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## Management of open tibia fracture—Anderson and Hutchins technique re-visited

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### Summary

Prior to September 1995, most open tibia fractures seen at the University College Hospital, Ibadan had hitherto been managed by the application of plaster-of-Paris after limited wound debridement. The outcome of this form of treatment was found, from the outpatient clinic follow-up records, to be associated with a high rate of complications including chronic osteomyelitis and joint stiffness. In most hospitals in the developed and developing countries, majority of these injuries are best managed by the use of various types of external fixators. However, these external fixator devices are by no means cheap and oftentimes most patients in our environment are unable to afford them since the country operates a health care system where the patients are solely responsible for their health care needs. In this study, the Anderson and Hutchins technique (Steinmann's pins threaded through bone and incorporated in plaster-of-Paris) was used in the management of thirty-four open tibia fractures between September 1995 and August 1999. Seventy-nine percent of these were severe or Type III open fractures. The time to radiological union was 21 weeks and pin tract infection occurred in 15 percent of the patients, mainly in the proximal (tibia) pins. The use of a single stout proximal (tibia) transfixing Steinmann's pin was found to offer a stable fixation.

**Keywords:** *Open tibia fracture, 'dynamization', 'primary' docking, pin tract infection.*

### Résumé

Avant Septembre, 1995, le plus ouvert fracture de tibia, vu à l'Hôpital du Collège de l'Université, Ibadan avait été traité en se servant de plâtre-de-Paris après un petit débridement de la blessure. On a constaté, d'après la suite de la clinique du malade en consultation externe, que cette forme du traitement est associée à plusieurs complications comme l'ostéomyélite chronique et raideur

du joint. Dans la plupart des hôpitaux des pays développés et dans les pays en voie de développement, la majorité de ces blessures est mieux traitée par l'usage de plusieurs types de fixateurs externes. Cependant, le pays opère un système du soin de la santé où les malades sont uniquement responsables pour leurs besoins du soin de la santé, ces appareils du fixateurs externes sont souvent très chers et la plupart des malades sont incapables d'en payer. Dans cette étude, la technique d'Anderson et Hutchins (le filet des épingle de Steinmann à travers os et a incorporé dans plâtre de Paris) a été utilisé dans la gestion de trente-quatre fractures du tibia ouvertes entre septembre 1995 et août 1999. Soixante-dix neuf pour cent de ceux-ci étaient sévères du Type III de fractures ouvertes (Gustillo et Anderson). Le temps à union radiologique était 21 semaines et infection de l'étendue de l'épingle se produites dans 15 pour cent des malades, principalement dans le proximal (tibia) épingle. L'usage d'un proximal solide seul (tibia) transpercer l'épingle de Steinmann a été trouvé pour offrir une fixation stable.

### Introduction

Open fractures, particularly of the tibia and fibula, are fairly common in Nigeria and although the exact incidence is unknown, it accounts for almost 10-20 percent of trauma admissions in our tertiary health care facilities [1]. The attainment of osseous stabilization is paramount in the management of open fractures as this reduces the rate of bone and soft tissue infection, protects the integrity of the surrounding soft tissues and ultimately ensures satisfactory wound healing [2]. The various surgical techniques employed in the stabilization of these fractures are often influenced by; (1) the anatomical site of the fracture, (2) the degree of wound contamination (3) degree of fracture comminution, (4) associated injuries and (5) the experience and competence of the surgeon [2].

The operative methods of skeletal stabilization in open fractures include, among others, external fixation devices [3], plate and screw fixation [4], Steinmann's pins incorporated in plaster-of-Paris [5] and intra-medullary nailing device [6,7]. At the University College Hospital, Ibadan, Nigeria, the Anderson and Hutchins technique

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was used with satisfactory outcome in the management of 32 patients with 34 open tibia fractures. This technique (Anderson and Hutchins) is similar to a bi-planar external fixator device which offers remarkable stability compared to the uni-planar devices.

### Patients and method

This is a prospective study of all patients with open tibia fractures seen at the accident and emergency unit of the University College Hospital, Ibadan between September 1995 and August 1999.

#### Initial treatment

The patients were admitted through the accident and emergency room where the wounds were evaluated before applying iodine soaked gauze to halt microbial proliferation in the wound. The patients were then commenced on parenteral antibiotics to mop-up microorganisms that had gained access to the circulation before the application of iodine gauze. Thereafter, parenteral analgesics (preferably narcotics unless they are contra-indicated) were administered to relieve pain and allow for adequate splinting of the fracture.

