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SURGICAL TREATMENT OF METASTATIC PATHOLOGICAL FRACTURE OF MAJOR LONG BONES

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Pathological fracture of major long bone induced by malignant tumour metastasis is comparatively rare in series of surgical patients, but surgeons are now and then called upon to consider the possibilities existing for treatment of such cases, which have not received much attention. Reports have been presented by Beals et al. (1971), Bennish & Hammond (1955), Bremner & Jelliffe (1958), Devas et al. (1956) and MacAusland & Wyman (1970) in which the advantages achievable by osteosynthesis and by endoprostheses have been stressed. According to Devas et al. (1956) and Donaldson & Horsley (1970), the most common primary tumours inducing metastatic fractures are cancer of the mammary glands and of the lungs, but metastases are also sent out into the bones by other malignant tumours, where they may produce pathological fractures.

Fracture of a long bone due to metastasis may heal by the aid of callus formation produced periosteally, particularly if the lesion is given proper treatment, but the healing tendency of such a pathological fracture is inferior to that of a fracture occurring in an intact bone. One should therefore take into account in planning the treatment that conservative treatment may confine the patient to bed for an unreasonably long period of his remaining life span. It is for this reason that surgical treatment is now being resorted to in order to stabilize the bone and rehabilitate the patient, although the prognosis is poor and the survival period may be short. The aim of such surgical treatment is, above all, to mobilize the patient by restoring his mobility, thus releasing him from bed and reducing pain during nursing. Walking with aids is possible regardless of whether bony union is achieved, stable osteosynthesis being the means for producing such a result. In

Table 1. Age distribution (11 men, 34 women; total 50 fractures).

Age (years)	Patients
30–39	2
40–49	7
50–59	9
60–69	20
70–79	4
80–89	3
Total	45

some cases even fracture consolidation and restored functional ability of the extremity can be achieved.

MATERIAL

The material, from 1960–1970, of 50 metastatic fractures in 45 patients was subjected to retrospective analysis, in order to clarify the results of surgical treatment and the indications for surgery.

The age distribution of the patients can be seen in Table 1. The majority were elderly patients, a fact which was significant as regards fitness for operation and postoperative ability to move. Sixty-six per cent of the patients were over 60 years of age. *The sex distribution* (Table 1) shows that three–fourths of the patients were women.

Table 2. Establishment of primary tumor and metastatization.

Type of primary tumour	Total	Time of discovery			Metastasis	
		prior to fracture	in connection with fracture		solitary	multiple
Cancer of breast	21	21			3	18
Cancer of lung	7	5		2	2	5
Hypernephroma	3	2		1	1	2
Cancer of bladder	2	2			1	1
Cancer of uterus	1	1				1
Myeloma/Leucaemia	5	2/0		2/1	3	2
Sarcoma	1	1				1
Undiscovered	5		(5)		2	3
Total	45	34	(5)	6	12	33

Table 3. Site and surgical treatment of 50 pathological fractures.

Site		Method of treatment			
	Medullary nailing	Nail-plate	Endo-prosthesis	L-plate	Plaster cast
Femur, collum		3	4		
„ trochanteric		8			
„ subtrochant.	1	9			
„ diaphysis	17				1
„ supracondylar				1	1
Humerus, collum					1
„ diaphysis	3				1
Total	21	20	4	1	4

The type of primary tumour, the time of its discovery with reference to the fracture and *the extent of metastatization* are presented in Table 2. The primary tumour of 34 patients had been established and treated prior to the fracture caused by its metastasis; in 11 the pathological fracture was the first symptom of malignant disease, necessitating a search for the tumour in addition to treatment of the fracture. The search was unsuccesful in five cases, the terminal phase ensuing before the location of the tumour could be found. In most of the present cases, treatment of metastases had also been necessary prior to the pathological fracture, and to this purpose radiotherapy, cytostatics, hormonal treatment or hypophysectomy and adrenalectomy had been applied. The metastasis responsible for the fracture had been irradiated in only two cases.

The location of the fracture can be seen in Table 3. The largest group consists of fractures, metastatic to mammary carcinoma, of the diaphysis of the femur or of its trochanteric region.

Methods of treatment

Table 3 also shows the surgical procedures applied in the present series. Most common were medullary nailing according to Küntscher and nail plate ostesynthesis. It is a fact deserving notice that the material does not include any fractures of the lower leg.

Fourteen patients received postoperative radiation treatment of the metastasis which had caused the fracture by X-ray or telecobolt device; the metastatic lesion of two others had already been subjected to radiotherapy prior to the fracture. In 11 patients no postoperative treatment of the fracture-inducing metastasis was possible by any method, owing to poor general condition; in the cases fitted with an endoprosthesis the region was not postoperatively treated after resection of the affected bone tissue. In 12 cases hormone treatment or cytostatics were used; hypophysectomy was performed in 2 cases and adrenalectomy in one. Apart from the endoprosthesis operations, no resection of destroyed bone was attempted in connection with the stabilizing procedure.

