

# Reconstruction after resection of the distal fibula for bone tumor

We have reviewed 11 patients after distal fibular resection for benign or malignant tumors with different techniques of reconstruction. Seven patients had normal function and four had reduced mobility, one of whom had a lateral subluxation of the talus. All the patients were without pain. After resection of the lateral malleolus without replacement the soft tissues should be reinforced.

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Resection of the distal fibula has usually been indicated only for pseudoneoplastic lesions or benign or low-grade malignant tumors (Carrel 1938, Shoji et al. 1970, Piccione & Martorana 1978, Persson & Rydholm 1979, Edmonson & Crenshaw 1980, Yadav 1981). After the introduction of combined therapy and improved preoperative radiographic staging, local surgery has recently been tried also for highgrade malignant tumors. We reviewed 11 patients who had undergone a resection of the distal fibula because of pseudoneoplastic, benign or malignant neoplasms.

## Material and methods

We reviewed 11 patients (five males and six females) with an average age of 21 (6-41) years. Four patients had an aneurysmal bone cyst; one, chondromyxoid fibroma; one, a desmoplastic fibroma; one, a Grade I central chondrosarcoma; and four patients had Ewing's sarcoma (Table 1).

The surgical margins were classified according to Enneking et al. (1980). An extraperiosteal and sub-total resection of the distal fibula saving the lateral malleolus was performed in three cases; the resection was considered marginal. In three cases of benign tumour involving the lateral malleolus a sub-total resection of the distal fibula and curettage of the lateral malleolus was performed; the operation was considered intralesional because of the curettage of the involved malleolus. A total resection of the distal fibula, including the lateral malleolus, was

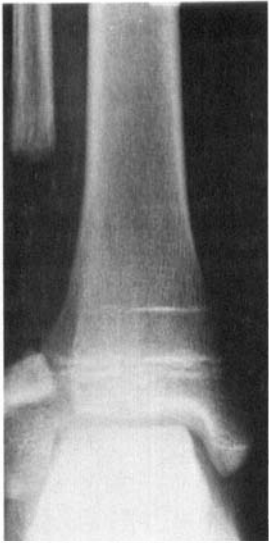
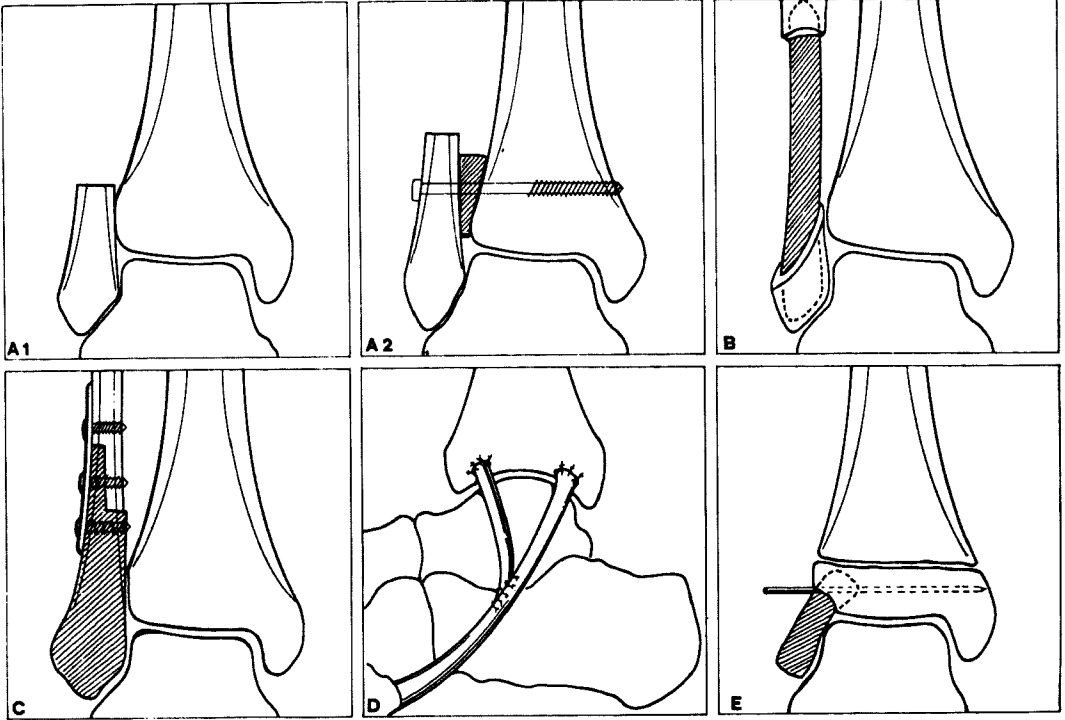
performed in five cases of malignant tumor; the surgical margins were judged marginal in two cases, and wide in three cases (Table 1). The operations were classified into six different types (Figure 1, Table 2).

