

## Result of Charnley Low Friction Arthroplasty in Old Tuberculosis of the Hip

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—국문초록—

진구성고관절결핵의 찬리저마찰인공고관절전치환술시술례에 관한 성적보고

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저자들은 1973년 7월부터 1978년 12월에 걸쳐서 임상적 및 X 선학적으로 진구성으로 판단되었던 60명의 고관절결핵환자에게 찬리저마찰인공고관절전치환술을 시술하였다. 그중 8년 이상 원격성적 추시가 가능하였던 20명의 환자에 관하여 보고 하고저 한다.

환자의 연령 및 남녀분포는 여자가 12명 남자가 8 명이고 최고 52세 최소 20세이며 평균 연령은 35세였으며 다음과 같은 결과 및 결론을 얻었다.

1. 진구성고관절결핵환자에게 인공고관절전치환술을 시술함에 있어서 가장 중요한것은 항결핵요법이라고 생각한다.
2. 보고한 증례를 찬리평가법으로 분석고찰해본결과 그중 50%의 환자에서 임상적 성공을 거두었으며 실패의 원인으로는 기계적 및 기타요인으로 사료된다.

**Key Words :** Hip, Charnley low friction arthroplasty, Tuberculosis.

### INTRODUCTION

The reported "standard" long-term results of total hip replacement arthroplasty are under much criticism because they differ depending on the design of the prosthesis, and the technical procedure and objective of the operation; possible sequela of a tuberculous hip require variations from accepted surgical technique. In addition, the anatomical distortion of a hip which had a tuberculous infection poses additional problems.

In fact, surgical treatment of tuberculous hip remained as a difficult problem and mostly arthrodesis has been accepted as a treatment of choice in the literature<sup>(22)</sup>. Contrary to these long term results, the authors had come to realise all activities of daily living require mobile hips and knees.

For this reason, we prefer to obtain a movable, stable and anatomically located hip. This goal can be achieved with reconstruction of the hip joint by low friction arthroplasty and this implied also for elimination of secondary changes in the lower lumbar spine as well as affected knee problems.

Johnson et al<sup>(24)</sup>, however, criticized surgery even after a lengthy period of quiescence. We have also found that a dormant infection was present in most of our series while performing LFA, despite the long absence of active infection. In the study, the clinical experience of first 20 hip procedures with 8-10 year follow-up will be subsequent to our previous publication<sup>(25)</sup>. Thus, we are presenting the study to show whether or not the results justify the operation.

### MATERIALS AND METHODS

From July 1973 to December 1978, low friction arthroplasties (LFA) were performed on sixty patients who were both clinically and radiographically judged to have quiescent tuberculosis at the hip joints. Most of these patients had histories of draining sinuses which had been arrested more than ten years previously. At the time of arthroplasty, however, most of the patients passed the “pseudoarthrosis test”, which indicated that the disability is so severe that a primary pseudoarthrosis would confer improvement in the clinical conditions (Fig. 1A-B).

In this study, twenty of those initial series were available for 8-10 years follow-ups and were analysed.

The remaining forty cases had rather favourable results and will be reported in the near future.

There were 12 women and 8 men with ages ranging from 20 to 52, with an average age of 35 years old. In the study, we have divided the cases into two groups: Group A consists of 12 quiescent tuberculosis without bony fusion and group B consists of 8 ankylosed hips. This latter group includes 7 cases where spontaneous fusion had occurred between 4 and 30 years of age and one case had valgus osteotomy while malposition of the spontaneous fusion (Fig. 2). On the other hand, one case of failed intra-articular fusion with poor posture was included.

Anatomico-pathological findings of these 20 cases were absolutely required when performing LFA. Although specimens for culture were taken routinely during the operation, they did not show any growth. However, 9 out of 20 cases in the presented series showed histological feature of tuberculosis. In addition, the bony trabeculae were thin and partially devitalised in most cases.

Concerning the method of reconstruction, the lateral approach to the hip joint, with a reflexion of the greater trochanter and re-attachment at the end of the arthroplasty, is a routine practice. Other-

**Fig. 1A-B. (AC-12):** 1A; 50 years old male with 29 years history of quiescent tuberculosis on the left hip. However, this patient is complaining of persistent pain in lower back and affected knee for 5 years. 1B; Radiograph made in August 1983, eight and half years after LFA. Clinically free of symptoms.

