International Journal of Orthopaedics Sciences

ISSN: 2395-1958
IJOS 2017; 3(2): 671-674

www.orthopaper.com
Received: 08-03-2017
Accepted: 09-05-2017

Dr. Ramachandra N Badami
D'Ortho, (DNB), Senior Resident, Tejasvini Hospital & SSIOT, Mangalore, Karnataka, India

Dr. M Shantharam Shetty
MS, FICS, Chairman, Tejasvini Hospital & SSIOT, Mangalore, Karnataka, India

Dr. M Ajith Kumar
Mch, FICS, Prof & Senior Consultant, Tejasvini Hospital & SSIOT, Mangalore, Karnataka, India

Dr. Ashok Shetty
Mch CTVS, Consultant Vascular Surgeon, Tejasvini Hospital & SSIOT, Mangalore, Karnataka, India

Dr. Lathika Shetty
MD Radiology, Consultant Radiologist, Tejasvini Hospital & SSIOT, Mangalore, Karnataka, India

Correspondence
Dr. Ramachandra N Badami
Senior Resident, Department of Orthopaedics, Shimoga Institute of Medical Sciences, Sagar Road, Shimoga, Karnataka, India

Outcome of vascular repair in lower limb fractures with vascular injury

Dr. Ramachandra N Badami, Dr. M Shantharam Shetty, Dr. M Ajith Kumar, Dr. Ashok Shetty and Dr. Lathika Shetty

DOI: http://dx.doi.org/10.22271/ortho.2017.v3.i2g.68

Abstract
Lower limb fractures with an associated vascular injury are a challenging management problem for the orthopedic and vascular surgeon. The effect of an associated vascular injury on fracture healing has not been enlightened much. Functional outcome following lower extremity vascular injury when assessed through limb salvage rates underestimates the of functional disability of the survived limb.
Methods: We studied 36 patients with fracture/dislocation of the long bones of lower limb with vascular injury, where in the limb was salvaged, between June 2009 to June 2012. Information regarding the mangled extremity severity score, ISS, revised trauma score, presence of circulatory, motor, sensory deficits was assessed. 8 patients had femur fracture with injury to the femoral artery, 28 patients had tibia & with injury to either popliteal artery, anterior or posterior tibial artery. All patients underwent vascular repair & skeletal fixation in the form of external fixator initially flap when required.
Results: From 2008-2011, 36 patients were studied. The mean age 35. A total of 6 patients had an amputation performed post vascular repair at a later date. Patients requiring amputation were significantly older than those without amputation. Fractures with an associated injury to the posterior tibial artery had a significantly higher nonunion rate and a greater number of weeks to union than fractures without this vascular injury. Poor outcomes (gangrene, amputation, or death) were associated with a Mangled Extremity Severity Score greater than or equal to 6.
Conclusion: Good early vascular repair, adequate stabilization of the fractures & early rehabilitation gives good results.

Keywords: Vascular repair, lower limb, vascular injury, mangled extremity severity

Introduction
Lower limb fractures with an associated vascular injury are a challenging management problem for the orthopaedic and vascular surgeon. Successful treatment of these injuries requires skeletal stabilization of the bony injury and careful management of the associated soft tissue injuries and a fine vascular anastamosis. The effect of an associated vascular injury on healing of lower limb long bone fractures has not been specifically analyzed previously [1].
Functional outcome following lower limb vascular injury has mostly been assessed by the limb salvage rates [2-5]. But the limb salvage rate when taken as the determinant factor to assess the final outcome tends to underestimates the incidence of functional disability of the lower limb [6].
The aim of the study was to evaluate the effect of a vascular injury on lower limb long bone fracture healing and to assess the clinical and functional outcome of vascular repairs with lower limb long bone fractures treated at our institution.

Materials & methods
We studied 36 patients, retrospectively with fracture/dislocation of the lower limb with vascular injury, where in the limb was salvaged, between June 2009 to June 2012. Information regarding the mangled extremity severity score (MESS), ISS, revised trauma score (RTS), motor & sensory deficits were assessed. All patients were treated by the same vascular & orthopaedic team. The mean age was 35yrs (22-66 years). We had 25 were males & 11 females. RTA was the most common cause of injury followed by occupational injury, sport injury and assault. All exept for 2 knee dislocations were open.
All the arterial injuries were at the level of the fracture. Eight patients had femur fracture with injury to the femoral artery, 24 patients had tibia fracture & with injury to either popliteal

