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Articulated distraction of the hip joint in the treatment of benign aggressive tumors located around the hip joint

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Abstract *Introduction:* The proximal femur and acetabulum are frequent sites for benign active and aggressive lesions. The risk of pathologic fracture is great when a bone-destroying pathology involves an anatomic location such as the hip joint that undergoes profound mechanical loading. If the destruction involves a large area around the joint, secure fixation cannot be achieved with internal fixation implants. The study investigates use of articulated hip distraction to protect reconstructions performed for the treatment of benign active or aggressive tumors presenting with pathologic fracture. *Patients and methods:* Five patients with a pathologic fracture of the proximal, intracapsular femur or the acetabulum were operated on at the authors' institution between 1997 and 1999. Following histopathologic approval of a benign tumor, all lesions were curetted, chemocauterized, and grafted and osteosynthesis was performed. The reconstruction was protected with an articulated hip distraction external fixator. All patients were mobilized in the immediate postoperative period. *Results:* The patients were kept in external fixators for an average of 19.8 weeks (range: 16–24). The fixator was removed when bony consolidation was observed in anteroposterior and lateral x-rays of the lesion. The patients were followed for an average of 47 months (range: 38–56) after frame removal. None of the lesions recurred. At the last follow-up examination, all patients displayed an excellent function according to the Musculoskeletal Tumor Society Rating Scale. *Conclusion:* According to the authors' knowledge, this investigation is the first in the literature describing the use of articulated

joint distraction in the treatment of benign active and aggressive lesions around the hip joint. The procedure adopts principles of joint distraction into bone tumor surgery.

Keywords Pathologic fracture · Benign aggressive tumor · Proximal femur · Acetabulum · Articulated hip distraction

Introduction

The proximal femur and acetabulum are common locations for benign bone tumors [7]. These tumors are often benign active and aggressive in nature, and a pathologic fracture is sometimes the first symptom. If complicated by a pathologic fracture, they present a treatment challenge, as there is a high risk of avascular necrosis of the femoral head and a high incidence of local recurrence [11]. Sometimes the bone destruction is so large that there is not enough bone stock left in the femoral head for secure fixation of an implant. Furthermore, acetabular lesions may be complicated by tumoral perforation of the articular surface. Because these tumors commonly occur in adolescents and young adults with a normal life expectancy [7], biologic reconstruction of the hip joint without sacrificing the anatomic structures is of paramount importance.

Following surgical treatment of pathologic fractures of the proximal femur or acetabulum, the patient is mostly mobilized without weight bearing and range of motion is restricted. At times, even a bed rest is necessary to protect the delicate reconstruction.

Articulated distraction of the hip provides unloading of muscle and body forces and distraction of the joint with the help of an external fixator crossing the hip [4]. Hip motion in the sagittal plane is enabled by the addition of a hinge. The current study investigates use of articulated hip distraction to protect reconstructions performed for the treatment of benign active or aggressive tumors presenting with a pathologic fracture.

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Table 1 Demographic data of the patient group

Case	Sex	Age	Site	Pathology	Operation	Ex. fix. time (weeks)	MSTS-93	Complications	Follow-up (months)
1	M	19	Femoral neck and head	Aneurysmal bone cyst (grade 3)	Curretage, phenol., burr., allografting, hip distraction	18	100	None	56
2	M	16	Femoral neck and head	Aneurysmal bone cyst (grade 3)	Curretage, phenol., burr., allo- and xenografting, angled plate, hip distraction	21	100	None	53
3	M	21	Femoral neck and head	Aneurysmal bone cyst (grade 2)	Curretage, phenol., burr., allografting, hip distraction	16	97	None	47
4	F	25	Acetabulum	Giant cell tumor	Curretage, phenol., burr., allografting, hip distraction	24	87	Minor pin tract infection	41
5	F	24	Acetabulum	Giant cell tumor	Curretage, phenol., burr., allografting, hip distraction	20	92	Minor pin tract infection	38

Ex. fix. Time external fixation time, *phenol* phenolization, *burr* speed burr, *MSTS-93* Musculoskeletal Tumor Society Rating Scale-93