A cast was applied postoperatively in all the patients: the immobilization time was 1 month in Types A1, C, and D surgical procedures; 2 months in Type A2; and 3 months in Type B. Partial weight-bearing was usually allowed 1 month after surgery, except in Type B and C reconstructions, in which it was delayed 3 months. Complete weight-bearing was allowed after 1 month of partial weight-bearing except in Type C surgical procedures, in which it was allowed 10 months after surgery.

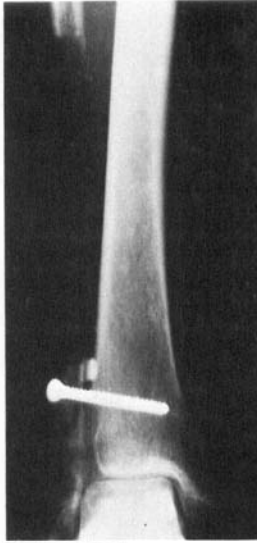
## Results

There were no postoperative infections. One patient (Case 11), with Ewing's sarcoma, who had postoperative radiotherapy, developed osteonecrosis of the distal tibia and a fatigue fracture, which healed spontaneously.

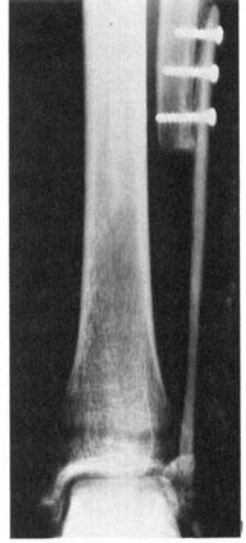
On follow-up at 18 (6-50) months, all the patients were without local recurrence or metastases. Patients (Cases 1-7) who underwent operation Types A, B, or C had normal mobility and stability of the ankle with no pain, neither at rest nor during weight-bearing. One patient (Case 8), operation Type C, had been operated on 6 months previously: at this short follow-up, she had no pain and a stable ankle, but re-



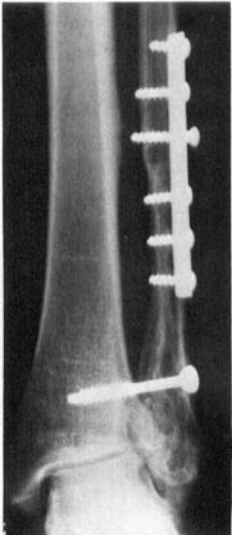
A1 (Case 2)



A2 (Case 3)



B (Case 4)



C (Case 7)



D (Case 10)

Figure 1. Surgical reconstructive techniques available after distal fibula resections (see Table 2).

Table 1. Clinical data and functional results in 11 cases of distal fibula resection

Case	Age	Sex	Diagnosis <sup>a</sup>	Stage <sup>b</sup>	Surgical <sup>b</sup> margin	Operation	Follow-up (yr)	Functional result <sup>c</sup>
1	41	F	ABC	3	M	A 1	1.5	E
2	13	F	Cmf	2	M	A 1	1	E
3	37	M	ABC	2	M	A 2	1	E
4	18	M	ABC	2	I	B	1	E
5	26	M	Df	2	I	B	1.5	E
6	16	M	ABC	3	I	B	0.5	E
7	39	F	Cs	I B	W	C	2	E
8	15	F	Es	II B	W	C	0.5	no pain, reduced mobility, stable
9	16	M	Es	II B	M	D	4	no ankle pain, reduced mobility (radionecrosis of distal tibia: healed), stable
10	9	F	Es	II B	W	D	2	no pain, reduced mobility, lateral subluxation, orthopedic shoes
11	6	F	Es	II B	M	D	1	no pain, reduced mobility, stable

<sup>a</sup> ABC Aneurysmal bone cyst.  
Cmf Chondromyxoid fibroma.  
Df Desmoplastic fibroma.  
Cs Central chondrosarcoma, Grade I.  
Es Ewing's sarcoma.

