Acta orthop. scand. *50*, 689–691, 1979

POST-TRAUMATIC BONE MINERAL LOSS IN TIBIAL SHAFT FRACTURES TREATED WITH A WEIGHT-BEARING BRACE

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The bone mineral content in the upper ends of the tibia and the fibula was measured in 27 patients with tibial shaft fracture. The loss of bone mineral associated with the fracture did not differ between patients who were allowed weight-bearing in a functional below-knee brace and patients treated with a long leg plaster cast without weight-bearing.

Key words: bone mineral; fracture; osteoporosis

Accepted 5.i.79

After the interest and enthusiasm for stable plate fixation of tibial shaft fractures declined, attention has been directed towards conservative methods. One such method, which offers some of the advantages of plate fixation, was advanced by Sarmiento (1967, 1970). This method includes a "functional" cast moulded tightly on the lower leg, which leaves the range of motion in the knee almost unrestricted. In later designs a movable ankle joint was also included. With this brace, the patients are allowed unrestricted weight-bearing.

Loss of bone mineral after fracture is a well established phenomenon. It is, however, not established to what extent this loss is due to disuse or to metabolic changes introduced by the fracture itself.

Gurd (1934) and Abramson & Delagi (1961) proposed that early exercise and weight-bearing could be effective means of preventing osteoporosis after fracture.

Early weight-bearing in a functional brace appears to be an acceptable treatment of tibial shaft fractures without serious soft tissue injuries. The time required for union of the fractures is comparable with that after other types of treatment and complications are rare (Önnerfelt 1977). An added advantage is that the treatment is comfortable for the patient.

The purpose of the present study was to investigate whether weight-bearing in a functional brace influences the loss of bone mineral in the tibia as compared with standard treatment with a long leg cast without weight-bearing.

PATIENTS AND METHODS

The study included 27 cases of fracture of the shaft of the tibia in 17 men and 10 women. Twelve fractures were long oblique or spiral whereas 15 were of the transverse or comminuted

Financial support was obtained from the Swedish Medical Research Council (project no. B 77-17X-2737-09B), and the Greta and Johan Kock, and Alfred Österlund Foundations.

0001–6470/79/060689–03$02.50/0

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types. The treatment of these patients was individual during the first 3 weeks after fracture with application of a long leg plaster cast with or without transfixation and in two cases open reduction with screw fixation and a long leg cast. However, after 3 weeks the patients were randomly divided into two groups. In 14 cases the treatment with the long leg cast was continued. In these cases weight-bearing was not allowed until the fractures were considered clinically stable. In the remaining 13 cases a weight-bearing below knee cast (functional brace according to Sarmiento 1967) was applied and weight-bearing permitted. This type of cast was also maintained until clinical union had been attained. In six of these cases the brace was supplied with a mobile ankle (Sarmiento 1970). The patients were assigned to the two groups according to random numbers.

The bone mineral content (BMC) of the injured leg was measured by a recto-linear gamma absorptiometry scan across the proximal ends of the tibia and the fibula 4 cm distal to the joint (Figures 1, 2 and 3). From the third week on, the patients were measured at approximately monthly intervals until 12 months had elapsed after the injury. Subsequently, measurements were carried out at approximately 6-month intervals.

The following data were calculated:

The rate of change between 3 weeks after fracture and the time for observation of the lowest value.

The maximum loss, which was usually recorded about 20 weeks after the fracture when weight-bearing was permitted in most patients in both the groups.

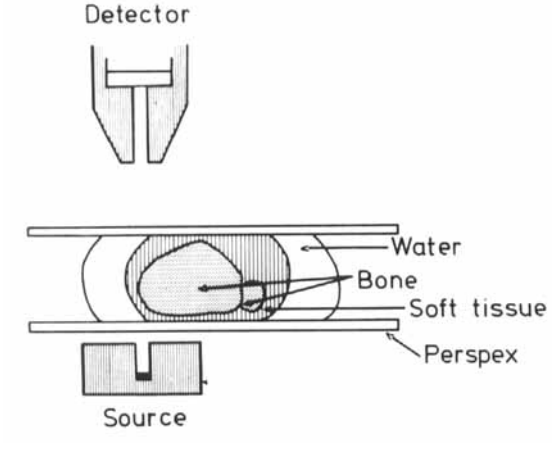

Figure 1. Gamma absorptiometry. An Americium-241 source and a detector (collimation 7 mm, circular) are moved across the sample at constant speed.