artery, anterior or posterior tibial artery, 4 patients had knee dislocation with injury to the popliteal artery. Of the 24 patients with fracture of the tibia 11 patients had popliteal artery injury, 10 patients had injury to both anterior and posterior tibial artery, 3 patients had isolated injury to posterior tibial artery. Of the 8 patients with femur fracture 6 had fracture at the level of mid 1/3rd shaft region, 2 had fracture distal 1/3rd femur. Of the 24 tibia fractures 9 had fracture with in the proximal 1/3rd, 8 had fracture at the level of mid1/3 rd shaft, 7 patients had fracture at the level of distal 1/3rd tibia. All knee dislocations were posterior. Of the 36 patients with arterial injuries 22 patients had transection of the artery (at the level of the fracture), 10 patients had thrombus of the artery (at the fracture site), in 3 cases had intimal avulsion & crushing & 1 case segmental involvement of the artery was seen. 11 pts presented to us before 6hrs, 19 pts presented between 6 to 12hrs, 5 pts presented between 12 to 18hrs & 1 pt presented after 18hrs of injury.

Routine colour Doppler was used to assess the distal flow in all the patients. We found it simple and easy to use in emergency department. Arteriography was not done in any of the patients.

In 24 pts end to end anastamosis done, vein graft was used in 10 pts, in 2 pts synthetic PTFE graft (Fig-1) was used.

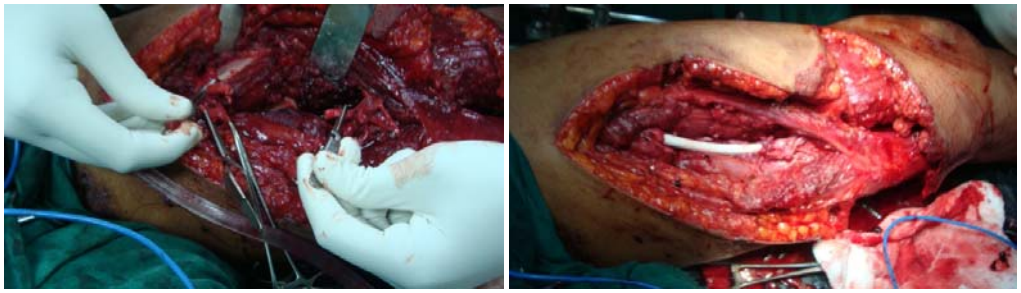

Fig 1: Segmental injury to the femoral artery treated by PTFE graft

8(27%) presented in shock. Crush injuries which needed primary amputations were excluded from the study. All patients were treated as per ATLS protocol. All patients underwent thorough debridement, vascular repair & skeletal fixation in the form of external fixation. Knee dislocations were reduced and checked for the reappearance of pulse & Doppler repeated.

Six patients had associated nerve injury which were repaired end to end primarily. Venous repair was not done in any of the case. Primary flap coverage done when necessary after the initial debridement. Patients were started on heparin & colloids post operatively. Carefully monitered in ICU for shock, reperfusion injuries, distal pulsations & compartment syndrome. Compartment release following the vascular repair was done in 8 cases, all of which were in the posterior compartment of leg due to the reperfusion injury. Repair of the posterior capsule of the knee done in case of knee dislocations. All patients were initially put on external fixator. Cases with knee dislocation & proximal tibia fractures required spanning fixator. Amount of flexion at knee was decided by the stability of the vascular repair at that flexion.

Following treatment protocol followed-First emergency vascular clamping done followed by Stabilization of bony injury, then arterial repair done, venous injuries were treated by ligation and then aggressive wound debridement when required. Following parameters used to evaluate the results-viability of the limb, -return to normal activity, persistent symptoms (Table-1).

Table 1: Criteria to evaluate the results

Result	Criteria
Excellent	Viable limb, normal activity, no symptoms
Good	Viable limb, normal activity, minor occasional complaints.
Satisfactory	Viable limb, restricted activity, disability requiring treatment
Poor	Loss of limb (Amputation)

Results

Five of the 8 femur fractures were converted to IMIL nailing between 5 to 12 days (Fig-2). One femur shaft fracture was left on an external fixator for 8wks & then mobilised in a functional brace. One supracondylar fracture femur was treated with an above knee cast after 2wks of hybrid external fixator. One supracondylar fracture femur treated with external fixator got infected & ended in above knee amputation. Average time of fracture union was 16wks, of which fractures treated with IMIL nailing took 12wks, those on external fixator took 18wks & a fracture treated with above knee cast took 15wks.

