Tumors About the Knee Misdiagnosed as Athletic Injuries

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Background: Musculoskeletal tumors may originally mimic a traumatic condition, and, on the basis of an erroneous diagnosis of an athletic injury, an invasive diagnostic or therapeutic procedure may be performed. We determined the number of such cases treated at our institution, and we analyzed the initial and final diagnoses as well as the changes in the indicated oncologic surgical technique due to the initial erroneous diagnosis.

Methods: Twenty-five patients who had a bone or soft-tissue tumor about the knee that originally had been diagnosed as an athletic injury were referred to our institution. The complete clinical, radiographic, and pathological records were reviewed. Studies that had been performed prior to the invasive procedure and at the time of admission to our institution were evaluated to determine differences in the tumor stage and the oncologic treatment that was indicated at each time.

Results: Of 667 knee tumors diagnosed in our institution, twenty-five (3.7%) previously had been treated with an intra-articular procedure as a result of a misdiagnosis of an athletic injury. The final diagnoses made at our institution were a benign tumor in eleven patients and a malignant tumor in fourteen. Oncologic surgical treatment was affected in fifteen of the twenty-five patients.

Conclusions: When a knee tumor is initially misdiagnosed as an athletic injury, treatment may be adversely affected by the delay in diagnosis or an inappropriate invasive procedure that results in extension of the tumor. Initial poor-quality radiographs and an unquestioned original diagnosis despite persistent symptoms were the most frequent causes of an erroneous diagnosis.

Level of Evidence: Prognostic study, Level IV (case series). See Instructions to Authors for a complete description of levels of evidence.

Sports-related lesions around the knee are very common in young athletes, with an estimated annual rate of 0.3 per 100 individuals, depending on the definition of such injuries[1]. Musculoskeletal tumors are much less common, but they frequently occur in the same age group and also around the knee, and patients often recall some traumatic event with pain and swelling about the knee.

At oncologic musculoskeletal centers, it is not uncommon to see patients with a knee tumor that had been previously treated, for variable periods of time, as an athletic injury. We studied a group of such patients who, prior to their admission to our institution, had been treated with an invasive diagnostic or therapeutic procedure for a traumatic condition. We selected these patients for our study because such procedures might influence the final treatment, either by increasing the time required to make the final diagnosis of the tumor or by contaminating surrounding tissues. Both factors may alter the original identified tumor stage, the prognosis, and the surgical approach required to treat the tumor.

The purposes of this study were to determine the number of patients with a tumor about the knee who had undergone an inappropriate intra-articular procedure before eventually being treated for the tumor at our institution, to analyze the initial and final diagnoses, and to retrospectively evaluate changes in the indicated oncologic surgical management before and after the final diagnosis was made.

Materials and Methods

Between 1980 and 1998, 667 patients with a benign or malignant lesion around the knee were treated at our institution. Twenty-five (3.7%) of these patients previously had had an invasive diagnostic or therapeutic procedure because of an original diagnosis of an injury due to sports participation. The mean age of these twenty-five patients (eighteen male and

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TABLE I Benign Tumors

Case	Gender, Age *(yr)*	Initial Diagnosis	Invasive Procedure	Final Diagnosis	Potential Initial Treatment	Final Treatment	Final Treatment Affected
1	M, 27	Meniscal lesion	Arthrography	Chondroblastoma	Intralesional curettage	Intralesional curettage	No
2	M, 35	Meniscal lesion	Arthrography	Giant-cell tumor	Intralesional curettage	Intra-articular resection	Yes
3	M, 27	Meniscal lesion	Arthrography	Giant-cell tumor	Intralesional curettage	Intra-articular resection	Yes
4	M, 38	Meniscal lesion	Arthrocentesis	Giant-cell tumor	Intralesional curettage	Intra-articular resection	Yes
5	M, 29	Ant. cruc. lig. rupture	Arthrocentesis	Periosteal chondroma	Marginal resection	Marginal resection	No
6	F, 18	Meniscal lesion	Open meniscectomy	Chondroblastoma	Intralesional curettage	Intra-articular resection	Yes
7	M, 15	Meniscal lesion	Arthroscopic meniscectomy	Chondroblastoma	Intralesional curettage	Intra-articular resection	Yes
8	M, 15	Meniscal lesion	Arthroscopic meniscectomy	Chondroblastoma	Intralesional curettage	Intralesional curettage	No
9	M, 24	Meniscal lesion	Open meniscectomy	Giant-cell tumor	Intralesional curettage	Intra-articular resection	Yes
10	M, 17	Meniscal lesion	Arthroscopic meniscectomy	Osteoid osteoma	Marginal resection	Marginal resection	No
11	M, 17	Patellofemoral subluxation	Arthroscopic lateral release	Hemangioma	Marginal resection	Marginal resection	No

seven female) was twenty-seven years (range, fifteen to fifty-five years). Fifteen of the lesions were in the distal part of the femur, eight were in the proximal part of the tibia, and two were in the popliteal space.

