Disability Following Fractures of the Tibial Shaft

Geoffrey Horne, MB, ChB, FRCS(C)*
John Iceton, BSc, MD, FRCS(C)†
Julie Twist, Dip Physio§
Robyn Malony, Dip Physio§

Introduction

There is a considerable volume of literature concerning the treatment of tibial shaft fractures. Treatment with a plaster cast and, more recently, the Sarmiento type of cast and cast bracing\(^1\) has many proponents. Others have favored internal fixation, with plates and screws, or intermediary devices.\(^2\) There are frequent reports in the literature concerning factors such as healing time, shortening, and angulation, but few detailed examinations of long-term disability following a fracture of the tibial shaft.

Ellis, observing disability following fractures of the tibial shaft, found 6% with limitation of ankle or foot movement or both, and stated that this was invariably a source of disability.\(^3\)

Nicolle, in a review of 241 patients followed until they returned to work, reported 25% had "significant" residual stiffness in one or more joints.\(^4\) Severe stiffness of the ankle occurred in five cases and in the foot in 11 cases. Eight percent of the patients had disabling stiffness. Nicolle indicated that the incidence of significant joint stiffness was three times higher when a moderate or severe wound was present in association with the fracture. The highest incidence of stiffness was seen in those patients with a combination of prolonged immobilization and a severe soft-tissue wound.

Other authors have drawn attention to compartment syndromes occurring in association with tibial fractures, and the potential sequelae of foot deformity.\(^5\)-\(^7\)

McMaster examined 100 patients following tibial shaft fracture and measured subtalar motion.\(^8\) Limitation

of subtalar motion was noted in 72%. Forty-three percent of the patients complained of difficulty in walking over uneven ground, but only 12% found the symptoms sufficiently troublesome to interfere with recreational activities or work.

Merriam and Porter reviewed 100 patients whose tibial fractures had been treated by open reduction and internal fixation. They reported that 50% had some degree of subtalar stiffness, and commented that ankle movement was more severely affected, with 60% having some degree of stiffness.\(^9\) Sixteen patients in that series had symptoms sufficient to interfere with work or recreational activity. Thirty-one patients complained of some degree of pain, and 46 patients had residual symptoms.

The purpose of this study was to examine disability following tibial shaft fractures, and attempt to identify factors associated with any recorded disability.

Material and Methods

The hospital records of all patients seen in the fracture clinics of the Wellington Public and Hutt Hospitals with a diagnosis of fracture of the tibia in 1979 and 1980 were reviewed. Patients under the age of 15 years, or those 15 years and older with open epiphyses, were excluded from this study. Fractures involving the tibial plateau, the tibial plafond, or the medial malleolus were excluded. The study began with 209 patients, but after excluding those patients who could not be contacted either directly or through their next of kin, those patients whose original radiographs had been lost or destroyed, or those who refused to attend for follow up, 97 patients returned for follow-up examination by the authors. Each patient completed two questionnaires, one dealing with their subjective assessment of treatment and subsequent recovery, the second dealing with an assessment of their physiotherapy. The hospital records of all 97 patients were examined, and the details of the fracture type and method of treatment noted.

Detailed examination was carried out by a surgeon (JI)
and a physiotherapist (JT or RM). The patient’s gait was assessed clinically, as was deformity of the fractured extremity. Shoes were assessed for abnormal wear patterns. Knee and ankle motion was measured by a goniometer according to the AAOS method. A muscle power was graded clinically according to the Medical Research Council scale. Knee flexion and extension power were measured with the aid of a device designed to measure the maximum torque generated by the flexors and extensors (Fig 1). Subtalar motion was measured using a second measuring device, which was a modification of the method described by McMaster. A Plexiglas box was constructed into which both tibiae were strapped by Velcro brand hook and loop fasteners. Prefabricated heel cups with metal pointers were attached by Velcro brand straps to the patient’s heels (Fig 2). Patients were then instructed to maximally invert and evert the feet, during which double exposure radiographs were taken, and subtalar motion was measured.

