Knee Stability after Resection of the Proximal Fibula

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Managing tumors of the proximal fibula may require en bloc resection of the fibular head with the attachment site for the lateral collateral ligament. These resections of the proximal fibula cause unavoidable knee instability. We describe a reconstructive technique intended to minimize that instability. We retrospectively reviewed 24 patients who had proximal fibular resections from 1987 to 2004 and analyzes their knee stability and functional outcome. Resections were less (Type I) or more (Type II) radical depending upon the tumor type. Reconstruction included stapling the lateral collateral ligament to the lateral tibial metaphysis, cast immobilization, and protected weightbearing for 3 weeks. MSTS function scores were available for 19 of the 24 patients. At their most recent followup, 20 patients had a stable knee, three had 1 to 5 mm lateral joint space opening, and one had 6 to 10 mm lateral joint space opening. Patients with Type I resection had a better stability and function than those with a Type II resection. Stapling the lateral collateral ligament was a reliable technique for reconstructing the lateral collateral ligament after resecting the proximal fibula.

Level of Evidence: Level IV Therapeutic study. See the Guidelines for Authors for a complete description of levels of evidence.

The proximal fibula is a rare location for primary bone tumors. Achieving local tumor control may require removing a fibular segment including the fibular head. These resections result in an unavoidable loss of knee stability because of resecting the lateral collateral ligament (LCL) insertion site on the fibular head. Reports regarding resecting the proximal fibula are rare. They include small series of patients, and lack detailed descriptions of the reconstructive techniques or analyses of postoperative knee stability.

We describe our technique of reconstructing the LCL attachment after resection of the proximal fibula and report postoperative lateral knee stability and functional outcomes.

MATERIALS AND METHODS

We retrospectively reviewed 24 consecutive patients with tumors of the proximal fibula treated with resection from 1987 to 2004. We did not include a control group. The series included 16 females and eight males ages 17 to 56 years (median, 29 years) diagnosed with 10 benign-aggressive tumors and 14 primary bone sarcomas (Table 1). Patients who had high-grade sarcomas were treated with preoperative chemotherapy. We followed patients a minimum of 9 months (median 44 months, range 9 to 97 months).

The types of proximal fibular resections were described by Malawer. A Type I resection included the proximal fibula, a thin muscle cuff in all dimensions, and the LCL attachment site. The peroneal nerve and its motor branches were preserved and the tibiofibular joint was excised intraarticularly (Fig 1). We used this resection for treatment of benign-aggressive tumors and low-grade sarcomas. A Type II resection included an en bloc removal of the proximal fibula and the tibiofibular joint, the anterior and lateral muscle compartments, the peroneal nerve, and the anterior tibial artery (Fig 2). We used a Type II resection for treatment of high-grade sarcomas.

We attached the LCL to the lateral tibial metaphysis using a staple with the knee in 20° flexion after an osteoperiosteal flap (Fig 3). We reinforced the fixation with nonabsorbable sutures to the overlying iliotibial band and fascia.

Postoperatively, the extremity was immobilized in a cast for 3 weeks in 20° flexion to allow soft tissue healing. After cast
removal, full weightbearing and full active range of motion (ROM) around the knee were allowed. An ankle-foot orthosis was used for patients who had Type II resections and had drop-foot because of peroneal nerve dysfunction.

Patients who had high-grade sarcomas were treated with pre-operative chemotherapy. Patients with Ewing’s sarcoma were further treated with radiation therapy consisting of external beam radiation of 6000 to 7000 Gy.

They were evaluated by plain radiography and a physical examination every 3 months for the first 2 postoperative years. Patients with high-grade sarcomas also had computed tomography (CT) of the chest. We assessed lateral knee stability by measuring the degree of lateral joint space opening using a varus stress with the knee in 30° flexion and in neutral tibial rotation. Instability was scored as Grades 1 to 3: Grade 1 = an opening of 1 to 5 mm, Grade 2 = 6 to 10 mm, and Grade 3 ≥ 11 mm (ie, complete LCL dysfunction), and it was determined by comparing the result with the normal contralateral knee.7 Functional evaluation was done according to the Musculoskeletal Tumor Society scoring system.3 With this system, a numerical value is assigned for each of six categories: pain, function, emotional acceptance, supports, walking, and gait. The results presented below are expressed as the proportion of full normal function in all six categories and are based on the values recorded during each patient’s most recent followup. We evaluated patients semi-annually for 3 years and annually thereafter.