Patients and methods

Patients

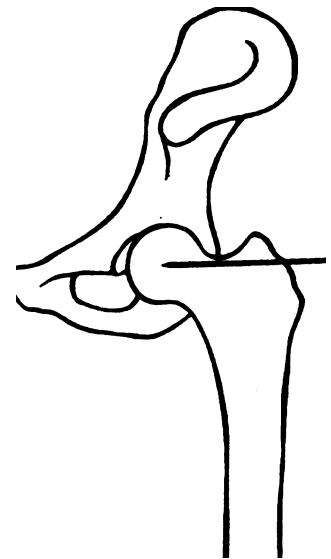
Five patients with a pathologic fracture of the proximal, intracapsular femur, or the acetabulum were operated on at the authors' institution between 1997 and 1999. Three patients were male and two patients were female, with an average age of 21 (range: 16–25). Three patients had a neoplasm located at the femoral neck extending into the femoral head. All three applied to our emergency ward with a sudden, severe pain in the groin. Following radiologic evaluation, one of them was diagnosed with a complete pathologic fracture, and two were diagnosed with nondisplaced pathologic fractures. The two female patients also applied to the emergency ward complaining of an abrupt pain in the hip region and inability to walk. Radiologic examination revealed lytic lesions located in the acetabulum expanding from the ilium into the hip joint in one patient, and expanding from the ischium into the ilium and hip joint in the other. The three male patients had typical radiologic signs on conventional anteroposterior and lateral x-rays, and magnetic resonance images, displaying septations and fluid-fluid levels. They were clinically and radiologically diagnosed to have aneurysmal bone cysts. In conventional x-rays and magnetic resonance images, the female patients with acetabular lesions displayed lytic lesions destroying the cortical bone and joint cartilage, with a big soft tissue component. One patient (number 4) also had fluid-fluid levels in the magnetic resonance images. They were suspected to have giant cell tumors, which was proved by a computed tomography (CT)-guided tru-cut biopsy (Table 1).

Surgical technique

All operations were performed with an experienced musculoskeletal pathologist available for interpretation of frozen section specimens. Definitive treatment proceeded after clinical, radiologic, and pathologic agreement on a benign lesion.

The proximal femoral lesions were operated on a fracture table through an anterolateral Watson-Jones incision. The fractures were reduced before the incision by fluoroscopic guidance. The bone was exposed anteriorly, lateral to the capsular attachment, through the fracture line, so that entry into the joint was avoided until histologic confirmation of the benignancy of the tumor. Afterwards, the cortical hole was enlarged by a capsulotomy. Subsequent to a thorough curettage, the cavity walls were further cleaned by a

Fig. 1 Insertion of guide wire through the rotation center of the hip joint



high-speed burr and phenolized. Following tumor removal, the cavity was impacted with cancellous allograft, or hydroxy-apatite blocks. In patient number 2, who had a displaced fracture, a 135° angled blade plate was also implanted.

The patients with an acetabular lesion were further evaluated by angiography preoperatively, and the lesions were embolized. They were operated on a lateral decubitus position through a posterior Kocher-Langenbeck incision. The tumor removal steps were the same as described before. The articular cartilage defects were covered with a prolene mesh, roofed by collagen leaflets, and then grafted in a similar fashion.

After the wounds had been closed primarily, hip distraction was performed on a fracture table in all patients. Accurate alignment of the external fixator with its rotating axis in line with hip joint flexion-extension arc is of vital importance. First, a guide Kirschner wire was inserted through the center of rotation of the hip under image intensifier (Fig. 1). Then, the hinge of the external fixator was aligned with this guide wire. The lower extremity was kept in 10° of abduction, neutral rotation, and 0° flexion with the help of the fracture table. Except patient number 5, who had a wide supraacetabular destruction, an Orthofixarticulated distraction de-



Fig. 2 Orthofix articulated hip distractor

vice (Verona, Italy) (Fig. 2) was applied to provide arthrodiastasis. In patient number 5, a ring circular external fixator with greater modularity for pin insertion sites was used. The proximal pelvic fixation was accomplished transversely with a T-clamp, or a pelvic arc, by three halfpins of 6-mm diameter. The distal three halfpins of the same diameter were placed in the femoral upper diaphysis using a template.

