 8 months after surgery, tibiofemoral angle is within normal range.

ed from 18.1 degrees ranging from 0 degree to 45 degrees (osteoarthritic knees 16.6 degrees, rheumatoid knees 24.4 degrees) preoperatively to 4.5 degrees ranging from 0 degree to 30 degrees (osteoarthritic knees 4.4 degrees, rheumatoid knees 4.9 degrees) postoperatively. The range of motion was not changed significantly with 110.0 degrees (osteoarthritic knees 116.0 degrees, rheumatoid knees 86.0 degrees), and the postoperative mean 106.6 degrees (ostearthritic knees 112.0 degrees, rheumatoid knees 89.7 degrees) postoperatively. Of 5 joints that had severe flexion contracture (more than 30 degrees) preoperatively, 4 joints showed the flexion contracture less than 10 degrees postoperatively (Figure 2,3). Moderate to severe pain was complained at walking in 38 joints (86%) and at rest in 24 joints (55%) preoperatively, but no or mild pain was observed in all patients postoperatively (Figure 4,5).

Mild (from 1 to 5 degrees) or moderate (from 6 to 15 degrees) anteroposterior or mediolateral instabilities were present in 17 knees preoperatively, of which eight of them showed improvements postoperatively (Figure 6).

The mean tibiofemoral angle was 4.0 degrees varus preoperatively, but 5.6 degrees valgus postoperatively.

There were not any major complications except joint effusions in 6 joints and superficial infections in 2 joints. The effusions were mild to moderate in amount, which usually lasted upto 6 months. But of course all effusions were absorbed spontaneously without specific treatment. Superficial infections could be managed conservatively.

CASE ILLUSTRATIONS

Case 1

A 57-year-old man was unable to walk and showed flexion contractures of 10 degrees and further flexions of 80 degrees at both knees. He had suffered from rheumatoid arthritis for 20 years. He underwent TKA on both knees at two separate times. Postoperatively he had no flexion contractures of the knees and the range of motion was improved 110 degrees on right and 115 degrees on left. Tibiofemoral angles measured were within normal range postoperatively. He is now able to walk with crutches (Figure 7).

Case 2

A 64 year-old women had severe difficulty in walking. She had flexion contractures of 10 degrees at both knees with further flexions 108 degrees on right and 105 degrees on left. Preoperative X-ray showed severe degenerative changes and the tibiofemoral angles were 5 degrees of varus at both knees. TKA was performed on both knees at the same setting. Postoperatively flexion contractures disappeared with further flexions 110 degrees on right and 115 degrees on left. Tibiofemoral angles were within normal range postoperatively (Figure 8).

DISCUSSION

Marked advancements have been made in the total knee replacement arthroplasty for the last fifteen years with the improvements in the implant design and surgical techniques.

The stability of the knee joint depends more on the soft tissue and the coordinated balance of incongruous joint rather than on the intrinsic stability as seen in the hip joint, so the difficulties arise in the design of artificial joint (Insall, 1984). In 1940's. Boyd, Campbell, and Smith-Peterson tried hemiarthroplasty (Insall, 1984; Scott, 1982), and in 1950's, Wallidus and Shier (1965) tried fully constrained arthroplasty, but they frequently failed due to higher rates of limited motion, loosening, and infection. Gunston developed a minimally constrained model in 1971, which became the prototype of prostheses currently used (Gunston, 1971).

The majority of prostheses frequently used today is semi-constrained type, and the arguments as to whether prostheses should spare the posterior cruciate ligament or not have been largely resolved since satisfactory results are reported (Freeman, 1977; Lew, 1982) in both methods. Murray (1965) reported that results could be significantly improved with the use of some form of stem on the tibial component with metal backing of the tibial polyethylene component. A flange for articulation with the patella is standard, and the resurfacing

of patella with a polyethylene button has almost become standard as well (Murray 1985).

The press-fit condylar knee was designed and developed in 1984, and it is primarily a cruciate retaining system with addressed refinement in metallurgy and design. The femoral component is made of chromium-cobalt alloy with its proven characteristics articulating with high density polyethylene. The tibial and patellar component are metal-backed with titanium alloy, which decrease wearing through the polyethylene surface. The trochlear flange is designed to maximize capping of the prepared trochlear surface while minimizing soft tissue impingement. The thickness of condyle is only .8 mm and therefore requires minimal bone resection for any given outer dimension of the component. The femoral fixation lugs of the beaded component are not porous coated, reducing the potential for stress concentration in this ares and facilitating the extraction of component if necessary in the future, and the lugs taper at a 3-degree angle to enhance their fixation. The central stem of the tibia is a cruciate-shaped keel that is slightly tapered and permits press-fit application into nonosteoporotic bone, and provides a large surface area to buffer varus/valgus, anteroposterior, and rotational force while minimizing the required amount of bone resection (2 times lesser resection and 2 times more surface area compared with rectangular stem). The nonporous surface also decreases the potential for peripheral stress-shielding. In patellar component, three peripheral lugs are used for fixation, eliminating the need for a central fixation hole where a stress-riser can cause a postoperative patellar fracture. The central convexity of the polyethylene articulates with the convexity of the trochlear groove with the knees in extension, and peripheral concavities articulate with the convexity of the distal femoral condyles in flexion, maximizing metal to plastic surface contact as the patellofemoral forces increase (Scott 1989).