Table 4. Postoperative mobility of patients with fracture of lower extremity.

	Number of fractures
Walking unaided or with crutches	20
On crutches with assistance	5
Able to sit	13
Bedridden	5
Total	43

RESULTS

Bony union. Distinct bony union of the fracture, observable in X-rays, ensued in 7 cases (see Figure 3). In the rest, the osteolytic process continued or the survival period was too short for consolidation to occur. Of the cases in which bony consolidation ensued, mammary carcinoma was present in 5, hypernephroma in one and carcinoma of the lung in another. The location of the fracture was in the diaphyseal region of the femur in 5 cases, in its trochanteric region in one and in the diaphysis of the humerus in another. The metastasis of pulmonary carcinoma had received full X-ray treatment just before the fracture occurred, whereas radiotherapy was given to the other 6 patients after the wound had healed.

Ability to move after operation. 58 per cent of the patients regained at least a temporary ability to walk, though mostly only with the aid of a stick or crutches. Table 4 gives the details of the patients' mobility after surgery.

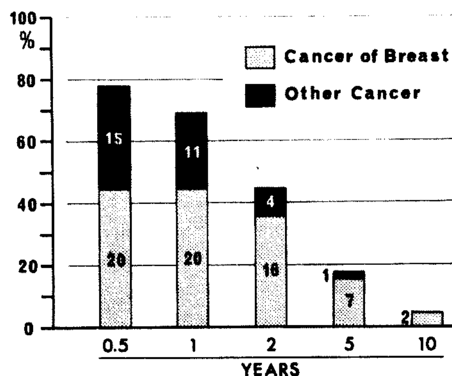


Figure 1. Survival periods after establishment of the primary tumour.

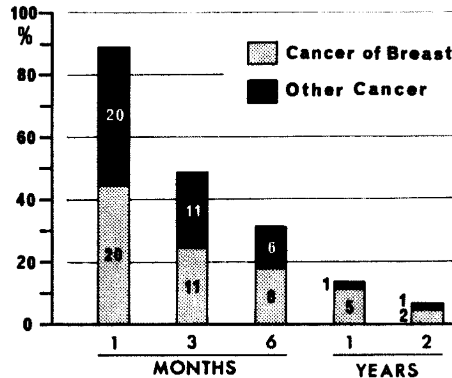


Figure 2. Survival periods after surgical treatment of metastatic fracture.

Survival period. One patient with myeloma died eight days after the operation from an intestinal haemorrhage. The survival periods of the other patients, both those counted from the operation and those after establishment of the primary tumour, can be seen in Figures 1 and 2. Three months after the operation, 48 per cent of the cases were alive, whereas the survival percentage after six months was 30, but after one year no more than 14. The longest survival period was 2 years and 8 months.

The cases with mammary carcinoma are shown separately in the figures; it can be seen that their proportion from the survivor groups increases with increasing survival periods and is, at 2 years and at 10 years after establishment of the primary tumour, 80 and 100 per cent of the respective group. It is further possible to conclude from both figures that in most of the present cases the pathological fractures did not occur until the malignant disease had already been present for a fairly long time and was approaching its terminal stage.

CASE REPORTS

The following cases illustrate the methods of treatment applied and the results achieved.

Case 1. A woman aged 49; subtrochanteric fracture of the femur, caused by the only metastasis observed, 2 years after radical mammary surgery and postoperative radiotherapy. The treatment was fixation with a Jewett fixed-angle nail-plate and postoperative radiotherapy. The patient was immediately able to walk with crutches and, 4 months

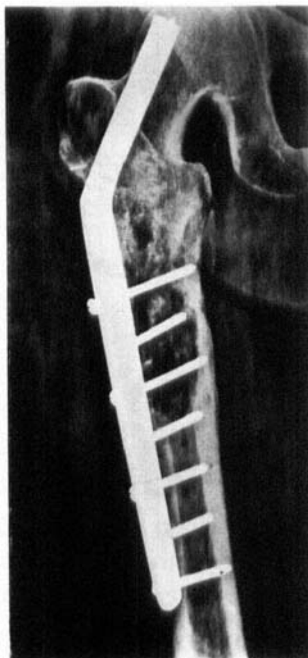


Figure 3. Destruction cavity of a metastasis of mammary carcinoma, and a subtrochanteric pathological fracture running through the proximal part of the cavity. Postoperative X-ray, 4 months after Jewett osteosynthesis and after postoperative radiotherapy, revealed bony consolidation.