**Note:** Ectopic bone in medial aspect of upper femur seems to be effect of periosteal stripping for release of contractures at the time of surgery.

**Fig. 2. ABC (AC-20):** Twenty-nine year old female with onset for tuberculosis of the left hip at the age of 8, treated by anti-tuberculous drugs only resulted in spontaneous fusion with adduction, flexion deformities. Therefore, this patient underwent subtrochanteric valgus osteotomy at the age of 17. A; On the left radiograph taken prior to LFA. B; In the middle, 3 years after LFA. C; On the right, Radiograph was taken 8 years after LFA. Clinically, excellent results up to date.

wise, great increase in surface area of endosteal bone in the upper level of the medullary cavity should be employed<sup>(2)</sup> because of narrow femoral cannal often associated with old tuberculous hip, for which an optimal cement thickness could be utilized<sup>(26)</sup>. In this way, longevity of prosthetic life can be expected by central insertion of the prosthetic stems.

The release of soft tissue contracture was an essential preliminary step. It was obvious that division of the adductors and the iliopsoas was necessary in most cases. Soft tissue release of the tensor fascia lata at the level of the distal thigh was also beneficial in some cases<sup>(36)</sup>. It was expected that the medial soft tissue release could be used to increase the range of abduction and extension to an appreciable extent<sup>(25)</sup>.

On the other hand, resection of the capsule is

**Table 1.** Radiographic Lucency in 18 hips

	Actabulum	Femoral component
Absent	3	5
Incomplete	9 (Type-1)	12
Complete	4 (Type-3) 2 (Type-4)	1
1mm or less	7	12
2mm or more	8	1

**Fig. 3. ABC (AC-1):** Thirty-nine years old female, painful pseudoarthrosis was converted to LFA. **A;** On the left, radiograph made in 6 months after LFA. **B;** In the middle, 2 years after LFA. **C;** On the right, exceeding calcar resorption associated with physiological hypertrophy whereas pronounced demarcation of the acetabular component when last seen 10 years after operation. Numerical code at final review was 4.4.4.

essential in this type of surgery in addition to local Betadine to prevent recurrence of infection.

Radiographic findings of demarcation, lysis under the colour, and cortical hypertrophy around the femoral stem were analysed in detail in twenty hips during the latest follow up and some of them were compared with early post operative radiograms.

In the study, radiographic findings of acetabulum was recorded in an attempt to classify the types of demarcation in relation to load bearing quadrants<sup>(11)</sup>. Radiographic demarcation of the femoral stem was also recorded in four zones (upper lateral, upper medial, lower lateral, and lower medial). Radiolucency was recorded as absent, complete, or incomplete. The size of the demarcation was measured and recorded at 1mm or less and 2mm or more (Table 1). The progression of the size of the demarcation was also observed (Fig. 3).

In the study, wear of the acetabular socket was measured with "Uniradiographic" method (Charnley and Cupic 1973) but sixteen out of twenty hips were available because of four cases of early or late infection were excluded for this study.

The study also included two cases of unusual radiographic features with remained dried abscess.

**Fig. 4. (AC-18):** Twenty-nine years old woman, tuberculosis of the left hip at the age of 8. On the left: Pre-operative radiograph shows 'carries sicca' in both acetabular and proximal end of the affected femur. **A;** Dried caseous abscess is demonstrable at lateral to the upper femoral shaft. **B;** In the middle: Anterior dislocation was occurred 10 days after operation when she tried to lay down on the sound hip. **C;** On the right: Fracture of the distal stem level was occurred accidentally after 10 weeks following LFA.

These two patients had similar radiological feature and we attempted to preserve these late effect of tuberculosis (Cheesy matter) very carefully in situ and Charnley LFA were performed by conventional technique. Despite of early complications, clinical success was remained (8 years follow-ups in both). Nevertheless, few relevant literature was available whether these remained caseous abscess may cause reactivation or not (Fig. 4). For this reason, biopsy was undertaken one of these patients for histopathological with bacteriological confirmations in addition to guineapig inoculations. The drug regime we used consisted of Rifampicin, Isoniazide and Ethambutol for the first 6 to 9 months after, and three weeks prior to the operation, with the modified drug regime as shown in Table 2, which is based on short course chemotherapy<sup>(14,15,16,23)</sup>.

