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INCIDENCE OF FRACTURE THROUGH METASTASES IN LONG BONES

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A knowledge of the incidence of fractures through metastases of various sizes in long bones is important when considering prophylactic internal fixation.
The notes and X-rays of 66 consecutive patients with 100 metastases in long bones were analysed. Fractures are highly unlikely to occur (2.3 per cent) when less than 50 per cent of the cortex is destroyed but likely (60 per cent) when 50–75 per cent of the cortex is destroyed and most likely to occur (80 per cent) when over 75 per cent of the cortex is destroyed.

Key words: long bone metastases; pathological fracture; prophylactic internal fixation

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Pathological fracture through a metastasis in a long bone is a distressing and painful event. Knowledge of the likelihood of a fracture occurring is important when considering prophylactic internal fixation, because only metastases which are likely to fracture need to be prophylactically stabilised.

It is the purpose of this investigation to determine the incidence of fracture through metastases of various sizes in the long bones.

PATIENTS

The notes and X-rays of 66 consecutive patients with 100 metastases in long bones were examined. These metastatic deposits had been initially detected following an isotope scan or skeletal radiological survey in patients with a known primary tumour, or presented as a pathological fracture or as the cause of local pain. The primary tumours were as follows: Breast 59, Bronchus 21, Prostate 11, Kidney 4, Myeloma 2, Thyroid 1, Lymphosarcoma 1 and Basal Cell Carcinoma 1.

METHODS

The sizes of the metastases were assessed on antero-posterior, lateral and where available oblique X-rays and classified, according to the percentage of the cortex involved, into four categories (Figure 1, A, B, C and D):

less than 25 per cent
25–50 per cent
50–75 per cent
over 75 per cent

Normally no difficulty was encountered in judging the size of a metastasis. However, if in the case of an eccentrically placed metastasis difficulty was experienced, the following simple technique was used. A piece of paper was rolled into a tube and held so by a paperclip at each end. A drawing of the metastasis was made on the paper tube (Figure 2A), so that it corresponded in appearance with the X-rays of the metastasis taken in two directions (in this case Figure 1A). The paper tube was then unrolled and laid flat (Figure 2B). The size of the metastasis as a percentage of the circumference i.e. of the cortex, is thus:

$$\frac{\text{metastasis } (M)}{\text{circumference } (C)} \times 100 \text{ per cent}$$

The metastases were divided into two groups depending on the presence or absence of a fracture.

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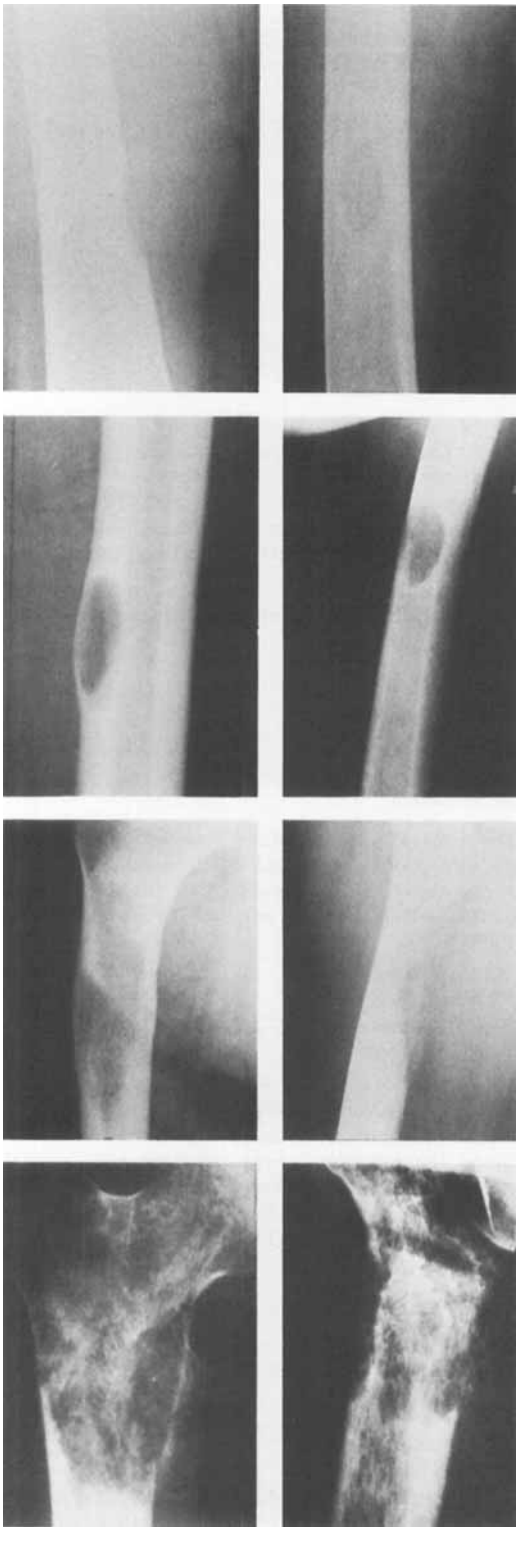

Because of the possible effect of weight-bearing on the development of a fracture, it was also recorded whether the arm or the leg was involved.

