

## 근위 경골의 골육종에 시행한 반관절성형술

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**목적:** 근위 경골 육종의 절제 후 재건은, 특히 골성장이 완료되지 않은 환자의 경우 많은 문제점이 있다. 본 연구에서는 근위 경골 육종의 절제 후 재건에 따르는 문제점을 보완하기 위한 새로운 술식을 시도해 보고자 하였다.

**대상 및 방법:** 근위 경골에 발생한 골육종의 절제 후 반관절성형술을 시행한 4례를 대상으로 하였다. 평균 연령은 13세였으며 술후 평균 추시 기간은 64개월이었다. 전례에서 초고분자량 폴리에틸렌 삽입물(ultra-high molecular weight polyethylene liner)을 이용하여 관절면을 재건한 후 엔더정(Ender-nail)과 골시멘트를 이용하여 남아있는 경골에 고정하였다.

**결과:** 최종 추시상 MSTS 기준에 의한 기능적 점수는 23.5점(78.3%)이었다. 전례에서 술 후 슬관절 동통, 불안정성은 관찰되지 않았다.

**결론:** 골성장이 완료되지 않은 소아 환자의 근위 경골 육종 절제 후 재건 방법으로서 반관절 성형술은 효과적인 술기로 판단된다.

**색인 단어:** 악성 골종양, 근위 경골, 폴리에틸렌 삽입물, 반관절성형술

### Introduction

The proximal tibia is the second most common site for primary malignant bone tumors<sup>12)</sup>. Compared to distal femur, such tumors in proximal tibia pose problems of surgical approach and its outcome is relatively discouraging. This is due to its complexities in anatomy and difficulty in reconstructing the extensor mechanism<sup>11)</sup>.

Limb sparing surgical options for tumors

of the proximal tibia include arthrodesis, Van Nes rotationplasty, allograft, autograft-tumor prosthesis composite, irradiated autogenous bone replacement, distraction osteogenesis<sup>1,2,4,5,7-10)</sup>. Each of these techniques has their own advantages and disadvantages. Currently, one of the simplest and economic surgical options is arthorodesis. But this procedure is not physiologic. Although expandable prosthesis seems to be an optimal option for children, it must be custom made and

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its related cost is considerable. The purpose of this study is to contrive a surgical option in patients having problems of expected growth and variable prognosis.

### Materials and Methods

Between May 1998 and September 2001, thirty-seven osteosarcomas of proximal tibia were enlisted to this institute. The inclusion criteria for this procedure were 1) expandable prosthesis is not indicated due to bone maturity or financial reason, 2) patients with distant metastasis at presentation. Four cases were eligible to this study. All the patients were male and the mean age was 13 years (11~15). Mean follow-up period was 64 months (47~89) (Table 1). The stage of two children was IIB (Case 1, 2) and skeletal age was less than 10 percentile compared to the chronological age.

Case 3 was 15 year-old boy who underwent primarily arthrodesis because of its initial tumor burden and poor clinical response to neoadjuvant chemotherapy. Sixteen months after resection arthrodesis, metal failure and solitary pulmonary metastasis was found. The last case was presented with proximal tibial osteosarcoma and concurrent single hepatic metastasis (3×3 cm) that was confirmed with ultrasonographically guided percutaneous needle aspiration.

All the patients had 2 cycles of neoadjuvant chemotherapy that consists of

methotrexate and cisplatin-adriamycin (modified T-10 protocol). The hepatic lesion of case 4 has disappeared on follow up ultrasonographic finding. An anteromedial approach was done and the level of tibial osteotomy was decided by postchemotherapeutic MRI with a safe margin of 3 cm.

All the cases showed long intramedullary extension of the tumor and the percent bone resection compared to the whole tibial length was more than 50%. Remaining tibial segments were too short for sound fixation. To enhance the mechanically supported area, cortical cylinder shaped block of the excised tumor were water bathed at temperature of 65°C for 30 minutes and repositioned. V-osteotomy was done to enhance the contact area and stability of the recycled bone.

The UHMWPE (Ultra-High Molecular Weight PolyEthylene) insert for the substitute of articular surface was chosen by the TKRA template. The thickest insert available was selected for sound fixation. Three or four screws were passed through the liner and the screw heads were sunken under the articulating surface through overdrilling. This liner was connected to the Ender nails which are posted to the distal intramedullary canal with intercalating low heat-treated bone. For additional stability and space filling, the bone cement was incorporated between the liner and distal fixation device.

After the construction of the hemiprosthetic device with secure distal fixation, the

**Table 1.** Demographic clinical characteristics of the patients

Case	Age (years)	Stage	F/U Duration (month)
1	12	IIB	47
2	11	IIB	70
3	15	IIB	89
4	14	III	48

knee joint capsule was repaired with Marlex mesh. The properly designed size of nylon mesh was wrapped around the device with enough recess for distal femoral attachment. The posterior part of the mesh was tightly attached to remnant joint capsule on femoral condyle.

The hemiarthroplasty devise was reduced and reconstruction of anterior part of the extensor mechanism was done along with the anterior transposition of the medial gastrocnemius. In this step, the associated structures were repaired with knee joint flexion of 80~90° for postoperative range of motion.

Long leg cast was applied for 6 weeks for the healing of the repositioned extensor mechanism.

The final functional result was evaluated by the criteria of MSTS<sup>3)</sup>(Table 2).