## RESULTS

Defective wound healings were occurred in five out of twenty hips and these were related with late complications. In two of these, one was a recurrence of tuberculosis in early post-operative period (AC-5) whereas the other had draining sinuses from the wound produced coagulase negative staphylococcus aureus on culture (AC-6).

Both patients were given appropriate antibiotics in sufficient time but wound was healed only in one patient. In that case, the wound was healed five months after restarting the anti-tuberculous drug regime.

In the other case, despite of several wound debridements, wound has not been healed (AC-6). Therefore, resection arthroplasty as well as removal of whole prosthetic components was undertaken one year after the LFA was performed. One year later, we had re-inserted both pro-

sthetic components and the patient has fairly good condition up to now.

On the other hand, late infection has occurred in three out of twenty hips with inclusion of one case of the reactivated tuberculosis. In all of these three cases, deep infections were identified between three to four years by clinical and radiographical manifestation (AC-7, AC-14, and AC-19). They were treated with Girdlesetone procedures in two patients (AC-7, AC-14) and radical debridement and direct exchange of the acetabular component was performed in one patient.

The average amount of H.D.P. socket wear was recognised as 4mm at the eight to ten years follow-ups and the amounts of wear were 2mm to 4mm in most of our presented series. However, one of these patients showed remarkable wear as much as 8mm after eight years.

In addition, one case of fatigue fracture of the femoral component was observed nine years after LFA and was treated by revisional surgery with Charnley P.I.Z. flanged acetabular cup and revisional stem (AC-9). Table 3 shows major complications (during the past 8-10 years follow-ups).

Grading the quality of the hip joint by a numerical code provides a mean of comparing the states before and after operations. The method modified by Charnley is utilized and follows that of Merle d'Aubigne and Postel<sup>(31)</sup>, which grades the hip by three sets of numbers from 1 to 6, pain being graded the first set, walking function by the second and the total range of movement by the third: the figure 6 represents the normality. The addition of decimal figures indicates the predominant grading within a group<sup>(20)</sup>.

The average grading of the twenty hips before arthroplasty and at six to twenty-four months after LFA and final review are shown in Table 4.

**Table 2.** Pre and post-operative chemotherapeutic regime

Drug	Dose	Method of administration
Rifampicin	15mg/kg to a maximum of 600mg/day	Oral, single dose 1/2 hr before breakfast
Isoniazide	10mg/kg to a maximum 300mg/day	Oral, single or divided dose
Ethambutol	25mg/kg for 60 days then 15mg/kg	Oral, single dose is preferred only in past history of INAH and streptomycin
Kanamycin	1g	Mixed with 40g methylmetacrylate polymer

**Table 3. Complications**

	No. of patients
A. General	0
B. Local	
Defective wound healing	5 (AC-5, 6, 7, 14, 19)
Ectopic bone formation	2 (AC-11, 12)
Deep wound infection (Confirmed)	3 (AC-6, 7, 19)
Deep wound infection (Reactivation of TB. Confirmed)	2 (AC-5, 14)
C. Technical	
Dislocation	2 (AC-2, 18)
Fracture upper femur	1 (AC-18)
Perforation of shaft	2 (AC-4, 9)
Femoral nerve palsy	1 (AC-4)
D. Mechanical failure	
Loosening and loss of fixation	5 (AC-1, 4, 5, 10, 15)
Fatigue fracture, stem	1 (AC-9)

**Table 4. The average numerical grading of the 20 hip before and after low friction arthroplasty**

	Pain	Function	Movement
Before operation	2.8	2.4	1.9
After operation			
At 6 to 24 months	5.8	4.2	4.3
At review (8-10 yrs)	4.5	4.4	4.1

### 1) Pain

The average grading of the twenty hips before arthroplasty was 3. There were also symptoms affecting the back and knee in most cases. The average grading of pain was 2.9 for Group A and 2.5 for Group B. Significant improvement was noted in the period from six to twenty-six months after operation. Pain levels were reduced to the grade 6 in five hips and to 5 in 13 hips. There were only two cases with grades less than 5.

However, an average of 4.5 for the latest review at 8-10 years follow ups was somewhat worse than average of 5.2 at the first review. Apparently, these were due to failures of the prosthetic joint systems as the results of either biologic or mechanical causes. In most cases, the back pains were relieved during the follow-up period but four patients still had knee discomfort. For these cases, correction by high tibial osteotomy were performed.