<sup>b</sup> Stage and surgical margins according to Enneking (1980),  
I, intralesional; M, marginal; W, wide.

<sup>c</sup> E Excellent: no pain, full mobility, stable

Case 8 had preop. and postop. chemotherapy.

Case 9 had postop. chemotherapy and radiotherapy.

Case 10 had postop. chemotherapy.

Case 11 had preop. chemotherapy and postop.  
radiotherapy and chemotherapy.

duced flexion-extension. Three patients (Cases 9–11), operation Type D, had no pain, but mobility was reduced, and one of them also had slight joint instability (Table 1).

## Discussion

Local surgery of tumors of the distal fibula presents two problems: the adequacy of the resection and the reconstruction of the ankle.

### Oncologic adequacy

In pseudoneoplastic lesions and benign tumors, curettage or a marginal resection of the lesion is almost always sufficient and possible. In malignant tumors, especially when high-grade, the surgical margins have to be wide or radical (Enneking et al. 1980) to reduce the risk of local recurrence. To obtain a wide margin, all the resected tumor must be covered by a layer of normal tissue. This is often possible for resection of the proximal fibula, which is completely covered by muscles. The distal third of the fibula, on the contrary, lies directly beneath the fascia laterally, is partially covered by the musculoaponeurotic parts of the peroneus

muscles posteriorly, and only anteriorly and medially is there a modest muscle coverage (Figure 2). Thus, in malignant neoplasms of the distal fibula, resection is indicated only in those rare cases when the tumor is still intraosseous or with minimal anteromedial invasion of the soft tissues, and in some tumors where local control may be achieved by combined therapy.

### Reconstruction

Ten cases of distal fibular resection have been reported (Carrel 1938; Shoji et al. 1970, Marcove & Jensen 1977, Piccione & Martorana 1978, Persson & Rydholm 1979, Edmonson & Crenshaw 1980, Yadav 1981). The lateral malleolus was saved in two patients and excised in eight. Of these eight, only in three patients was it reconstructed (Table 3).

From our experience, mobility and stability of the ankle usually remain unaltered when the lateral malleolus is preserved. However, in these cases the lateral malleolus may rotate in valgus hinging on the syndesmosis with widening of the tibiofibular mortise. Although we did not observe this, we prefer to use a bony wedge screwed into the intertibioperoneal

Table 2. Six types of resection and reconstruction of the distal fibula

Type	Distal fibula	Lateral malleolus	Reconstruction	Indication
A 1	resection of diaphysis and metaphysis	completely retained	none	pseudoneoplastic and benign neoplastic lesions that do not invade the lateral malleolus
A 2	resection of diaphysis	completely retained	intertibiofibular arthrodesis to stabilize the lateral malleolus	pseudoneoplastic and benign neoplastic lesions that do not invade the lateral malleolus
B	resection of diaphysis and metaphysis curettage of the lateral malleolus	conserved as osteo-cartilaginous shell	cortical graft within lateral malleolus and proximal fibula	pseudoneoplastic and benign neoplastic lesions that invade the lateral malleolus
C	total resection	resected	proximal fibula rotated 180°	benign and malignant neoplastic lesions that invade the lateral malleolus but do not require postoperative radiotherapy
D	total resection	resected	suturing of distal peroneal tendons to lateral side of tibia	malignant neoplastic lesions that invade the lateral malleolus and require postoperative radiotherapy
E	total resection	resected	partial reconstruction of lateral malleolus with a graft inserted and fixed into lateral side of the tibial epiphysis	pseudoneoplastic, benign, and malignant lesions in young children that invade the lateral malleolus but do not require postoperative radiotherapy