As Laskin (1989) dilated, the amount of range of motion did not change significantly after total knee replacement in our series. The postoperative range of motion decreased by 4 degrees in osteoarthritic knees, whereas increased by 3.7 degrees in rheumatoid knees. The mean flexion contracture was 18.1 degrees preoperatively, and it was more severe in rheumatoid knees than in osteoarthritic knees. It was reduced down to 4.5 degrees in average postoperatively, providing useful range of motion in most patients. The importance of axial alignment has been emphasized by several authors, and inappropriate alignment is considered to be a cause of loosening. Kettlecamp (1973) defined the appropriate postoperative tibiofemoral angle as 7 degrees valgus, but Lotke and Ecker (1977) thought the angle satisfactory if within 3 to 7 degrees valgus. The accurate amount of femoral and tibial bone resection and soft tissue release are required to obtain desired alignment. If varus or valgus deformity is due to soft tissue contracture, deformity correction by bone resection should not be tried (Laskin,1989). In authors's series, preoperative tibiofemoral angle ranged from varus 15 degree to varus 7 degrees, and it was from varus 3 degrees to valgus 7 degrees postoperatively. The correction of mean tibiofemoral angle was 9.6 degrees. Instability could be reduced in 15 of 17 knees by deformity correction and adequate soft tissue release.

The reported complications of TKA include thromboembolism, delayed wound healing, infection, limitation of motion, instability, fracture, quadriceps weakness, peroneal nerve palsy, loosening of prosthesis, wear or failure of implant, and patellofemoral pain (Crenshaw, 1987; Moreland, 1888). The incidence of thromboembolism varies from 27% to 57% with authors, and it is considered to be the first cause of death after TKA in United States, but there was not a single case in our series. Ecker and Lotke (1989) reported that problems of wound healing occured in 10 to 20% of patient after TKA, and that the high risk factors were malnutrition, diabetus, obesity, large amount of correction in deformity, previous knee surgery. The specific difficulty lies in the fact that joint motion should be started in the period of wound healing. There were 2 cases of superficial infection in the authors' series. This could be managed nonoperatively and was thought to be related to delayed wound healing. The peroneal nerve palsy occurs when the correction of flexion contracture or varus deformity is great, or when excessive compressive dressing is ap-

plied. Careful dissection of the nerve prior to soft tissue release or fibula head resection is of course required for prevention of peroneal nerve palsy. If it occurs, compressive dressing should be removed and knee joint should be flexed 15 to 20 degrees (Murray, 1985). In the authors' series, there was no single case of peroneal nerve palsy even when large amount of deformity correction was required, therefore, we believe that fine surgical technique and careful attention at surgery are mandatory to prevent the peroneal palsy. Infection signals the gravest prognosis among late complications, and the reported incidences are from 0.5 to 2 percents (Murray, 1985). There was no deep seated infection in the authors' series. We experienced the events of effusion, although not severe, persisted in 6 knees upto 6 months postoperatively, but was disappeared spontaneously with the passage of time without specific treatment. Recently, Wright and Scott reported two-to-four- year result of 114 cases of Press Fit Condylar TKA.

The problems of loosening, wear or failure of implant are related to the life span of artificial joint, and the research for a new better prosthesis purposes on solving those problems. Although the authors found no cases of loosening or implant failure as yet in this series, the follow up period is too short to discuss about these complications.

In conclusion, the short term results of the press-fit condylar TKA was promising and believed to be a good system for both pain relief and restoration of function for the disabled knees.

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=국 문 초 록=

Press-Fit Condylar 슬관절 전치환술의 임상결과

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성상철 · 임군일

슬관절 전치환술은 퇴행성 관절염과 류마치성 관절염에 의해 불구가 된 슬관절의 동통감소와 기능향상을 위해 시행되어 왔다. 본 논문의 목적은 1988년 1월부터 1989년 10월까지 서울대 병원에서 press-fit condylar(PFC) 슬관절 전치환술을 시행받은 29명을 대상으로 그 결과를 평가하기 위한 것이다. 환자들의 평균연령은 61.0세이었고 성별로는 남성이 3명, 여성이 26례이었으며 평균 추시기간은 1년 5개월이었다. 진단별로는 퇴행성 슬관절염이 24명이었고 이 중 12명은 양측에 슬관절 전치환술을 시행하였고 류마치성 슬관절염이 4명으로서 이 중 3명에서 양측 슬관절 전치환술을 시행하였으며 1명는 화농성 슬관절염의 후유증으로 인한 슬관절 강직이었다. 수술후 슬관절 지수는 수술 전 47.2에서 술후 83.1로 35.9의 평균 향상을 보였고 술후 44관절중 39관절(88%)의 기능이 우수 또는 양호에 속하였다. 술후 동통은 크게 감소하였으며 슬관절 운동범위에는 큰 변화가 없었으나 굴곡구축은 크게 감소하였다. 술후 합병증으로서 6관절에서 경도내지 중증도의 종창, 2관절에서 표재성 감염이 있었으나 보존적인 요법으로 치유되었다.