Several fractured bones were stiffer than the intact bone from the contralateral limb so that the mean stiffness ratios are slightly greater than unity. The mean strength ratios, however, are still less than unity.

Variation of results with time (Fig 6): In spite of the large scatter, the improvement in both strength and stiffness, as time elapses after fracture, is evident, as is the consistently more rapid increase of stiffness than of strength. This last observation might suggest that fracture healing is a self-regulating mechanism governed by signals dependent on deflections occurring in healing bone.

A natural expectation would be that ultimately both the stiffness ratio and the strength ratio should return to unity; further work is in hand to investigate this.

Conclusions

(1) A satisfactory method has been developed for measuring the return of function, i.e. the return of strength and of stiffness, in healing experimental fractures. This method has been applied to the study of healing after surgically produced fracture of the rabbit's radius.

(2) The surgical interference necessitated by the implantation of onlay plates and screws or of intramedullary nails did not impair the recovery of strength and stiffness as measured at five weeks.

(3) Five weeks after fracture, both the strength and the stiffness of the rabbits' radii varied widely from bone to bone but not independently of each other.

(4) As the rabbits' radii healed, stiffness returned more rapidly than strength.

(5) These observations suggest the possibility that the process of fracture union is regulated by the stiffness of the healing bone.

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Fractures of the Shaft of the Femur and Tibia in the Same Limb [*Abridged*]

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In the treatment of simultaneous fractures of the shafts of the femur and tibia in the same leg, two principles are generally accepted: first, that each patient presents individual problems to be assessed on their own merits and, second, that internal fixation of one bone should be carried out. No study can be traced on this subject and this paper presents the results of treatment of 43 patients who sustained this injury during the last five years. Patients with other injuries in the same limb have been excluded from this study to enable a comparison to be made between different methods of treatment.

The injury usually occurred in the adolescent and the young adult and 31 of the patients were less than 25 years old. The mechanism of injury which produced these fractures was usually a motor-cyle or scooter accident (36 patients) but 7 were pedestrians who were knocked down by a moving vehicle. In the first instance, the fractures of the femur and tibia were treated conservatively using skeletal traction. Compound wounds were excised but internal fixation was never employed on the same day as the injury, though often used later when primary wound healing had been obtained. The definitive treatment of these complicated cases is summarized in Table 1.

Table 1
Types of treatment● (43 cases)

Treatment of femur	*Treatment of tibia*	*No. of cases*
Conservative	Conservative	11
Conservative	Plating	2
Intramedullary nail	Intramedullary nail	9 } 12
Intramedullary nail	Plating	3 }
Intramedullary nail	Conservative	9
Intramedullary nail	Early below-knee amputation	2

● An immediate amputation was performed on 3 patients. Four patients died from shock or fat embolism

Permanent disability has been classified into four groups: (1) None. (2) Slight – mild complaints not interfering with work or recreation. (3) Moderate – marked complaints, shortening, stiffness especially of the knee and/or foot. (4) Severe – gross disablement, e.g. below-knee amputation, quadricepsplasty or permanent caliper. When the final result was assessed, all patients had photographs of the injured leg taken from the lateral side in the squatting position as this gives an indication of the disability.

Results

Conservative treatment of the fracture of the tibia resulted in delayed or non-union in 15 patients out of 20. A bone-grafting operation was required in 10 patients. Ellis (1958) demonstrated that the most important factor influencing the speed of union of a fracture of the tibia was the severity of the injury and in his study 60% of cases due to major violence developed delayed union. His conclusion has been supported by this small study and I believe that difficulties of union must be anticipated by internal fixation (Fig 1A) or, if necessary, by early bone grafting (Fig 1B). Prolonged immobilization in plaster must be avoided, since with a fracture of the femur there is a serious risk of knee stiffness and in 2 patients in this study a quadricepsplasty had to be performed.

Table 2 shows a comparison between the results of conservative and operative treatment.

Table 2
Relation of treatment to result

Treatment	*No. of cases*	*Good result*	*Period in hospital (median in weeks)*	*Period off work (months)*
Conservative (both fractures)	11	3	20	12
Operative (both fractures)	12	11	7	5

This is not a statistical paper and a strict comparison cannot be made between these two types of treatment, since it may be argued that those treated conservatively were more severely injured and could not be treated by internal fixation. Nevertheless, I consider that this study has shown that internal fixation of both fractures should be carried out wherever possible: good results with full movement at the knee and ankle were seldom achieved by conservative treatment (Fig 1C). Further, patients treated by internal fixation in the first two or three weeks after injury were less likely to develop knee stiffness or shortening and were in hospital and off work for less time than those treated conservatively.

Internal fixation cannot be carried out in all fractures, particularly where the comminution is severe; in these cases every endeavour should be made to fix one fracture internally if at all possible, then treatment should be employed which will achieve early movement of the knee and foot. For example, a severely comminuted fracture of the femur may be treated by skeletal traction, with a Steinmann pin in the upper end of the tibia and early knee movement, provided that a relatively simple associated fracture of the tibia has been plated.