AP radiographs of both tibiae were obtained to determine varus and valgus angulation, as well as tibial shortening. A lateral radiograph of the fractured side was used for measurement of anterior or posterior bowing.

All data were processed in the computer facility at the Wellington School of Medicine, and analyzed with the help of statisticians using the SPSS statistical package.

**Results**

Ninety-seven patients returned for follow up, but only 82 of these had complete radiographic documentation. The average follow up was 67.7 months. The most frequent cause of injury was motorcycle accidents (34%), followed by sports injuries (21%). Seventy percent of patients had suffered a fracture of the tibia as an isolated injury. Seventy percent were closed fractures and 30% were open. The open fractures were distributed evenly among grades I, II, and III. Seventy-five percent of patients were treated in long-leg plaster until fracture healing had occurred, or a sequence of long-leg plaster followed by below-knee plaster. Twenty-five percent of patients underwent some form of open reduction and internal fixation.

**Medical Questionnaire**

Seventy-nine percent of patients seen at follow up stated that they had symptoms in their leg as a result of their fracture. There was no statistically significant difference in the incidence of symptoms in those patients with open or closed fractures. Similarly, there was no statistically significant difference in the incidence of symptoms related to the level of the fracture in the tibia. Nineteen percent stated that these symptoms were severe and always present; 12% stated the symptoms were severe and occasionally present. Thirty-nine percent felt the symptoms were mild. Forty percent stated that they could participate in all activities without trouble from
their leg. Of those who could not do all that they wished, the most frequent complaints were related to walking on rough ground, walking on hills, and running.

Twenty-four percent of patients said they had to modify their work activities because of their fracture. Five patients changed from a heavy laboring job to a job involving a moderate amount of walking, three changed from a heavy laboring job to a desk job, and one changed from a job entailing a moderate amount of walking to a desk job. Thirty-seven patients had to downgrade their level of sporting activity following their fracture. Prior to their fracture most patients could walk unlimited distances. After the fracture 48 patients stated they could still walk unlimited distances; the remainder had a reduction in their walking tolerance because of the fracture. Fifteen percent stated they could walk less than 3 kilometers, whereas before the fracture they could walk unlimited distances.

Physiotherapy Questionnaire

Seventy-seven percent of patients had physiotherapy following their tibial fracture. Of those who did not, one third felt they should have had physiotherapy, and another third felt that they did not need any therapy. Sixty-four percent of patients stated that they felt it took longer than 9 months for them to recover completely from their fracture. Of the patients undergoing inpatient physiotherapy 92% were taught to use walking aids, 58% were given exercises for the involved limb, and 17% were given exercises for the non-involved limb. Of the patients undergoing outpatient physiotherapy, 35% were shown exercises to improve their knee movement, and 50% were shown exercises to improve their foot and ankle movements. Fifty-three percent were shown exercises to improve lower limb strength.

During convalescence the majority (85%) felt that they had been referred for physiotherapy at the appropriate time. Eighty percent of patients undergoing outpatient physiotherapy had between 0 and 9 weeks of treatment. Seventy-four percent of patients having outpatient physiotherapy remembered being treated by the physiotherapist on an individual basis; the remainder were treated in a class. Eighty-two percent of patients having outpatient physiotherapy recalled having gait re-education with the physiotherapist. Forty percent of patients having outpatient physiotherapy stated that the physiotherapist did not assess them at regular intervals and record their progress. Twenty-eight percent of patients felt that they had not had sufficient physiotherapy treatment.

Examination

Forty-two percent of patients had asymmetrical shoe wear; abnormal wear on the lateral side of the shoe was the predominant finding, occurring on the full length of the sole in 12% of patients and on the heel only in 23% of patients. There was a visible deformity of the tibia observed in 60% of cases. The most frequently observed deformity was a varus deformity, which occurred in 30% of cases; there was an external rotation deformity in 23%, and valgus or posterior angulation was seen in 18%, respectively. Clawing of the toes was noted in only 5% of patients. Five percent were also noted to have at least 1 cm of shortening of the affected foot. No difference was noted in the average range of knee flexion and extension.