#### Operative technique (Anderson and Hutchins)

The patients either had general or regional anaesthesia and tourniquet was not used in any patient. At surgery, the wounds were extended (usually proximally and distally) to allow for adequate exposure of the bone ends. Thorough debridement was carried out and copious saline irrigation of the wound was embarked upon until the bone ends and the surrounding tissues were clean. Subsequently the proximal (tibia) pins were inserted just distal and slightly posterior to the tibia tubercle and the distal (os calcis) pins were inserted just below the tarsal tunnel but in line with the long axis of the tibia (Fig. 1 and 2). Some 4 mm diameter Steinmann's pins with an average length of 180 mm were used both for the tibia and the os calcis. In this series, a single tibia (proximal) transfixing pin was used with no rotational instability. The fractures were reduced open, the wound extensions were closed primarily, but the skin overlying the debrided open fracture wound was left open. With two assistants holding unto the Steinmann's pins at either end, the fracture reduction was maintained by relying on soft tissue tension and alignment was evaluated using normal anatomical landmarks. Over-distraction at the fracture site and posterior sag was curtailed by avoiding stretching of the soft tissues by the assistants. The pins were subsequently incorporated into an above knee plaster-of-Paris cast. In one of the patients (a 7 year old boy), the proximal and distal pins were

inserted into the tibia diaphysis to avoid damage to the growth plates of the proximal tibia and that of the os calcis (since these procedures were carried out without an image intensifier or a mobile x-ray unit). Patients had a combination of parenteral cefuroxime and metronidazole for 3-5 days in the peri-operative period.

#### Post-operative management

Check radiographs were taken as soon as the patients had recovered fully from the effect of the anaesthesia and this was usually within 48 hours of the surgery. Unacceptable angulations at the fracture sites were corrected by appropriate wedging of the cast. Over distraction was also corrected by excision of a circumferential strip of the plaster cast, docking of the fracture sites and reinforcement with plaster-of-Paris. A window was made in the plaster cast over the area of the wound after 48 - 72 hours (to allow for the plaster-of-Paris to dry up) and the wounds inspected in the theatre with repeat debridement carried out as deemed appropriate.

Patients were mobilised on non-weight bearing crutches as soon as they were comfortable and wound dressings were carried out through the windows created in the plaster cast. Serial plain radiographs of the affected legs were taken every fortnight until there was radiological evidence of callus formation. Thereafter, the fractures were "dynamized" by removing the proximal and distal Steinmann's pins and the above knee plaster cast was converted to a Sarmiento cast (patella tendon bearing cast). Patients were then commenced on graduated weight bearing.

#### Data collection and analysis

The bio-data of the patients, type of open fracture (using the Gustilo and Anderson classification), interval between injuries and definitive surgeries and the time to "dynamization" and fracture union were documented.

### Result

There were twenty-five male and seven female patients with a male to female ratio of 3.6 : 1. The average age of the patients was 35.3 years (range 7-65 years). Sixteen

**Table 1:** Aetiology of open tibia fractures

Causative factor	Number	Percentage
Road traffic accident (RTA)	16	47%
Pedestrian RTA	13	38%
Falls	2	6%
Blunt trauma to limb	2	6%
Gun shot injury (Short gun)	1	3%
Total	34	100%



(47%) fractures occurred in the proximal third of the tibia, thirteen (38%) occurred in the middle third and five (15%) occurred in the lower third (Fig. 3). Road traffic accidents accounted for 85 percent of the cases (Table 1). Twenty-seven patients had Gustilo type III fracture with seventeen type IIIA and ten type IIIB. Six patients had type II fracture and only one patient had a Gustilo type I open tibia fracture [8,9]. The average time interval between injury and the initial surgical debridement was 6 days and most of the delays were due to lack of funds for surgery.

**Table 2: Associated Injuries**

<b>A. Fractures and dislocations of the lower limbs</b>	
Hip dislocations	2
Femoral shaft fractures	3
<b>B. Head and facial injuries</b>	
Close head injury	2
Significant facial lacerations	2
Zygomatic fracture	1
Close depressed skull fracture	1
<b>C. Soft tissue injuries</b>	
Degloving limb injuries	2
<b>D. Thoracic injuries</b>	
Multiple rib fractures with tension pneumothorax	1
Pulmonary embolism	1

The average time to "dynamization" was 9 weeks and the average time to radiological union of the 22 fractures followed to union was 21 weeks (13-36 weeks). Twelve patients were lost to follow-up. The mean follow-up was 30 months (range 10-60 months). The mean hospital stay was 8 weeks and the associated injuries encountered in this study are shown in table 2.