The hip joint was distracted by 0.25-mm increments daily, beginning in the immediate postoperative period. Patients were mobilized with full weight bearing using two crutches.

Distraction was discontinued when the Shenton line was broken on an anteroposterior x-ray of the pelvis. The hip was kept immobile for 3 weeks, and then unlimited flexion-extension was allowed around the hinge. To alleviate range of motion exercises, an epidural catheter was inserted for analgesia during the first 7–10 days.

Results

The patients were kept in external fixators for an average of 19.8 weeks (range: 16–24). The fixator was removed when bony consolidation was observed in anteroposterior and lateral x-rays of the lesion. The frames were removed under general anesthesia, and the patients were told to walk with partial weight bearing for 4 weeks.

The patients were followed-up for an average of 47 months (range: 38–56) after frame removal. They were examined with radiographs every 4 weeks before frame removal, and every 3 months after frame removal for the first 2 years, and every 6 months thereafter (Table 1). The revised Musculoskeletal Tumor Society Rating Scale-93 [6] was utilized to assess the patients clinically. This systems contains six items (pain, function, emotional acceptance, supports,

walking, and gait handicap), each item is scored from 0 to 5, and the overall scores are converted to percentage. The average score of the study group was 95.2 (range: 87–100), with patients with acetabular lesions displaying a slightly poorer result but still with excellent function.

None of the lesions showed recurrence during radiologic follow-up examinations. No avascular necrosis of the femoral head was observed. All patients had excellent graft healing. As to complication of external fixation, minor pin tract infections were observed in two patients, which healed with meticulous pin tract care and oral antibiotics (Fig. 3A–E).

Discussion

The proximal femur and acetabulum are frequent sites for benign active and aggressive lesions. The risk of pathologic fracture is great when a bone-destroying pathology involves an anatomic location that undergoes profound mechanical loading, like the hip joint. Besides, fractures in this region have the potential risk of avascular necrosis and nonunion [5].

Except for fibrous dysplasia, there are few studies dealing with the treatment of pathologic fractures of the proximal femur due to benign bone tumors [8, 11]. Treatment of aneurysmal tumors of the pelvis are also well described [3, 9]. All of these studies emphasize the normal life expectancy of patients belonging to a young age group, which necessitates a meticulous surgical planning and a biologic reconstruction, unlike the principles of metastatic pathologic fractures. The importance of local adjuvants such as high-speed burr or chemocauterization was also underlined [3, 8, 9, 11]. The current study deals with a patient population with an average age of 21, all with active or aggressive benign lesions. There were no local recurrences, avascular necrosis, or other degenerative complications.

Articulated distraction off-loads the hip joint. Movement in one plane is also encouraged through a hinge. The hinge should be placed exactly on the sagittal axis of rotation of the hip joint [1, 2]. Frontal plane movement (abduction-adduction) is prohibited with the device. The hinged external fixator allows movement only in the sagittal plane (flexion-extension). The patients are educated by physiotherapists not to try to rotate and abduct their hips before they leave the hospital.

Creating a space between the injured joint surfaces, reducing mechanical stress, and providing movement are thought to restore the synovial circulation and encourage fibrous repair of articular cartilage without the formation of adhesions [2]. Articulated distraction of the hip joint was previously reported to be used in degenerative pathologies of the hip joint such as avascular necrosis, chondrolysis, and osteoarthritis [1, 2]. After the removal of the external fixator, the patients are allowed to walk with partial weight bearing to prevent complications such as secondary femoral fractures or collapse of the grafted defects. The authors reported good clinical results, which were not always parallel to clinical improvement [1, 2]. According to the au-