For the first three years this study was retrospective. After adopting in the last two years the principles enumerated above, the incidence of permanent disability has been reduced from one-

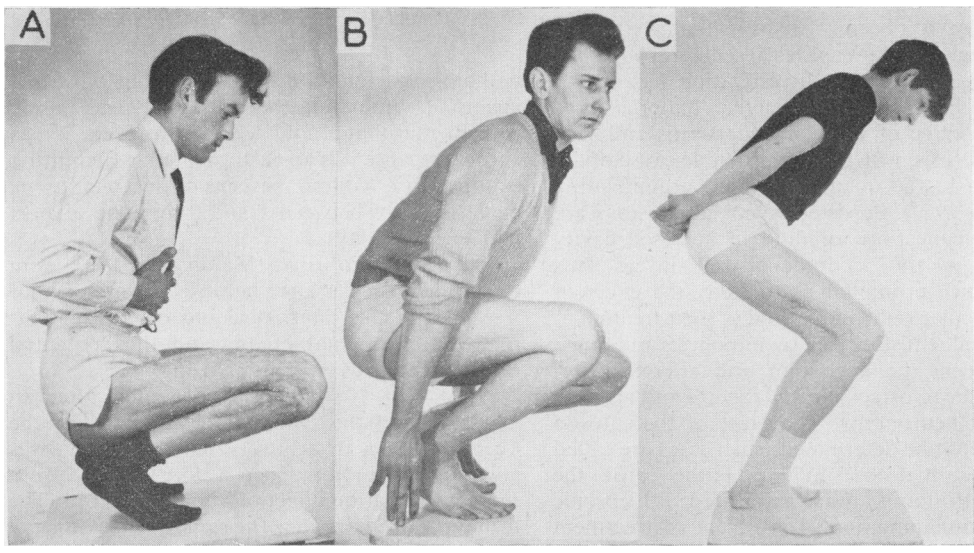

Fig 1 A, *man aged 26, seven years after a fracture of the shaft of femur and tibia; both fractures were treated by an intramedullary nail, five days after injury; no disability.* B, *man aged 21; fracture of femur treated by intramedullary nail, tibia treated conservatively; delayed union developed but fortunately was anticipated, the tibia was plated and bone-grafted, followed by mobilization without plaster; a good though not perfect result.* C, *an example of a poor result where non-union had not been anticipated; a fracture of the femur had been treated conservatively and then an intramedullary nail inserted for non-union sixteen weeks after injury; permanent knee stiffness*

half to one-quarter of the patients. I believe that a bolder policy will have to be adopted in the future and that some, at least, of the compound fractures should be internally fixed, if a good result with full knee flexion and excellent foot movements is to be achieved. Then, these young patients will be able to squat and run normally and return to a full and active life without disability.

Acknowledgment: I am grateful to my orthopædic colleagues in the Bristol Clinical Area who have allowed study of their cases with this injury.

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Radioactive Colloidal Gold in the Treatment of Chronic Synovial Effusions

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Surface irradiation, using radioactive colloidal gold (^{198}Au) has been extensively used as a means of treating malignant ascites and pleural effusions (Andrews *et al.* 1953). Investigation has shown that the intraserous radioactive material produces a degree of vascular endarteritis and subserosal fibrosis, which is the probable cause of the reduction in the quantity of fluid accumulating (MacKay 1957). Persistent synovial effusions are similarly collections of fluid in a closed cavity lined by a thin endothelial cell layer. This resemblance prompted us to essay the effect of intra-articular radioactive gold in their treatment.

Synovial effusions are commonest and most persistent in the knee-joint and are most frequently due to osteoarthritis, rheumatoid arthritis and joint neuropathy. The cause of the effusion often cannot be determined; such cases are called 'idiopathic hydrops'. Whatever the cause the chronic effusion is always associated with chronic synovial inflammation. The object of treatment has been to produce an effect on the synovium similar to that achieved on the peritoneum and pleura, that is, a vascular endarteritis and a mild subserous fibrosis.

Intra-articular radioactive gold was not considered as a definitive treatment for the primary pathological condition in the joint but only as a means of eliminating the effusion. It was purely coincidental that a gold isotope was used; it was chosen because it is an easily available β-emitting isotope in a colloid suspension with a tissue penetration of between 1 and 2 mm and a short half-life of 2·7 days.

Fig 1 *Autoradiographic section through the suprapatellar pouch twenty min after injection of 3 μCi of ^{198}Au. There is an aggregation of radioactive particles on the synovial surface in the recess of the pouch.* × 36·5

The first clinical trials (Makin *et al.* 1963) were undertaken on the knee because the presence of free fluid in this joint is easy to detect; it is far removed from vital organs and thus potential radiation hazards were minimized.

A dose of 10 millicuries was used after an assessment of the synovial surface area for the knee-joint and an arbitrary dose of 3 mCi was given in ankle-joints: such a dose should give a synovial radiation effect of about 2,000 rad. The technique of injection is the same as in giving any sterile intra-articular injection. The injection is painless, without immediate after-effects. Treatment consists of a single injection of about 2–3 ml of the colloid suspension.

With this method, due to strict case selection, only 41 patients have been treated during the past