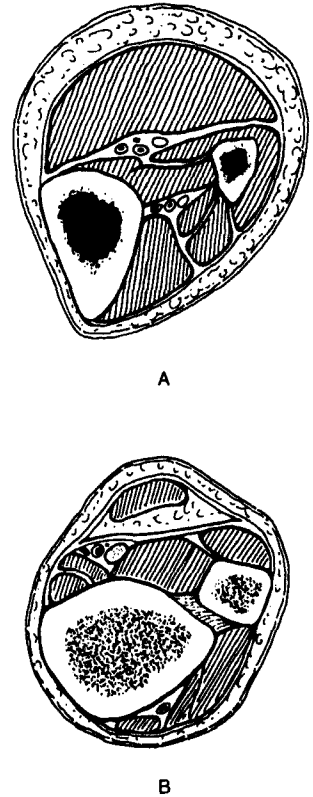


Figure 2. Transverse sections of the leg at its proximal (A) and distal (B) third showing the muscle coverage of the fibula.

Table 3. Clinical data and results concerning distal fibula resections as described in the literature.

Author	Age	Sex	Diagnosis	Operation	Follow-up (yr)	Instability	Motility
Edmonson & Crenshaw	—	M	—	D	40	none	normal
Carrel	45	F	Hemangioma	C	—	—	—
	6	F	Ewing's sarcoma	E	2	—	—
Marcove & Jensen	15	F	Osteosarcoma	D	2	none	limited, because of peroneal nerve section
Persson & Rydholm	36	M	Central chondrosarcoma	C	3	none	normal
Piccione & Martorana	17	M	Chondromyxoid fibroma	A1	2	—	—
Shoji et al.	11	M	Aneurysmal bone cyst	A1	8	none	normal
	14	F	Aneurysmal bone cyst	D	2	none	normal
Yadav	43	M	Giant cell tumor	D	2	none	25°
	12	F	Aneurysmal bone cyst	D	2	none	35°

— : not reported.

space to prevent rotation of the lateral malleolus: this technique (Type A2 reconstruction, Figure 1) can be performed when the lateral malleolus is resected 1.5–2 cm above the tibiofibular syndesmosis.

If the tumor is benign and involves the lateral malleolus, the distal metadiaphysis can be resected and the malleolus curetted. Only an osteocartilaginous shell of the malleolus is saved; this will provide a bed for the distal end of a cortical graft, the proximal part of which is placed in the medullary canal or screwed to the cortex of the stump of the fibula (reconstruction Type B, Figures 1 and 2). This results in an efficient reconstruction with normal stability and mobility.

If the lateral malleolus has to be resected completely, it is advisable to reconstruct the tibiofibular mortise with a bone graft, preferably the proximal fibula, rotated 180° and placed distally. The cartilaginous facet of the proximal fibula will then articulate with the talus, and the styloid apophysis will become the apex of the neomalleolus, rendering stability to the ankle. The distal portion of the biceps tendon is left inserted into the styloid apophysis for reinsertion of the lateral ankle ligaments. Internal fixation is achieved with a plate and a temporary screw above the syndesmosis. After reinsertion of the biceps tendon and the lateral collateral ligament, the knee was stable in our cases (reconstruction Type C, Figure 1).

Complete reconstruction of the fibula with bone grafts is not indicated in children because the grafted fibula does not grow proportional to the tibia, and this would cause a valgus deformity of the ankle. To preclude this complication after resection of the distal fibula in children Carrel (1938), reconstructed the malleolus with a small graft inserted into the tibial epiphysis below the growth cartilage (reconstruction Type E, Figure 1).

Fibular grafting is probably not indicated if the patient requires postoperative radiotherapy, because this would compromise the incorporation of the grafts. After resection of the malleolus, ankle stability can then be increased by suture of the distal ends of the peroneal tendons to the lateral side of the dis-

tal tibia (reconstruction Type D, Figure 1). Joint mobility and stability will be reduced, but the function of the limb remains good and only one of our three patients needed orthopedic shoes. Soft-tissue fibrosis due to radiotherapy contributes to ankle stability, although it reduces joint mobility.

Reconstruction of the distal fibula thus has different indications and solutions. In selecting the best procedure, the stage of the tumor, the age of the patient, and the need for postoperative radiotherapy or chemotherapy must be considered (Table 2). The functional results were excellent in cases where the tibiofibular mortise was preserved or reconstructed. Also the results were satisfactory when the lateral malleolus was resected without replacement and the soft tissues repaired.

### Acknowledgement

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