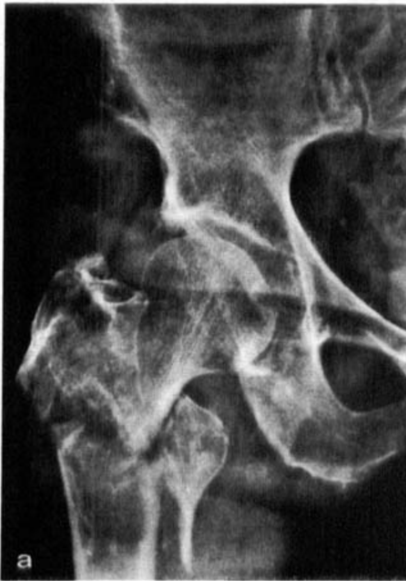
after the fracture had consolidated (Figure 3), without crutches. Survival period: 8 months.

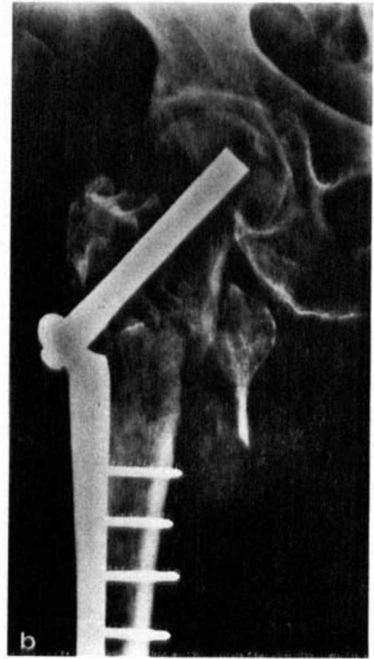
Case 2. A woman aged 67; trochanteric fracture of the femur, caused by the only metastasis observed, 3 years after radical mammary surgery. The treatment was fixation with McLaughlin's nail plate; bony union ensued after postoperative radiotherapy. The patient was able to walk and was still alive more than two years later, when there was already multiple metastatization (Figure 4).

Case 3. A woman aged 65; radical mammary surgery, oophorectomy and adrenalectomy. There was multiple metastatization when fracture of the diaphysis of the femur occurred 4 years after surgery on the primary tumour. Fixation by intramedullary nailing (Figure 5) merely facilitated the general treatment, in bed, of the patient's poor condition during the remaining 3 months. This case reveals the possibility of using nailing for reinforcement of other metastatic regions in the same bone.

DISCUSSION

Fracture may occur in a bone weakened by metastasis, either suddenly, whereby the extremity loses its stability, or gradually by micro-frac-





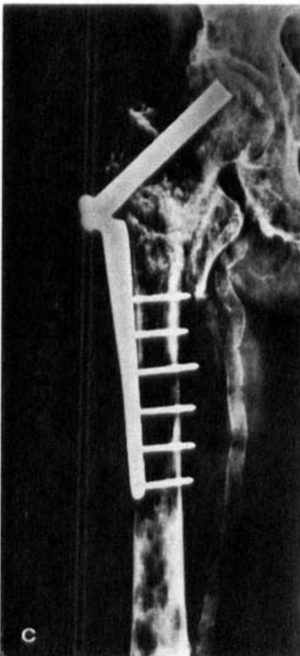


Figure 4. Subtrochanteric fracture of the femur from metastasis of mammary carcinoma, preoperative X-ray (a). Osteosynthesis with a McLaughlin nail plate (b). Bony consolidation appeared after postoperative radiotherapy, although owing to collapse of the destruction area the nail was driven in cranial direction in the collum. The continuation of destruction, more distally, points to the prophylatic significance of a long side plate (c, 16 months after operation). Powerful calcinosis of femoral artery appeared after the fracture.

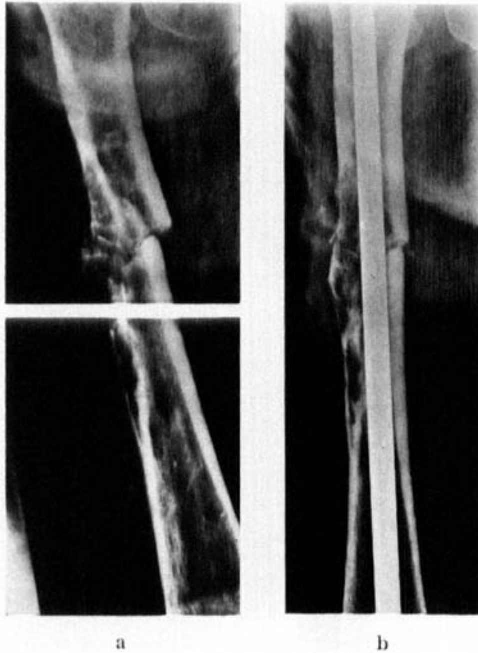


Figure 5. Fracture of diaphysis of the femur in the large bone destruction area of a metastasis from mammary carcinoma (a). Intramedullary nailing provided good fixation, and furnished good prophylactic protection of the incipient destruction areas seen more distally (b).

