

Report of Salvage Procedures in Failed Total Hip Replacement

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— 초 록 —

고관절전치환술 실패예의 재수술에 관한 보고

김영웅 · 배대경 · 안제환 · 박동욱 · 최경열 · 김영권

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곽 병 만

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부산 정형외과

인공고관절 전치환술후 심층감염과 골시멘트를 사용하여 관절대치물 고정에 따른 합병증을 구별하는 것은 어려운 문제이다.

대퇴 관절대치물의 내반 및 골시멘트 고정이 합병증에 관계가 있다. 또한 대퇴 관절대치물 상단에 과다한 골시멘트가 합병증을 일으킨 예에서 관찰되는 것은 적절한 골시멘트의 두께가 이상적이란 설의 합당성을 뒷받침 하는것 같다.

감염치료에 있어서 혈침속도가 가장 신빙성이 있는 근거가 되며 그람 음성균이 발견되었을 때는 관절대치물의 완전한 제거가 필요하다.

합병증을 일으킨 예에서 대퇴부 상단을 절제한 후 대퇴 대치물을 사용할 때에는 대퇴부의 근간중격을 비흡수성 봉합사를 사용하여 대퇴 대치물의 근관에 부착시켜야 한다.

본 경희대학교 정형외과학 교실에서는 1973년부터 1979년까지 인공고관절전치환술을 시행한 후 합병증을 일으킨 예에 대하여 재수술을 시행한후 최단 1년에서 최장 3년까지의 원격추시가 가능하였던 16예에 대하여 문헌고찰과 함께 보고하는 바이다.

16예 중에서 3예는 고관절 고정술로 치료하였다.

합병증의 원인은 감염 5예, 기계적 요인 4예 및 감염이 의심되었던 예가 7예였으며 세균으로 구별하여 분석하였다.

Key words : Failed total hip replacement arthroplasty — deep infection — Mechanical loosening — Infected suspected

Implant loosening is one major complication in cemented stem-type hip arthroplasties. A new approach to total hip replacement is currently attracting attention, the idea being to 're-surface' the head of the femur with a hollow metal cup, thereby avoiding femoral endoprosthesis.

On the other hand, Charnley's experience with 12 to 15 years of LFA operations has led him to an almost diametrically opposite point of view. Recently, his experience with the femoral prosthesis has had almost 100% success, using only cement. Recent improvement in unsophisticated cement technology is largely responsible for this success.

Case Analysis

This paper presents the results of revisional surgery for failed total hip replacement during the period of 1973 to 1979. During that period 16 patients required removal of prosthetic components in which failure was due to infection or loss of fixation of the components. The cause of loosening seems to be the cement technique at the operation time.

Of the 16 patients, 9 were female and 7 were

male. The age distribution was 36 to 60 years old. Salvage procedures, either replacement or removal of prosthetic components were undertaken 1 to 4.5 years following the original hip arthroplasties. After revisional surgery, all patients except one, were followed up for minimum of one to maximum of three years.

Table 1 shows the original diagnosis and type of prosthesis which we have revised. At revisional surgery, Charnley heavy prosthesis (3rd generation) were used in most cases. There were 3 cases in which it was impossible to replace the prosthetic components.

For the study of causes of prosthetic failures, we have considered 3 main categories listed on the Table.

Discussion

1. Deep Infection

In the Group of Deep-seated infection, there was a significant increment of Erythrocyte sedimentation rate and some leukocytosis noticed in most patients.

Radiographically, they were all positive to common changes including radiolucent zone at

Table 1. Original Diagnosis and Prosthesis Used

Diagnosis	No.	Cause of Loosening	No.	Prosthesis	No.
Pre-op.					
Aseptic necrosis	4	Deep Infection	5	Charnley LFA (1st gen.)	12
				Muller	3
				McKee	1
Treated fracture (Secondary Osteoarthritis).....	7	Mechanical	4	At revision	
Old tub. hip	4			Charnley LFA (2nd gen.)	3
				Charnley LFA (3rd gen.)	9
				Resection Prosthesis with muscle plate	1
Other	1	Infection suspected	7	Hip Arthrodesis	1
				Girdlestone Procedure	2

the bone cement interface, scalloping effect at the cortex, periosteal reaction resembling lamination and definite evidence of Osteitis. In addition, radiographic specific of sinogram always showed the sinus communicating with hip joint (Fig. 1).

treatment. At least 4 weeks of intra-venous antibiotic therapy is preferred. This treatment in this Group after removal of prosthetic components was very successful.

Management of established infection is still a debated issue but the original recommendation of debridement and removal of prostheses may have brought favourable results in our patients. Murray, Wilson, Coventry and even Eftekhari favor debridement, suction drainage, and intensive antibiotic therapy without removal of prosthetic components in some patients but long term results are still not certain.

In this series, we attempted the concept of Murray et al. for some patients initially, but it failed due to the remaining of persistent sinuses. So we decided to perform removal of prosthetic components with debridement, intensive antibiotics followed by delayed implantation (Fig. 2).