Because of the unsatisfactory clinical results of the original procedures, the patients were reexamined, and the final diagnosis was a benign tumor in eleven patients (Table I) and a malignant tumor in fourteen (Table II). The complete clinical, radiographic, and pathological records of the twenty-five patients were reviewed. No patient had had previous

Fig. 1-A

Figs. 1-A and 1-B Case 12, a forty-three-year-old male soccer player who was finally diagnosed with an osteosarcoma after having been initially treated as if he had an athletic injury. **Fig. 1-A** Knee pain was interpreted as being caused by a meniscal lesion. An arthrogram was performed (lower arrow indicates the arthrogram study showing the contrast). Increased bone density in the metaphysis and a radiolucent area in the popliteal space (upper arrow) were not noted at that time. A palpable posterior mass, thought to be a popliteal cyst or a traumatic hematoma, was punctured with the needle intentionally during the procedure, in order to clarify its nature. **Fig. 1-B** Sagittal magnetic resonance image, made at the time of admission to our institution, shows an osteosarcoma of the distal part of the femur with cortical destruction and soft-tissue extension (arrow).

TABLE II Malignant Tumors

Case	Gender, Age *(yr)*	Initial Diagnosis	Invasive Procedure	Final Diagnosis	Potential Initial Treatment	Final Treatment	Final Treatment Affected
12	M, 43	Meniscal lesion	Arthrography	Osteosarcoma	Intra-articular resection	Amputation	Yes
13	M, 21	Meniscal lesion	Arthrocentesis	Osteosarcoma	Intra-articular resection	Intra-articular resection	No
14	M, 20	Meniscal lesion	Arthrocentesis	Osteosarcoma	Intra-articular resection	Intra-articular resection	No
15	F, 16	Meniscal lesion	Arthrography	Osteosarcoma	Intra-articular resection	Amputation	Yes
16	M, 20	Meniscal lesion	Arthroscopic meniscectomy	Ewing sarcoma	Intra-articular resection	Intra-articular resection	No
17	M, 26	Chronic synovitis	Open synovectomy	Ewing sarcoma	Partial femoral resection	Partial femoral resection	No
18	M, 33	Meniscal lesion	Open meniscectomy	Chondrosarcoma	Intra-articular resection	Extra-articular resection	Yes
19	M, 29	Meniscal lesion	Open meniscectomy	Chondrosarcoma	Intra-articular resection	Amputation	Yes
20	F, 55	Meniscal lesion	Arthroscopic meniscectomy	Chondrosarcoma	Intra-articular resection	Extra-articular resection	Yes
21	M, 18	Meniscal lesion	Open meniscectomy	Osteosarcoma	Intra-articular resection	Amputation	Yes
22	F, 22	Meniscal lesion	Arthroscopy	Fibrosarcoma	Intra-articular resection	Extra-articular resection	Yes
23	F, 40	Meniscal lesion	Arthroscopy	Fibrosarcoma	Intra-articular resection	Amputation	Yes
24	F, 34	Meniscal lesion	Arthroscopy	Fibrosarcoma	Intra-articular resection	Intra-articular resection	No
25	F, 33	Synovial cyst	Open synovectomy	Synovial sarcoma	Extra-articular resection	Amputation	Yes

magnetic resonance imaging. Most likely, had that diagnostic study been performed, the knee tumor would have been diagnosed and the intra-articular procedure would have been avoided. Since the original diagnoses had been made on the basis of clinical examination and radiographs (with no additional imaging studies in most cases), we compared the results of those studies with the results of studies performed prior to tumor treatment, in order to determine how the indicated oncologic surgical procedure might have been affected by changes in the stage and size of the tumor.