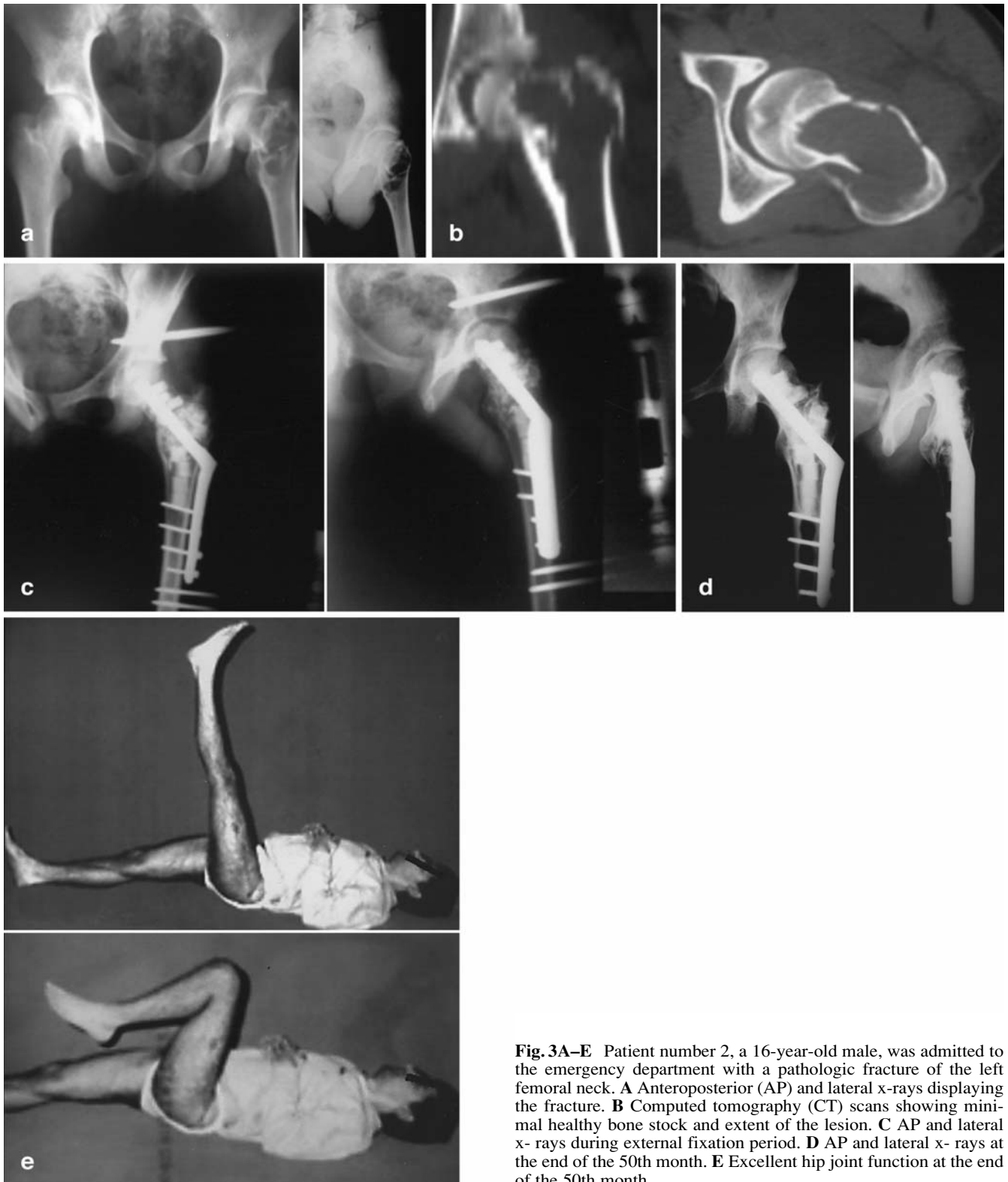


Fig. 3A–E Patient number 2, a 16-year-old male, was admitted to the emergency department with a pathologic fracture of the left femoral neck. **A** Anteroposterior (AP) and lateral x-rays displaying the fracture. **B** Computed tomography (CT) scans showing minimal healthy bone stock and extent of the lesion. **C** AP and lateral x-rays during external fixation period. **D** AP and lateral x-rays at the end of the 50th month. **E** Excellent hip joint function at the end of the 50th month

thors' knowledge, this investigation is the first in the literature describing the use of articulated joint distraction in the treatment of benign active and aggressive lesions around the hip joint. With the use of articulated external fixator, complications of conventional methods like limb

length discrepancy or arthrodesis failure [9] may be anticipated. Taroni et al. published a case of pathologic fracture of the femoral neck due to a bone cyst with a good result [10]. However, this study is the first to adopt principles of joint distraction into bone tumor surgery.

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