### 2) Function

There was little difference in function between Group A (mean 2.5) and Group B (mean 2.3) before the arthroplasty. In general, the results of LFA also showed little difference between Group A and Group B, with a numerical grading of 4. Among seven patients having the grade 5, five belonged to Group A and two to Group B, respectively.

Since gluteal lurches were more pronounced in some cases in the early post-operative period, uses of crutches for a period of at least three months were recommended to avoid wide adduction in the early post-operative phase. Better walking ability obtained in this way contributed to a significant improvement in gait.

The final review showed some improvement over the early result being graded as 4.4 (Group A 4.3, Group B 4.5). Only a little improvement was observed in function and walking ability. This difference is not great, which implied still high activity in younger age group despite of assessment of "built in restraint" in all presented series.

### 3) Movement

In spite of the relief of pain and improved function, mobility after LFA was only slightly improved and no cases resulted in grade 6 in the series presented. As far as pre-operative mobility of the hips was concerned, twelve cases of Group A were graded 2 (mean 2.4). There were gradual improvements over the twelve months period after operation in all, except two hips in Group B having a total range of motion of around 100 degrees. .

At the final review of 8-10 years follow-ups, range of motion was decreased from 4.3 to 4.1 (Group A:3.8, Group B:4.4). In Group A, one of the deep infections turned out to be spontaneous fusion with acceptable posture after removal of both prosthetic components (AC-13).

### DISCUSSION

The authors emphasize that prevention of the reactivation should be the surgeon's prime goal and this implies the use of appropriate chemotherapy. Nevertheless, it was thought that the most successful treatment in primary tuberculosis of a joint is one that achieves sound bony union<sup>(18)</sup> but even these cases must be reviewed critically since anti-tuberculous therapy might not preclude reactivation. A search of literature revealed only few which criticised replacement arthroplasty because of reactivation of tuberculosis even after long period of quiescence<sup>(12,24,27)</sup>.

On the other hand, contrary to these arguments, Schulze reported rather favourable outcome in such cases with several similar features<sup>(33)</sup> was like our materials which we published<sup>(25)</sup>.

The final outcome of these 8-10 years results of our early twenty hip procedures implied interesting features and five out of twenty hips had either early or late deep infections. Meanwhile, we are not certain that "reactivation has been held to be more common in tuberculosis with it's tendency to chronicity than in acute septic infections<sup>(21)</sup>". Nevertheless, it is now certain that the vital factor in the effective treatment of this type of surgery proposed is proper chemotherapy<sup>(19)</sup>. This matter of fact

is finally demonstrated by the report of the Medical Research Council's working Party<sup>(28,29,30)</sup>.

In analysis of five of twenty patients, two of them showed reactivation of the tuberculosis, which was proven by histopathological features despite of repeated cultures. Apparently, failure of these two patients were due to discontinuation of anti-tuberculous drug treatment by the patients. Thus, it was presumed that insufficient medical treatment after surgery may have caused reactivation ensued (AC-5, AC-14).

In cases of deep infection either early or late occurrence caused by staphylococcal and pseudomonase, three different types of salvage procedures were employed. For the purpose of reducing infection, all patient were received anti-tuberculous drug regime (Table 2) combined with local Betadine<sup>(35)</sup> and 4 x 1500 mg of Cephobid intravenously until the wound was healed. Nelson found that preventive antibiotics are very effective in reducing infection<sup>(32)</sup>. We also operated on these cases at the ultra-clean operating room. An assessed treatment was resection arthroplasty in two patients (AC-5, AC-14) and two stage re-implantation in one (AC-6).

On the other hand, concerning caseous abscess related with tuberculous hip, there have been well established knowledge of the morbid anatomy of the disease: if they have been effectively cured by various form of treatment, not all but in some instance, usually calcification take place in the abscess in addition to carries sicca ensue in the affected hip joints. However, it has been generally believed that incidence is more higher in those particular late product with bone tuberculosis which may become reactivative of the underlying disease. Nevertheless, few had proven to find M. tuberculosis in those particular situations.

In the relevant literatures, observations on the bacteriology of bone tuberculosis were made by Canetti, Deberyre and de Seze in 1957 and Debaumont in 1966. It was reported that tuberculosis of parenchymatous organs is characterized by a high bacterial population: tuberculosis of bone by a low one<sup>(3,10)</sup>. This explains the reason why so few M. tuberculosis can be found in pus aspirated from psoas abscess and in the discharge from a sinus.

