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# POST-FRACTURE CHANGES OF THE FEMUR CORTEX

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Roentgenograms of the femora were obtained in 21 patients who on average 10 years earlier had sustained a fracture of the shaft of one tibia. On the fracture side a slightly uneven "spotted" appearance could be detected in most patients. Also, the marrow canal was about 10 per cent wider in the femora of the fractured limb – this widening was unrelated to the time factor, indicating a permanent loss of endosteal bone.

*Key words:* cortical bone; fracture; osteoporosis.

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A fracture causes a loss of bone, not only from the fracture site but also from other parts of the fractured limb. This has been demonstrated in animals and in man (Bauer 1954, Nilsson 1966, Westlin 1974, Andersson & Nilsson 1979). All measurements in man have been conducted in the trabecular bone near the ends of the fractured bone or in the neighbouring bones. However, Wendeberg (1961) was able to demonstrate that not only the fractured tibia and the bone tissue of the knee joint, but also the shaft of the femur is participating in the high mineral turnover process and Garn et al. (1963) suggested the cortical thickness of the femoral shaft to be a good measuring site for evaluation of bone mass.

The objective of this investigation was to study the long-term effects of fracture on the femur cortex.

## MATERIAL AND METHODS

Included in the study were 15 men and 6 women, age 49 ± 13 years, who on average 10 years earlier (range 2–17) had sustained a fracture of the shaft of the tibia. The age at the time of the fracture was 39 ± 14. The subjects were selected from a larger series using the time of immobilization as the only selection criterion – it was a condition that the plaster immobilization should have exceeded the average time (4.5 months). Immobilization ranged from 4.5 to 40 months (9 ± 7) and all fractures had subsequently healed.

The subjects all had a roentgen examination including only the antero-posterior view of the mid-portion of both femora in a standard rotation position with focus in the mid-line. The films were measured and evaluated by an investigator who was not aware which leg had been fractured with regard to the following variables.

*Endosteal and periosteal width.* The narrowest part of the marrow canal was identified. Also, measuring points were found 2 and 4 cm proximal and distal to this point – altogether 10 sites for each femur (Figure 1). The total (periosteal) thickness of the femur and the cortical thickness were measured on the same sites. The marrow width was calculated by subtraction and the ratio marrow width/total width was calculated. The average was calculated for each bone and the injured and uninjured sides were compared using the *t*-test for paired observations.

*Endosteal irregularities.* The subjective impression of the shape of the bone lining of the marrow cavity.

*Density irregularities.* Possible signs of "spottedness" of the cortical bone projected over the marrow cavity.

Also, for the two subjective estimates, the films were mixed and re-mixed.

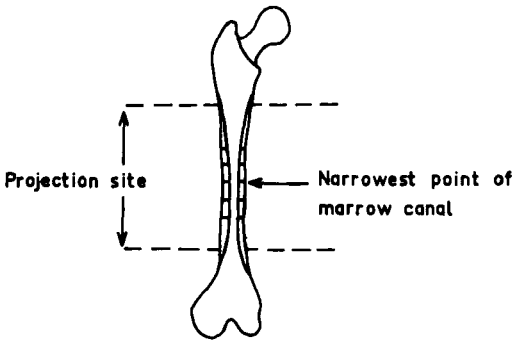


*Figure 1. Measuring site.*

## RESULTS

The total (periosteal) width of the femora did not differ between the injured and the uninjured sides. However, the marrow canal was nearly 10 per cent wider in the fractured limb (Table 1).

The duration of plaster fixation and the time elapsing between the fracture and the follow-up measurement were not correlated* with the degree of widening of the marrow canal, nor was this variable influenced by the age at the time of fracture.

Attempts to identify the fractured limb from the film of the mid-portion of the femur by the shape of the endosteal cortex marrow border failed completely but in the image of the femur overlying the marrow cavity, the structure appeared slightly more "spotted" on the fracture side in 20 of the subjects.

* Linear correlation – marrow/total width ratio as the independent variable.

## DISCUSSION

In an earlier study of roentgen findings in trabecular bone after tibia shaft fracture, the image appeared, with few exceptions, normal after 2 years (Nilsson 1966). In the present study there were subtle changes in the femoral cortex even after that time. The difference in marrow width which in the fractured limbs was increased by about 10 per cent indicates a long-lasting or possibly irreversible loss of endosteal bone. There was no tendency to restoration of bone during the time period covered by this study. Restoration, if any, must have taken place during the very first years after the injury. A loss of this magnitude should increase the risk of fracture unless the tubular shape of the femur is sufficiently regular, particularly if the loss is not uniformly distributed.

The findings suggest that not only the trabecular but also the cortical bone of an injured limb, as proposed by Wendeberg (1961), participates in the post-traumatic changes of bone resorption and formation leaving long-lasting – perhaps lifelong – roentgen-morphometric evidence of a net loss.

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*Table 1. Total (periosteal) width in mm and the marrow width/total width ratio*

| | N | Uninjured Av±SD | Injured Av±SD | Difference Av±SD |
|---|---|---|---|---|
| Total width, mm | 21 | 33.6±3.7 | 33.6±3.8 | 0 |
| Marrow/total | 21 | 0.391±0.036 | 0.416±0.047 | 0.025±0.006 p<0.001 |

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