For this reason, it was essential to perform this type of surgery on the basis of infecting organism.

Fig. 1. 40 year old female, old tuberculous hip showing that Radiographic specifics of infection after LFA is demonstrable. Deep seated infection occurred immediate post-operative period and draining sinuses persisted despite debridement and removal of trochanteric fixation. Sinogram was taken on year after LFA.

In particular to bacteriology, predominant infecting organisms were Gram-positive cocci in 3 patients and Gram-negative organisms in others but no growth of AFB could be observed in this latter group.

Reconstruction was performed on the basis of infecting organism and undertaken by a two-stage operation with use of systemic antibiotic therapy.

It was found that antibiotics must be given in high doses to maximize the serum bactericidal level, which must be maintained throughout the

Fig. 2. Same patient (Fig. 1).

1. Immediate post-operative radiogram.
2. X-ray was taken one year later after wide debridement and removal of trochanteric fixation.
3. X-ray was taken two years from original LFA (Girdlestone Procedure). Abductor was sutured lateral to the femoral shaft.
4. X-ray was taken 3 years interval since re-insertion of the prosthetic components.

As far as the source of infection is concerned, we selected the patient carefully when Gram-positive organism were sensitive to antibiotics. It is quite obvious that contra-indication to this Group appeared to be Gram-negative, anaerobic organism, mixed flora and pelvic osteomyelitis (Fig. 3).

plantation. Proximal drift of trochanter with contraction of the abductors may ensure although unlikely.

We found retention of the Thompson prosthesis is valuable to solve this problem and greatly facilitates future re-implantation (Fig. 4).

Fig. 3. Case of disastrous result. Infecting organism was Gram-negative bacilli and was also an old tuberculous hip (left). Deep-seated infection occurred 4.5 year after LFA (middle). Draining sinuses stopped after removal of prosthetic components but it would be difficult to replace the prostheses (right).

On the other-hand in some cases for re-implantation, we have converted to hip arthrodesis and two others led to Girdlestone procedures.

Although, contrary to accepted procedures, we performed one direct change of an implant and retention of the Thompson prosthesis during the initial debridement for deep infection. In fact, removal of all cement is essential for performing this type of surgery. Furthermore, de-vitalised tissue must be removed at debridement, which eliminates the possibility of recurrence of the infection. An X-ray is required at the end of surgical procedures.

The abductors were sutured as distally over the lateral aspect of femoral shaft for ease of re-im-

Fig. 4. 39 year old male, Originally avascular necrosis of the femoral head. Deep infection occurred 2 year after LFA and predominant infecting organism was Gram-positive cocci (left). Reconstruction was undertaken by two-stage operations with intensive antibiotic therapy. Direct exchange of an implant after wide debridement by Thompson prosthesis (middle). Two and half year follow up since re-insertion of the prosthetic components with satisfactory clinical result (right).

2. Mechanical Loosening

In this Group, 4 cases of loss of fixation of the components were also revised. All the patients noticed a totally pain free period followed by a sudden onset of pain while walking. However, no patient had a history of defective healing in this series.

Charnley has reported in his clinical study of 14 year follow-up for the cement-bone interface that radiological demarcation of cement in the acetabulum was observed in roughly 60% of cases. In addition, Charnley also noticed and 8.9% in-

cidence of subsidence in patients followed for an average of 8.3 years.

Amstutz has reported a 19.5% frequency of the radiographic changes of loosening in his patients followed up for 2-5 years and more recently, Beckenbaugh has reported radiographic changes in 24% of 333 patients followed up for a period of 4-7 years.

The causes of loosening seem to be poor cement technique and varus positioning of the femoral component.

Most of our loosening are from our early cases of total hip replacement. Thus cement technology at initial operation is the more likely cause of failure. Another possibility lies in that we have performed LFA in younger aged patients in the presented series. (Fig. 5-6).

Theoretically, causes of loosening may include breakdown of the mechanical bond between the cement and stem as well as at the cement-bone

Fig. 6. 52 year old male, Originally secondary to hip fracture. Patient remained symptomless for one year following LFA but noticed sudden hip pain while walking and restricted activity since that time. However, all laboratory parameters were negative. Radiographic specifics of loosening of the whole of the cement-bone interface is demonstrable (left). One year after revisional surgery (right).

interface as a result of repetitive cyclic loading or sudden impact loading of the prosthesis as in a fall; fixation with acrylic cement can be inadequate for young patients. It is difficult to ascertain loosening from mechanical stresses since it is not known exactly how much stress is imposed on the prosthetic materials and how much is transmitted at the interfaces.

We found that the thickness of cement of an implant is a contributing factor. The finite element stress analysis shows that the maximum tensile stress in the stem is increased as the layer of cement thickens, while the stress in the cement is decreased. From this study, a cement layer between 3 and 4 mm thick is recommended (7).

Nevertheless, it is known that too little stress or much stress causes bone resorption. It is the stress distribution that will determine the reaction of the bone to the cemented prosthesis and affect the long-term stability at the cement-bone interface.