Results

The initial diagnoses included twenty-one meniscal lesions, one traumatic synovial cyst, one patellofemoral subluxation, one acute rupture of the anterior cruciate ligament, and one case of chronic

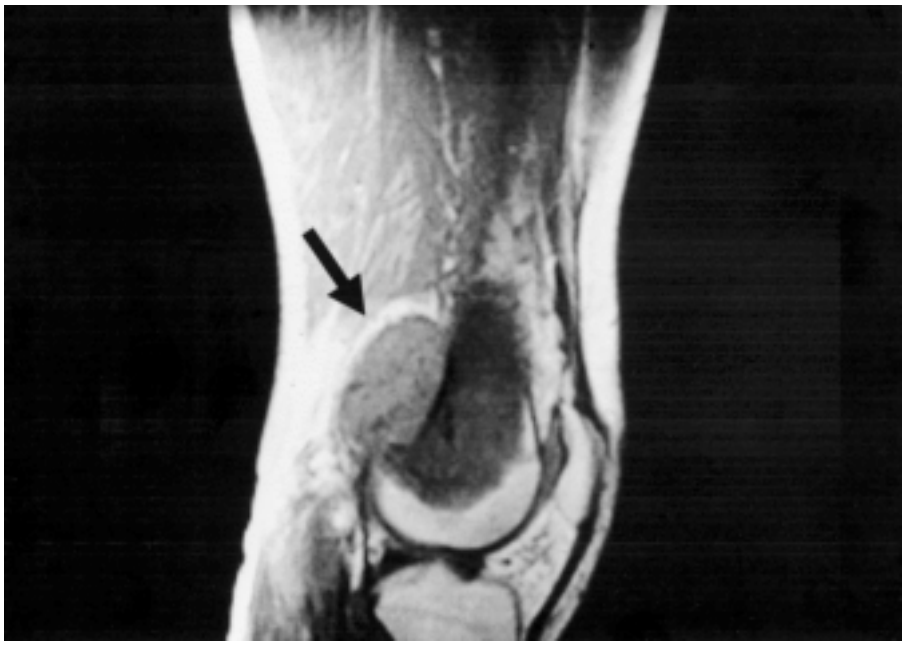

Fig. 1-B

Fig. 2-A

Figs. 2-A, 2-B, and 2-C Case 15, a sixteen-year-old girl who had had knee pain for six months and was treated for that period of time as if she had a meniscal lesion. A distal femoral osteosarcoma was finally diagnosed. **Fig. 2-A** Initial lateral radiograph of the affected knee, in which an originally unappreciated metaphyseal condensation can be seen.

unspecific synovitis. On the basis of these diagnoses, the patients underwent four arthrocenteses for supposed traumatic hemarthroses, five arthrographic procedures (Figs. 1-A through 2-C), five open meniscectomies, five arthroscopic meniscectomies, three diagnostic arthroscopic procedures (Fig. 3), two synovectomies, and one arthroscopic lateral release.

After the patients were reexamined at our institution, the final oncologic diagnoses included fourteen malignant lesions (five osteosarcomas, two Ewing sarcomas, three chondrosarcomas, three fibrosarcomas, and one synovial sarcoma) and eleven benign lesions (four giant-cell tumors, four chondroblastomas, one hemangioma, one osteoid osteoma, and one periosteal chondroma).

According to an evaluation of the studies performed when the diagnosis of an athletic injury was made and the studies performed at the time of admission to our institution, the final indicated oncologic surgical procedure was altered by a delay in diagnosis or contamination of the tumor margins in fifteen of the twenty-five patients and was not altered in the remaining ten. Delay in making the final tumor diagnosis seemed to be the factor that most frequently affected treatment. Of the eleven benign tumors, all four stage-1[2] giant-cell tumors became stage-3 tumors requiring an intra-articular resection without preservation of the knee joint. Also, two of the four chondroblastomas required a resection instead of intralesional curettage because of extracompartmental tumor growth (Table I). Of the fourteen malignant tumors, nine that had initially been stage IIA[2] progressed to stage IIB[2] and were treated with an amputation or an extra-articular resection (Table II). Arthroscopic portals were not a factor affecting final treatment in any of these patients. However, in three patients (Cases 12, 23, and 25), the intra-articular procedure clearly had altered the final surgical technique needed because of contamination of surrounding, previously unaffected tissues. According to the original clinical information and imaging studies, a limb salvage procedure would have been indicated in these patients, but an amputation was performed either because of difficulties in defining oncologic margins or as a result of local tumor recurrence.

Fig. 2-B

After several weeks of physical therapy, an arthrogram was performed. A well-demarcated soft-tissue mass at the posterior cortex of the femur is seen (arrows).

Fig. 2-C

Lateral radiograph made at the time of admission to our institution, showing a tumor mass with gross periosteal reaction (arrows). The diagnosis of an osteosarcoma was confirmed by a needle biopsy. The patient underwent amputation.