RESULTS

Separate analysis of the three main groups (breast, bronchus and prostate) did not reveal any significant differences from the results obtained after pooling all the 100 metastases. The distribution of the 100 metastases amongst the four categories of cortical involvement is shown in Table 1. No meaningful difference was noted between arm and leg metastases which were therefore considered together when calculating the incidence of fracture occurrence in the various categories (Table 2).

When less than 50 per cent of the cortex was involved there was only one fracture in 43 deposits, an incidence of 2.3 per cent. However there was a sudden rise in fracture incidence when over 50 per cent of the cortex was involved. This is illustrated by the histogram (Figure 3) which depicts the numbers of metastases and fractures in each category and shows an obvious differentiation point for fracture occurrence when there is over 50 per cent cortical involvement. In fact 39 (97.5 per cent) of the 40 fractures in this series occurred in the over 50 per cent categories.

DISCUSSION

Prophylactic internal fixation has been reported several times (Altman 1952, Beals et al. 1971, Bremner & Jelliffe 1958, Coran et al. 1968, Fidler 1973, Fidler & Stollard 1977, Galasco 1974, Harrington et al. 1976, Mickelson & Bonfiglio 1976, Parrish & Murray 1970, Ryan et al. 1976, Zickel & Mouradian 1976), since first described

Figure 1. Antero-posterior and lateral X-rays showing metastases involving.
A) 0–25 per cent of the cortex.
B) 25–50 per cent of the cortex.
C) 50–75 per cent of the cortex.
D) over 75 per cent of the cortex.

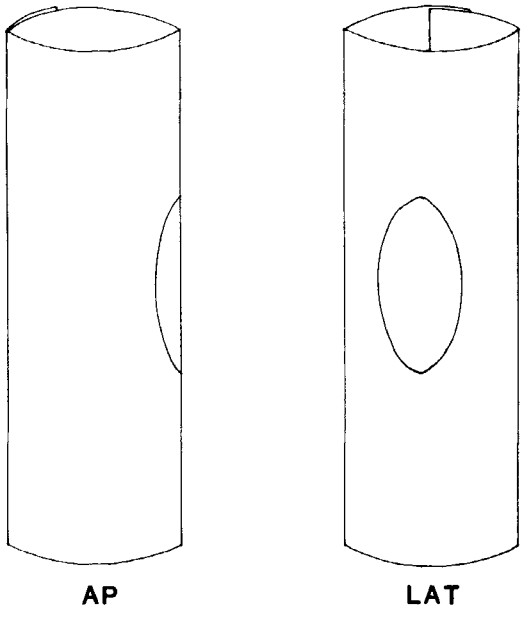

Figure 2A. Drawing of metastasis on rolled paper tube, corresponding to antero-posterior and lateral X-ray appearances. In this case compare with the metastasis in Figure 1A.

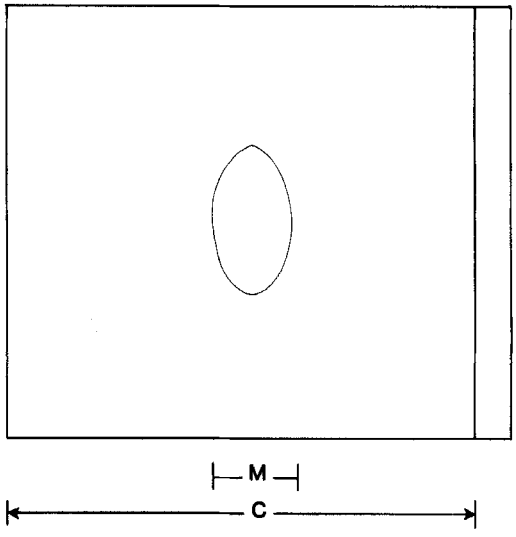

Figure 2B. The paper tube unrolled. The size of the metastasis as a percentage of the cortical circumference of the bone is given by $\frac{M}{C} \times 100$ per cent. In this case $\frac{13}{80} \times 100$ per cent = 16 per cent.

by Griessmann & Schüttemeyer in 1947, but little has been written about the size of the metastasis which should be thus treated. In 1970, Parrish & Murray suggested, as the indication for operation, increasing pain combined with destruction of at least one half of the cortex of a long bone, and in 1971 Beals et al. advised

Table 2. Fracture incidence

Category	Incidence
0–25%	0 %
25–50%	3.7 %
50–75%	61 %
over 75%	79 %

Table 1. The distribution of the 100 metastases amongst the four categories of cortical destruction

% Cortex involved		0–25%	25–50%	50–75%	over 75%	Total
Fractures	Leg	0	0	19	13	
	Arm	0	1	1	6	
	Total	0	1	20	19	40
No fractures	Leg	16	24	11	4	
	Arm	0	2	2	1	
	Total	16	26	13	5	60
All metastases	Grand Total	16	27	33	24	100