Fig. 5. 51 year old male, loosening occurred one year after LFA and the cause of loosening seem to be poor cement technique at operation. Originally secondary osteoarthritis (Acetabular fracture). Modes of cement failure can be manifested as Mode 1: Pistoning behavior 1-b after Amstutz (left).

Two years after revisional surgery with satisfactory clinical result (right).

We have included a case of early complication of bio-centric hip arthroplasty (so called English conversion) in this study (Fig. 7).

Fig. 7. 47 year old female originally Avascular necrosis. Primary intervention was so called English conversion but pain persisted since 6 months following operation (left).

We observed a definite loss of cartilage in the acetabulum at revisional surgery. Therefore we have converted to Charnley heavy prosthesis (right).

3. Infection Suspected

One of the most difficult aspects of the diagnosis in suspected infection of a total hip replacement is differentiation between deep infection and mechanical loosening.

In this variety of Group, 7 cases of loss of fixation of the components were revised under suspicion of the low grade infection. In most cases, radiographic changes are consistent with resembled osteitis and gross demarcations were observed in bone and cement interface, either acetabulum or femoral components. However, those changes do not appear to progress to abscess formation despite most of them having a history of defective wound healing at previous hip arthroplasties.

Of all laboratory parameters, persistent elevation of the sedimentation rate was the most reli-

able single measure of chronic infection and presented cases disclose a somewhat elevated value but less than 40mm/hr in most cases. A rate lingering above 40 is indicative of infection unless proved otherwise, but at least 3 sedimentation values must be determined prior to diagnosis.

When infection is highly suspected and identification of organisms is essential to institute appropriate antibiotic treatment, or the diagnosis of infection cannot be ascertained from clinical and radiographic appearances, an aspiration might be indicated. Although we do favor routine aspiration, all results were negative.

Dupon and Charnley reported positive cultures from operative specimens in 13 hips after revisions for previous unsuccessful operations. Nine of these cultures showed evidence of growth of *Staphylococcus albus*, coagulase negative, and one, *Staphylococcus aureus*, coagulase positive. They reported successful treatment in eight of these 10 staphylococcal infections.

Wilson et al. reported on 19 patients suffering from subacute or recently arrested sepsis of the hip joint, treated by massive antibiotics and total prosthetic reconstruction. It must be recognized that in both of these series the most frequently offending organisms were *S. albus* and other mild pathogens. Also no cement was used in both series.

As a rule, direct contact of cement with bone makes it impossible for bone to escape contamination when an organism reaches the interface. So that it is essential to remove the whole prosthetic components and cement for the Group of infection suspected as well as deep infections.

Another difficulty encountered was a case of bilateral hip arthroplasties with loss of proximal femur on the right hip after long-standing Cobalt-Chrome McKee prosthesis and asymptomatic left hip after Charnley 1st generation Stainless prosthe-

sis (Fig. 8).

In the literature, metal sensitivity has been reported to be implicated in the loosening of prosthetic hip replacement but was not observed in this patient. When the bone of the upper femur has been lost, as in this case, resection prosthesis with muscle plate can be facilitated for reconstruction (Fig. 9). At revisional surgery, we found a

definite loosening in both prosthetic components and extracted prosthetic stem disclosed excessive cement around the collar of femoral prosthesis (Fig. 10).

Fig. 8. McKee prosthesis on the right hip since 1974 and Charnley prosthesis on the left hip since 1975 for avascular necrosis of both femoral head. 58 year old female, patient has long history of indiscriminate use of steroid. Radiographic specifics of loosening of whole of the cement-bone interface and loss of proximal femur is evident on the right hip whereas wire breakage is demonstrable on the symptomless left hip (right).

Fig. 9. Immediate post-operative radiogram showing that Resection prosthesis with muscle plate on the right hip (left).

Fig. 10. Picture showing that the extracted McKee-Farra prostheses and notice the excessive cement around the collar of femoral prosthesis. Thus, this may be a reason for defective orientation of the prosthesis.

As for surgical technique, it is important that the inter-muscular septa in the thigh should be anchored to the perforation of the "Muscle plate" by non absorbable sutures as described in Fig. 11.

Fig. 11. Picture taken at operation and showing that the Resection prosthesis with muscle plate. Note: It is important that the inter-muscular septa in the thigh should be anchored to the perforations of the "muscle plate" by non absorbable sutures in order to restrict excessive rotation of the prosthesis and thereby avoid dislocation.

Conclusions

It was found difficult to distinguish between failure due to mechanical loosening or to deep infection. However, in every case it is essential to maintain an antibiotic treatment.

Poor cement techniques and varus positioning of the femoral components contributed to some failure. Excessive cement around the collar of femoral prosthesis was observed, which tends to confirm the theory (7) of optimal cement thickness.

In the treatment of infection, sedimentation rate was the most reliable indicator of infection. Complete removal of prosthesis is recommended for deep infection when Gram negative conditions are found.

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