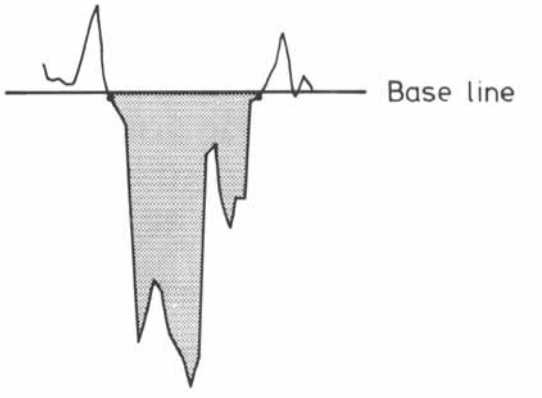

Figure 2. Graphical tracing of absorptiometry printout from the upper ends of the tibia and the fibula.

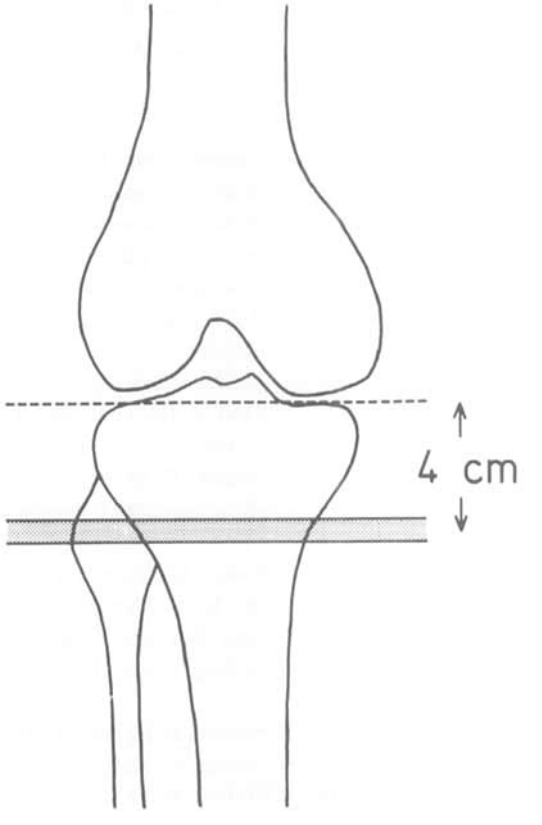

Figure 3. Measuring site. In patient measurements the site was located with the aid of a roentgen image intensifier.

Table 1. Changes in BMC in relation to treatment

	n	Age	Loss, %/week	Gain, %/week	Maximum loss %	Final loss %
Weight-bearing	13	35 ± 16	2.6 ± 3.3	0.6 ± 0.5	44 ± 14	24 ± 16
Non-weight-bearing	14	49 ± 14	2.1 ± 1.2	0.5 ± 0.4	46 ± 21	29 ± 17

The rate of change from the lowest value to the 1-year value.

The final loss (after 1 year).

RESULTS

The rate of loss as well as the rate of gain was slightly increased in the weight-bearing cases as compared with the non-weight-bearing but there was a considerable scatter and skewness in the data and the difference was not significant (Table 1). The maximum loss and the final loss did not differ significantly between the two groups. To some extent, age appeared to influence the sequence of events. There was a significant negative correlation between age and rate of loss ($r_{27}=0.42$, $0.05>P>0.02$) and between age and rate of gain ($r_{27}=0.51$, $0.01>P>0.001$). In this context, however, age may be replaced by the initial BMC value since older subjects had a lower BMC. This indicates that in older patients with a smaller amount of bone mineral the changes are less conspicuous and the final outcome the same.

DISCUSSION

There was no evidence that the type of fracture or the duration of treatment influenced the process triggered off by the injury. Nilsson (1966) found a relationship between duration of disability, duration of plaster fixation and bone loss. However, in the present study those patients with the longest healing time and the longest disability were excluded from the material since open fractures were not included. There was no obvious influence of age that could not be explained by the fact that older patients had initially less bone mineral. There were large differences between individual patterns which cannot be explained by imperfections of the method. The most important finding in this study was the similarity of the patterns in those patients who were allowed early weight-bearing and those in a long leg weight-bearing protected cast. The process of losing bone is neither interrupted nor modified when the patient starts weight-bearing, just as it tends to continue even when the plaster – in both groups – is subsequently removed. The hypothesis that post-fracture osteoporosis can be prevented or at least modified by exercise and weight-bearing may still hold true. However, the weight-bearing and the physical activity permitted a patient in a functional brace as treatment for a tibial fracture are not sufficient to break the pattern initiated by the fracture.

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