## Results

### 1. Oncologic result

Case 1, 2 were continuously disease free at 47, 70 months postoperatively. Case 3 showed no recurrence or metastasis after 89 months of pulmonary metastasectomy and hemiarthroplasty. Case 4 developed multiple pulmonary metastasis at 12 months. Despite

aggressive chemotherapy and metastasectomy he expired at 48 months.

### 2. Prosthetic result

Radiologically, subchondral sclerosis and irregularity of the femoral articular surface commenced around 11~14 months postoperatively (Fig. 1, 2A). These findings had a tendency of slight progression but reached to a plateau at 24 months postoperatively.

The junctional site bridging between the recycled bone and remaining tibial bone stock began at 6 months and clinical and radiologic union seems to be obtained at 15 months.

At final follow up of 2 cases of pediatric osteosarcoma(case 1, 2), mean leg length discrepancy was 3cm which could be corrected with shoe lift only. This result was satisfactory compared to the arthrodesis cases that showed more than 5 cm discrepancy.

### 3. Functional result

All the cases did not showed any instability and pain and there was no need for clutch or brace for indoor or outdoor activity. The mean MSTS score at final follow up was 23.5 (78.3%).

**Table 2.** Functional results evaluated by ISOLS score

Case	Pain	Function	Emotional acceptance	Supports ability	Walking	Gait	Total (%)
1	5	4	4	4	4	4	25 (83.3)
2	5	4	4	4	4	4	25 (83.3)
3	5	4	5	4	3	3	24 (80.0)
4	5	3	3	3	3	3	20 (66.6)
Mean	5	3.75	4	3.75	3.5	3.5	23.5
Total	25	15	16	15	14	14	94 (78.3)

## Discussion

Several types of options for proximal tibial reconstruction exist and each procedure has its own indications and limitations. The instant surgical option for the osteosarcoma patients in their growing age is arthrodesis by using intramedullary rod and bone cement. The advantages of this type of arthrodesis are its cost effectiveness, durability and ease of revision. But it has fatal drawback of sacrificing knee joint function that is essential for the quality of life<sup>4,7)</sup>.

In many cases patients with fused knee have to give up public transportation and this will raise extra medical expenses that will keep up the original prosthesis value. This fact forces the surgeon to apply an expandable prosthesis even in the cases of

less than 10 years old. It has advantages of early weight bearing and superior functional results. However, the potential for mechanical failure, overlengthening, neurovascular compromise associated with lengthening,



**Fig. 1.** Plain radiographs at initial visit show osteolytic and osteoblastic lesion in proximal meta-diaphysis of left tibia.



**Fig. 2.** (A) Plain radiographs at a post-operative 1 year show complete union at junction of pasteurized bone and tibia shaft, some osteoporotic changes and flattening with subchondral sclerosis of femoral condylar surface. (B) Plain radiographs at a post-operative 4 years and 4 months show intact growth plate.

loosening, osteolysis associated with stress shielding and high cost are of concern.

The authors' concept for the osteosarcoma in their growing age was stepwise approach. After the survival status (>2 years postoperatively) is stabilized, switching from the arthrodesis to the more functional reconstruction. But the functional status and related leg length discrepancy posed as a main issue.

The background of this procedure is to construct a mobile joint regardless of their age or tumor stage. And we presumed the epiphyseal damage would be bypassed through the hemiarthroplasty(Fig. 2B).

Historically, hemiarthroplasty was a major issue of hip joint that has a ball and socket joint. The hemiarthroplasty described here is comparable to the osteoarticular allograft of proximal tibia. Although some authors reported good results, osteoarticular allograft have unacceptably high rate of infection, collapse and in some cases having much difficulty in obtaining proper donor<sup>1,2)</sup>.

Considering these drawbacks of osteoarticular allograft reconstruction, hemiarthroplasty described here provides a stable and cost-effective surgical option.

Some authors have studied high-density polyethylene prosthetic femoral head replacement in the dog and its influences on articular surface, and they concluded that the effect was deleterious<sup>6)</sup>. But, the purpose of our procedure was intended to preserve the knee joint motion and distal femoral epiphyseal plate. Radiological changes suggesting femoral joint cartilage damage had no effect on functional result or pain itself.

This procedure was contrived to attain a temporary mobile joint for pediatric patient. As there is no evidence of instability, mechanical failure and infection on long

term follow up, it may be applied to patients with variable prognosis and can afford a cost effective mobile joint.

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## Abstract

### Hemiarthroplasty for Osteosarcoma of Proximal Tibia

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**Purpose:** The proximal tibial sarcoma patients, especially in their growing ages have problems of reconstruction. This study is to devise a methodology which can circumvent this limitations.

**Materials and Methods:** Four cases of proximal tibial osteosarcoma underwent hemiarthroplasty. The mean age was 13 years (11~15) with a mean follow-up of 64 months (47~89).

The procedure consists of ultrahigh molecular weight polyethylene (UHMWPE) liner as an substitute for the joint surface and this piece was fixed to the remaining tibial bone stock with Ender nail and bone cement.

**Results:** Final functional score was 23.5 (78.3% of control) by MSTs criteria. All the cases showed stable joint without pain. Hemiarthroplasty related complications were absent. By saving the femoral physis, expected leg length discrepancy could be minimized by this procedure.

**Conclusions:** Hemiarthroplasty of proximal tibia can be an option in pediatric sarcoma patients.

**Key Words:** Malignant bone tumor, Proximal tibia, Polyethylene liner, Hemiarthroplasty

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