Discussion

The number of knee tumors compared with the number of true sports injuries occurring in the general population has not been clearly documented in the literature[1]. We did not attempt to clarify this issue in our study because we were unable to obtain information regarding the total number of athletic injuries diagnosed at the referring institutions during the study period. However, we do know that, of 667 new knee tumors referred to our institution during the study period, only twenty-five clearly had been originally managed as athletic injuries.

Our study group included patients treated since 1980 because, from that time forward, most chemotherapy and limb salvage procedures were standardized. Patients who were treated with intra-articular procedures, such as arthrography or open meniscectomy, that were usually indicated in the 1980s but are rarely done now, were included in the study. There are few reports in the literature related to this subject[3-6]. Joyce and Mankin[4] reported on eleven patients with a knee tumor in whom arthroscopy had been done. They suggested that such a procedure might violate the cuff of normal tissue surrounding a knee tumor, seeding cells into the joint. Lewis and Reilly[5] studied a series of patients who initially had been thought to have a sports-related knee injury but ultimately were diagnosed as having a primary bone or soft-tissue tumor or a tumor-like condition involving the knee; however, only some of those patients had either knee arthroscopy or arthrography, and no attempt was made to evaluate the consequences of such procedures on the clinical outcome. Schwartz and Limbird[6] reported on thirteen patients who had had arthroscopy (performed on the knee in twelve) before they eventually were diagnosed as having a tumor. Consequences such as compartmental contamination or inaccurate or delayed diagnosis were briefly addressed.

The prognosis for most musculoskeletal tumors depends not only on the therapeutic techniques that are used, but also on the stage at which the tumors are diagnosed[7,8]. A delay in diagnosis allowing tumor progression or an alteration of previ-

Fig. 3

Case 23, a forty-year-old woman with knee pain who had poor-quality initial radiographs and underwent a diagnostic arthroscopy at another institution. This anteroposterior radiograph shows a pathologic fracture of the distal part of the femur that occurred during the arthroscopic procedure. The final diagnosis was fibrosarcoma, and the patient eventually had an amputation because of gross local tumor contamination.

ously uncontaminated tumor margins may change the tumor stage and substantially affect the type of surgical techniques that must be used as well as the prognosis. In our series, the type of definite treatment needed was altered for six of the eleven patients with a final diagnosis of a benign bone or soft-tissue tumor. Four giant-cell tumors and two aggressive chondroblastomas that, according to the initial radiographs and records would have been managed with curettage, had to be treated with resection and allograft reconstruction because of progressive growth of the tumor. Nine of the fourteen patients with a malignant tumor also had an alteration in the final treatment required, as a result of changes in the original tumor stage or because of soft-tissue contamination. According to the initial records, eight of those nine patients would have been treated with an intra-articular resection and one (Case 25) would have been treated with an extra-articular resection, but three were finally treated with an extra-articular tumor resection and six had an amputation. A delay in the appropriate treatment caused by an inaccurate diagnosis seemed to be the most frequent cause for the selection of a more aggressive procedure. Also, in three patients, the type of treatment ultimately needed was substantially altered by tumor contamination of originally unaffected tissues caused by the initial procedure.

With regard to the validity of our results, it should be noted that this was a retrospective clinical study with potentially uncontrolled variables. Also, criteria for appropriate tumor margins may have changed during the last two decades. In addition, for some patients, only basic clinical information and imaging studies from the time of the initial diagnosis were available. Finally, variations in individual responses to chemotherapy may have influenced the choice of surgical treatment for some sarcomas.

Athletic injuries are much more frequent than tumors in active young people, and the knee is one of the most frequently affected joints[9]. However, a high proportion of primary aggressive benign or malignant bone tumors occur in the same age group and have a predilection for the same joint[2,10]. In addition, the clinical presentation of a musculoskeletal tumor may mimic that of a sports-related injury.

Reviewing the records of our patients, we found that initial poor-quality radiographs and an unquestioned original diagnosis despite persistent symptoms seemed to be the most frequent causes of an erroneous diagnosis.

It is important to note that no patient in this study had magnetic resonance imaging prior to the invasive procedure. Although at many institutions, including ours, magnetic resonance imaging now would be performed before an intra-articular procedure such as arthroscopy was done, the indications for magnetic resonance imaging under these circumstances have been controversial[11-14]. However, not performing such a study when the diagnosis is in question might have serious consequences for the patient. ■

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