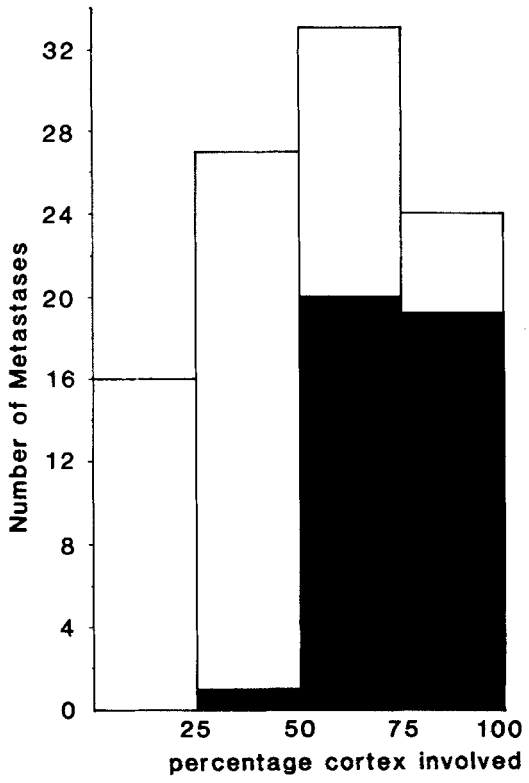

Figure 3. Histogram to show the number of metastases in each of the four categories. The fractures are shaded black.

operation for femoral lesions of 2.5 cm diameter. In 1973 it was reported (Fidler 1973) that the majority of pathological fractures in long bones occur through metastases which involve over 50 per cent of the cortex on radiological examination but the incidence of fracture was not investigated.

The present study was therefore carried out and has shown a clear division at the 50 per cent cortical destruction stage. When less than 50 per cent of the cortex was involved only 2.3 per cent of the metastases fractured, whereas approximately 60 per cent fractured when 50–75 per cent of the cortex was involved and approximately 80 per cent when over 75 per cent of the cortex was involved. As far as the size of the metastasis is concerned this study therefore indicates that a metastasis involving less than 50 per cent of the cortex is highly unlikely to fracture whereas a metastasis involving 50–75 per cent, and especially over 75 per cent, of the cortex is likely to fracture and should be considered for prophylactic internal fixation.

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REFERENCES

Altman, H. (1952) Intramedullary nailing for pathological impending and actual fractures of long bones. *Bull. Hosp. Joint Dis.* **13**, 239–251.

Beals, R. K., Lawton, G. D. & Snell, W. E. (1971) Prophylactic internal fixation of the femur in metastatic breast cancer. *Cancer* **28**, 1350–1354.

Bremmer, R. A. & Jelliffe, A. M. (1958) The management of pathological fractures of the major long bones from metastatic cancer. *J. Bone Joint Surg.* **40**-B, 652–659.

Coran, A. G., Banks, H. H., Aliapoulios, M. A. & Wilson, R. E. (1968) The management of pathologic fractures in patients with metastatic carcinoma of the breast. *Surg. Gynaecol. Obstet.* **127**, 1225–1230.

Fidler, M. W. (1973) Prophylactic internal fixation of secondary neoplastic deposits in long bones. *Br. Med. J.* **1**, 341–343.

Fidler, M. W. & Stollard, G. (1977) The management of secondary neoplastic deposits in long bones by prophylactic internal fixation. *Arch. Chir. Neerl.* **29**, 177–185.

Galasco, C. S. B. (1974) Pathological fractures secondary to metastatic cancer. *J. R. Coll. Surg. Edinb.* **19**, 351–362.

Griessmann, H. & Schüttemeyer, W. (1947) Weitere Erfahrungen mit der Marknagelung nach Küntscher an der Chirurgischen Universitätsklinik Kiel. *Chirurg* **17–18**, 316–333.

Harrington, K. D., Sim, F. H., Enis, J. E., Johnston, J. O., Dick, H. M. & Gristina, A. G. (1976) Methylmethacrylate as an adjunct in internal fixation of pathological fractures. *J. Bone Joint Surg.* **58**-A, 1047–1055.

Mickelson, M. R. & Bonfiglio, M. (1976) Pathological fractures in the proximal part of the femur treated by Zickel-nail fixation. *J. Bone Joint Surg.* **58**-A, 1067–1070.

Parrish, F. F. & Murray, J. A. (1970) Surgical treatment for secondary neoplastic fractures. *J. Bone Joint Surg.* **52**-A, 665–686.

Ryan, J. R., Rowe, D. E. & Salciccioli, G. G. (1976) Prophylactic internal fixation of the femur for neoplastic lesions. *J. Bone Joint Surg.* **58**-A, 1071–1074.

Zickel, R. E. & Mouradian, W. H. (1976) Intramedullary fixation of pathological fractures and lesions of the subtrochanteric region of the femur. *J. Bone Joint Surg.* **58**-A, 1061–1066.

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