tures and infraction, in which stress pain in the damaged region is a prodromal symptom. The dislocation is usually slight in the beginning, but it increases under load and, for instance, in fractures of the proximal part of the femur a typical varus deformity rapidly develops.

A metastasis-induced fracture may undergo bony consolidation if enough is left of the patient's life span. In the present series more than half of the patients died before three months had passed after the operation; therefore, there was no chance of achieving consolidation of the fracture. The bony union of a metastatic fracture appears to be essentially affected by the type of the tumour and by its response to palliative treatment. If the destructive process cannot be checked, an increasing defect develops between the ends of the fragments, which the callus formation is unable to overcome. In this respect, medullary nailing has proved to be an advantageous fixation method; it permits, at light stressing of the extremity, the ends of the fragments to meet or at least to approach each other if the end of the nail protrudes proximally. Such compression may sometimes also occur in nail-plate fixing (Figure 4). With regard to the chances of bony union, cases of mammary carcinoma were found to be the most favourable in this

series. Postoperative radiotherapy does not preclude the callus formation, although from the present material nothing can be learned about the possible degree to which it delays the process.

In this study, the site of the fracture was the femur in 90 per cent of cases, which is consistent with the frequencies in the surgical series presented by Bremner & Jelliffe (1958). The cases of femur fracture profit most from surgical treatment, whereas fractures of the tibia and humerus are well suited to conservative treatment and rarely appear in any surgical series.

The most suitable method of operation in the region of the diaphysis is medullary nailing, which was exclusively used in the present series. This method has recently been recommended for prophylactic treatment of femur metastases by Beals et al. (1971). It is especially suitable in cases with multiple metastatization in the fractured bone. In fractures of the trochanteric region, nail-plate fixing is appropriate. The fixed-angle nail allows weight-bearing even if no bony union has taken place. As a prophylactic measure, the use of a long side plate should be borne in mind if other metastases are simultaneously observed in the shaft of the femur. Endoprostheses are highly appropriate in metastatic fractures of the region of the neck of the femur.

In spite of the advanced age of the patients, there was no operative mortality in the series. Substantial improvement of the patient's mobility was achieved in 58 per cent of cases, although bony consolidation ensued in only seven cases of the series.

The treatment of metastatic pathological fractures is merely palliative, and such patients mostly have a short life span after surgery. But since the prognosis is frequently difficult to assess in individual cases, particularly in those of mammary carcinoma, there are indications for giving most of these patients the benefit of surgical treatment without indulging in excessive pessimism. It must be considered a prerequisite for surgical treatment that the patient's operability ensures a reasonable chance of survival. The fractured fragments should contain enough healthy bone to render a stable osteosynthesis possible. In addition to the group of fractures of the femur, which is most notable in practice, medullary nailing may be applied in diaphyseal fractures of the humerus with an extensive area of bone destruction, whereby the upper extremity can be made functional.

Fractures close to the knee joint may also be immobilized by plaster cast, although the use of an L-plate may be indicated. It is thought that tibial fractures may well be immobilized by plaster, and the patient's

ability to walk with crutches is still preserved; in these patients little is to be gained by surgical treatment, considering the comparatively poor bony union tendency of metastatic fractures and the usually short survival period.

SUMMARY

The surgical treatment used in 50 metastatic fractures was osteosynthesis in 42 and endoprosthesis operation in 4 cases. Of the patients, 52 per cent died of the malignant disease within 3 months, and 70 per cent within 6 months. Only 14 per cent were still alive after one year. Of the different types of tumour, mammary carcinoma proved to have the best prognosis as regards survival.

By means of stable fixing of various parts of the femur, or of an endoprosthesis operation, 60 per cent of patients were rapidly released from confinement to bed; most often, however, walking was only possible with crutches because bony union only occurred in 7 cases. The majority of these involved mammary carcinoma.

The fractures had mostly occurred during the final stage of the disease. However, it appeared difficult to give a reliable prognosis in individual cases. Accordingly, osteosynthesis or endoprosthesis as treatment for metastatic fracture of the femur is considered indicated if the general condition of the patient permits operation. In fractures of other long bones, operative treatment is occasionally indicated.

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