Of the 22 patients followed-up to union, five (22.5%) had pin tract infection (Table 3), all of which subsided following "dynamization", (13.5%) had chronic osteomyelitis, and one patient each (4.5%) had delayed union, non-union, valgus and varus deformities at the fracture sites. There were no deaths in this series and

**Table 3: Outcome of treatment using the Anderson and Hutchin's technique**

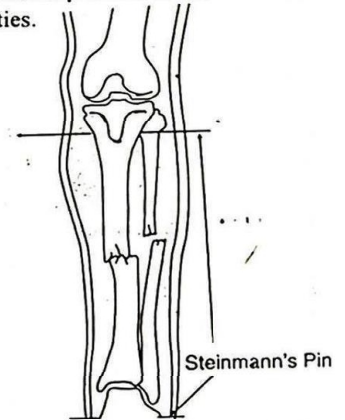
Fracture union with no complication	10 (45.4%)
Pin tract infection	5 (22.5%)
Chronic osteomyelitis	3 (13.5%)
Delayed union	1 (4.5%)
Non-union	1 (4.5%)
Valgus deformity at fracture site	1 (4.5%)
Varus deformity at fracture site	1 (4.5%)

none of the patients had amputation. Using the classification of results by Anderson and Hutchins [5] (based on shortening and degree of angulations), 17 (77%) fractures were good to excellent, 2 (9%) were fair and 3 (14%) were poor.

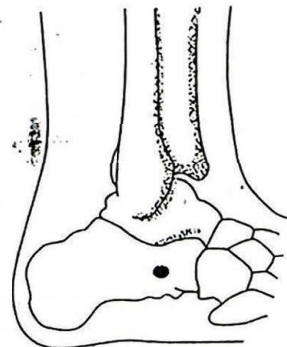
## Discussion

In clinical practice, skeletal stabilisation in open fracture can be by; (1) external splintage by plaster cast or traction, (2) external fixation and (3) internal fixation. Traditionally, external fixation is generally recommended for type III fractures [4] while plate and screw fixation and intramedullary nailing can be employed for types I and II fractures [4]. Although most external fixation devices do not give rigid fracture stabilisation when compared to compression plating, however, they allow for easy access to the wound sites and adequate wound care. The Anderson and Hutchins technique, which was utilized in this study, is similar to a bi-planar external fixation device and it offered a satisfactory skeletal stabilisation.

In developed countries there has been advocates for the use of internal fixation devices for almost all types of open tibia fractures [4], however, these management options should only be embarked upon by surgeons who are experienced in these techniques and in units with the necessary back-up facilities.



**Fig. 1: The Steinmann's pins incorporated in the plaster-of-Paris**



**Fig. 2: The point of insertion of the os calcis pin.**



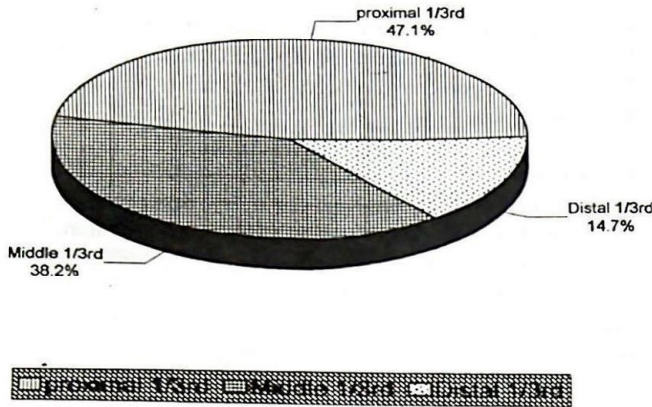


Fig. 3: A pie chart showing the sites of open fractures in the tibia.

Immediate or delayed open tibia nailing is associated with an increased rate of infection [6] and this is often attributed to the lack of a surrounding muscle envelope [4]. However, Gad [7] treated 47 open tibia fractures (predominantly Gustilo types I and II fractures) with delayed closed reamed intramedullary nailing with good outcome.

Although Anderson and Hutchins used this technique for closed comminuted, segmental and open fractures, in our institution, this technique was exclusively reserved for the management of severe open tibia fractures. In this study, the outcome of this technique is satisfactory with sound fracture union, in 77% of the patients followed up to union bearing in mind that the types of fractures that were treated in this series were severe open fractures (79% were Gustillo and Anderson type III). The use of the Sarmiento patellar tendon-bearing cast has been strongly recommended to augment the rate of fracture healing [10] as this allows for micro-motion to take place at the fracture site thereby increasing new bone formation. In this study, "dynamization" and early graduated weight bearing after the application of the Sarmiento plaster cast could have contributed to the rate of fracture union. The delay in "dynamization" and commencement of functional bracing (Sarmiento) in this series is at variance with the recommendation of Rowley [10] of 3-6 weeks and was due mainly to the severity of the fractures treated in this series. The only drawback with this technique was the high incidence of pin tract infection, which can however be minimized by ensuring a generous 'cruciate' incision at the sites of pin insertion, encouraging early "dynamization" and probably the use of Denham pins

instead of the Steinnman's pins. Early presentation will also reduce the incidence of chronic osteomyelitis [11].

### Conclusion

The Anderson and Hutchins technique is a cheap and effective method of managing open tibia fractures particularly in developing countries where facilities for external fixation are not readily available or affordable. The outcome of this modality of treatment compares favourably with the conventional but rather expensive external fixation devices.

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