**Fig. 5. (AC-18): A;** Photograph was made at operation. Relatively hard mass measured 3×9cm was observed above the rectus femoris muscle. **B;** Extirpated whole specimen. **C;** Longitudinal dissection of the specimen which disclosed no growth of AFB. or tubercles. Specimen were also aseptically smashed and suspended into the normal saline and was injected into the peritoneal cavity of the 12 guinea-pigs 2ml. each. Animals were sacrificed at 2,3,4, and 6 weeks after inoculations spleen, liver, omentum and adrenals were examined. There were also no Tubercles or AFB.

For this reason, we have undertaken Charnley arthroplasties in two cases of those hips for the purpose of comparative study (Fig. 4). These two patients had similar radiological feature and we attempted to preserve these late effect of tuberculosis (cheesy matter) very carefully in situ and arthroplasties were performed with conventional technique, and up to this point, the results seems to be satisfactory despite of arguments about hazard of reactivation. In addition, biopsy was performed on one of these patient 8 year following LFA, which revealed also no activity in tuberculous nature (Fig. 5).

**Fig. 6. (AC-9):** Fracture wave as seen on the proximal fragment. Origin of wave at antero-lateral corner is demonstrable.

Recently the fatigue fracture in the femoral stem is one of the most challenging problem in the revision of the total hip arthroplasty with incidence rates in the literature ranging from 0.23 to 0.67 percent<sup>(1,4,6,8,9,13,17)</sup>.

In our presented case (AC-9), perforation of the femoral shaft was made as a complication at initial LFA but he underwent fairly good conditions up to nine years following surgery. The reason of fatigue fracture of this patient might be caused by heavy weight gained after LFA and it was the only available 1st generation configuration of Charnley prosthesis at the time of surgery. In addition, this patient did not followed 'built in restrain' contrary to an our routine protocols.

In the analysis of the pattern of stem fracture, the crack was started at the anterior-lateral corner of the mid-stem and propagated upward with slope of 8 degrees when viewed from the lateral aspect (Fig. 6). This can be explained as such that the fracture was caused by the torsion from the anterior-

**Fig. 7. (AC-8):** Histologically proved Tuberculosis while performing LFA. Thirty-one year old male, converted from spontaneous fusion with mal-position. **A;** Immediate post op. film. **B;** One and half years post. op. film. **C;** Post. op. nine years film.

**Note:** Despite of presence of small cavitation under the spring loaded wire clinically excellent.

superior force at the femoral head<sup>(34)</sup>.

Another interesting features which we encountered was resorption of the medial femoral neck and typical example are illustrated in Fig. 3, a.b.c.. These were ranged from less than 7mm in most cases except one had exceeded 15mm in ten years follow-up (AC-1). In addition, cavitation in region of femoral calcar were observed in seven cases; it was measured 5mm × 5mm in most cases except one case of deep infection (AC-19), in which we proved staphylococcal infection, was underwent revision during the 8 years follow-up. Among these cases (one out of seven), we could not rule out any evidence of infection so far by laboratory and clinical manifestations and three of them had spring-loaded wires for reattachment of the trochanters (Fig. 7).

The acetabular components failure is much more greater when compared with prosthetic stems (Table 1). These results explain that one of the major cause of the acetabular cup failure was due to the excessive deepening of the acetabulum.

On the other hand, there were four cases of unusual radiographic appearance of fracture in cements as well as in the bore at proximal portion of the femur associated with typical physiological hypertrophy. All of these cases had minimum

symptoms except some limited mobility. Therefore, we considered that mode of failures would be compatible with 'Cantilever beam bending without proximal loosening which requires an early revision in the near future. The average rate of wear was 0.38mm year for 16 patients. In one exceptional case of a patient of 21 years old, the wear was 8 mm for 8 years, which is 3 times faster wear than average. The average wear rate in this study was 3 times higher than reported by Charnley and Cupic<sup>(5)</sup>, but also the average age of patients was 35 years which is far lower than the group they studied with average of 64 years. The size of the sample may be too small to make any definite conclusion but it seems to indicate that the wear rate is depending on the age and weight of the patients. The high density polyethylenes used were procured from various sources.

These results are intended as a criteria against which the results of future research into improved technique of using low friction arthroplasty can be compared. Sir John also suggested that "In this type of patient it is possible that a socket using the expanded surface technique with perhaps 6 months of avoidance of load-bearing might be the solution<sup>(7)</sup>.

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