An orthopaedic oncologist (JB) analyzed the clinical records, imaging studies, and operative reports. We recorded data regarding histologic diagnoses, surgical techniques of tumor resection and reconstruction, complications, knee stability, knee ROM, and rates of local tumor recurrence. Knee stability was assessed by the operating surgeons (JB, YK, IM, MM) who were not blinded to the type of fibular resection done on the patients. The results of knee stability and ROM were based on each patient’s most recent followup.

Statistical analyses included Fisher’s exact test to compare results of knee stability and functional parameters after different types of fibular resections. Significance was set at the p < 0.05 level.

**RESULTS**

Of the 24 patients who had proximal fibula resections, 15 had a Type I resection and nine had a Type II resection.
Postoperatively, one patient (4%) had a deep wound infection and underwent surgical débridement and a 6-week course of antibiotics. Two patients (8.3%) had superficial wound infections that were treated successfully with a 10-day course of oral antibiotics.

All nine patients who had Type II resections had an expected iatrogenic complete and permanent loss of peroneal nerve function. Three patients who had Type I resections had a transient peroneal nerve palsy that resolved spontaneously within 4 to 7 months. None of the patients had flap ischemia, wound dehiscence, or thromboembolic complications.

Twenty patients (83%) had stable knee, three (13%) had Grade 1 instability, and one (4%) had Grade 2 instability (Table 2). Patients who had reconstruction after a Type I resection had a higher (p < 0.025) rate of knee stability compared with patients who had a Type II resection. All patients had full ROM of the ipsilateral knee. The three patients who had Grade 1 instability were asymptomatic and did not require knee support for ambulation. The one patient with Grade 2 instability required a knee brace, and occasionally, a cane for ambulation.

Data regarding functional outcome were available for 12 patients who had Type I resections and for seven patients who had Type II resections; the former group had better (p < 0.02) functional outcome (Fig 4).

**DISCUSSION**

We report our technique of reconstructing the LCL after resecting the proximal fibula and analysis of lateral knee stability and functional outcome. Our reconstruction technique included stapling the LCL to the tibial metaphysis, immobilization, and protected weightbearing. Faeyzpour et al described a similar technique of reconstructing the LCL, but their five patients had benign tumors and had Type I resections of the proximal fibula. We analyzed a relatively large group of patients who had two types of resections for benign (Type I resection) and malignant (Type II resection) diagnoses, and compared the stability and functional outcomes between the two groups.

We acknowledge this is a relatively small series although we could identify differences in functional outcome with the two types of resection. Knee stability was assessed by the operating surgeons, who were aware of the type of fibular resection done on the patients at time of assessment. Clinical assessment of instability is prone to interobserver variability and our retrospective evaluation did not allow evaluation of interobserver variations or accuracy of the ranges of instability.

The patients who had a Type II resection of the fibula had more lateral knee instability. Most patients had a mild Grade 1 instability that was asymptomatic and did not require knee support. We speculate the reason for the increased instability after a Type II resection might be a shorter LCL stump, which provides a short lever arm for its function and less viable adjacent soft tissues to support its healing. Furthermore, delayed healing is anticipated in patients who received postoperative chemotherapy.

In addition to the impairment of LCL function, patients who have a Type II resection lose the peroneal nerve and a considerable amount of muscle tissue from the anterolateral compartment of the leg. These losses are considered the reason for their inferior functional outcome when compared with outcomes of patients who had a Type I resection. Of all functional parameters assessed, the most profound difference between the two groups is the need for supports because of the use of peroneal braces in all patients who had a Type II resection.

**TABLE 2. Knee Stability in the 24 Patients**

<table>
<thead>
<tr>
<th>Type of Fibular Resection</th>
<th>Stable Knee</th>
<th>Lateral Knee Instability</th>
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<tr>
<td></td>
<td></td>
<td>Grade 1</td>
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<tr>
<td>Type I</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>Type II</td>
<td>6</td>
<td>2</td>
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Stapling the LCL to the tibial metaphysis was a safe and reliable technique to reconstruct knee stability after resection of the proximal fibula. It provided stability and good function in the majority of patients. This technique is simple to perform and associated with minimal morbidity.

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**References**