Examination of the range of ankle motion revealed that dorsiflexion was normal in 48% of patients, 18% had a fixed plantar flexion deformity, and 20% had less than 5 degrees of dorsiflexion. Dorsiflexion of the normal ankle averaged 11.8 degrees and on the fractured side 7.8 degrees. The total range of ankle motion on the normal side averaged 64 degrees, on the fractured side 54 degrees. Statistical analysis to compare the incidence of pain to the range of ankle motion indicated that if the ankle motion was normal, patients had no pain. If ankle motion was decreased by 30% or less, patients complained of pain in the foot, but if ankle motion was decreased by 70%, patients complained of pain in the ankle. Clinically subtalar motion on the fractured side was felt to equal the normal side in 28% of patients, to be slightly reduced in 41%, and markedly reduced in 31%. Between 81% and 87% of patients were normal in squatting, toe and heel walking, and walking on an inverted foot. Only 68% were normal walking on an everted foot.

Radiographic Assessment

Twenty-nine percent of patients had equal tibial length on the AP radiographs. Thirty percent had greater than 10 mm of shortening. Thirty-four percent of patients had a varus deformity, with a mean of 6.2 degrees. Almost 22% of patients had a valgus deformity. On the lateral radiographs 18% had anterior angulation, with an average of 6.8 degrees; 35% had posterior angulation with an average of 7.2 degrees. Radiographic assessment of subtalar joint motion revealed that the subtalar eversion on the normal leg averaged 7.3 degrees, on the fractured leg, 3.9 degrees. Inversion was 22 degrees on the normal leg and 21 degrees on the fractured leg. Looking at this data in another way, 21% of patients were unable to evert their foot to the neutral position, and 30% of patients had less than 5 degrees of eversion. There was no statistically significant correlation between decreased subtalar motion and pain in the foot or ankle. The more distal the fracture, the more likely it was that patients had ankle problems. There was no correlation between the degree of varus or valgus at the fracture site and symptoms at follow up. However, there was a
definite correlation between the site of fracture and the ankle problems.

Discussion

Unfortunately, there are no comprehensive studies of disability following tibial shaft fractures in the literature with which to compare the results of this study. However, there are certain aspects of tibial shaft fracture management that have been well defined, and with which comparisons can be made. In McMaster's series, 28% of patients had normal subtalar motion following treatment of their tibial fractures. Digby et al reported 55% of patients had normal subtalar joints, following treatment in a functional brace.11 Neither author commented on the significance, if any, of the loss of subtalar movement, nor did they comment on which direction of subtalar movement was lost. In the current series, 50% of patients had significant loss of eversion, but inversion was not significantly affected. However, we were unable to show any correlation between the loss of subtalar motion and subsequent symptoms. This relationship has not been investigated by other authors.

Ellis3 and others have commented that the disability following tibial shaft fractures was directly related to the severity of the soft tissue injury, i.e., whether the patient had sustained an open or closed fracture, and, if an open fracture, the severity of the soft tissue wound. However, in this series there was no statistically significant difference in the incidence of symptoms related to either the type or the level of fracture. The reason for this is not clear.

A high percentage of patients in this series stated that they had symptoms related to the fracture. We were able to show a direct relationship between ankle stiffness and the presence of pain, but not between pain and any other factors. Further, the more distal the fracture the more likely it was that patients had ankle problems. Therefore, any changes to the method of treatment of tibial fractures should be directed at preventing ankle stiffness.

Treatment analysis revealed that a long leg cast followed by a Sarmiento type of PTB cast was the most common treatment sequence in this series. Surprisingly, the time in long plaster was considerably higher than the average in other series, and this alone may have influenced ankle stiffness. However, a study of function after tibial cast bracing1 showed no statistically significant difference between those patients treated in a functional Sarmiento below-knee cast, or a cast brace with a hinged ankle unit.

A review over 5 years following injury showed that tibial shaft fractures produce a high incidence of symptoms. Changes to treatment protocols should be directed toward reducing the long-term incidence of symptoms, particularly ankle stiffness.

References