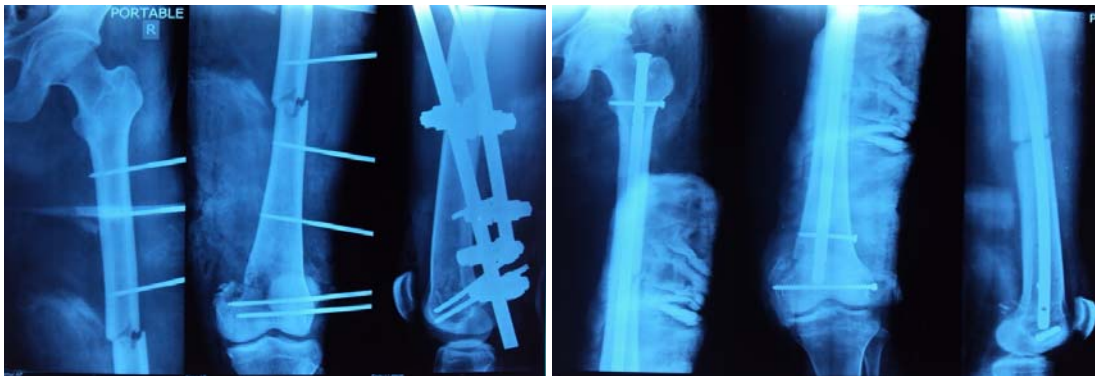

Fig 2: Patient with femoral artery repair initially put on external fixator, converted to IMIL nailing after 5 days.

12 of the 28 tibia fractures were converted to IMIL nailing at about 1wk. 6 fractures were treated with hybrid or spanning fixator for proximal tibia fracture. 5 fractures were treated with above knee cast after serial gradual extension of the knee on the external fixator. 5 fractures of distal tibia were converted to ring fixator of which 2 pts required bone transport in view of their gap non union. Both the fractures united by 18 mths. 2 distal tibia fractures treated with IMIL nailing had delayed union which united at 6mths.

In cases with combined anterior & posterior tibial artery injury (10 cases) posterior tibial artery was unrepaired due to bad crushing of the vessel in 4 cases. All 4 patients had non union which required subsequent procedures for the union. Amputation was done in 4 patients after vascular repair due to thrombosis of the vessel. Patients requiring amputation were significantly older than those without amputation, 3 of which were above 50yrs. Also 3 of 4 patients had come after 12hrs of the injury.

7 of the 36 patients had problems with wound healing. 5 patients had superficial infection which resolved with IV antibiotics. 2 patients had deep infection which required repeated curettage & debridement with IV antibiotics. 8 patients had knee stiffness & 8 patients had ankle stiffness of which 6 had difficulty in carrying activities of daily living which was common in patients treated with external fixator or cast.

Poor outcomes were associated with a Mangled Extremity Severity Score greater than or equal to 6. We had good to excellent results in 28 pts (78%) & fair to poor results in 8 pts (22%) (Table-2).

Table 2: Functional outcome of the study

Result	Criteria	Number	Percent
Excellent	Viable limb, normal activity, no symptoms	22	61.11
Good	Viable limb, normal activity, minor occasional complaints.	6	16.66
Satisfactory	Viable limb, restricted activity, disability requiring treatment	4	11.11
Poor	Loss of limb (Amputation)	4	11.11

Discussion

Lower limb long bone fractures with associated vascular injury is quite common in the present scenario in any trauma center but the literature addressing it is very less [1]. Also, there are many differences in the treatment protocols which makes the assessment even more difficult [1]. We used Doppler study of the lower limb as the imaging modality to detect the level of the vascular injury. We found it simple, easy & a rapid, cost effective modality. The findings of which correlated with the intraoperative findings. Lynch. *Et Al*, Bliss. *Et Al* and Panetta *et al* [7] supported the use of doppler in trauma setting and they also showed that it is as sensitive and specific as arteriography in occult arterial injuries.

In our series of 36 patients, femur fractures united earlier than tibia. There were no cases of non union in the femur fractures. Fractures treated with IMIL nailing united faster than those on ex fix or cast. 5 of the 22 tibia fractures had non union, all of which were distal tibia fractures with vascular injury at that level. 2 of which were treated by corticotomy & bone transport on a ring fixator & 3 patients required bone grafting at 6 to 14 months.

The amputation rate in the current investigation was 16.6% (six of 36 cases). This finding is comparable to the 17% amputation rate reported by segal *et al*. [4] All amputations were performed within the early period after injury post vascular repair (range 3-11 days), and there have been no late amputations. Most of the patients were above 50 yrs & presented after 12hrs of injury. Brinker *et al* [1] in his series also had poor outcome & more amputations in older patients. This is probably because of the atherosclerotic nature of the vessels.

In the current study, 22% (8 of 36 cases) developed an infection (5 superficial and 3 deep infections), which is better than 42% reported by Gustilo *et al*. [5, 9] in 12 III C long-bone fractures. No significant relationship was observed in regard to the size of the open wound and bony union or complications. All cases of infection were highly contaminated wounds. Fracture pattern and location influenced the rate of bony union. Comminuted fractures united about 2wks later than simple fracture patterns. Also in 5 patients with fracture at the level of distal tibia went into non union. An unrepaired injury to the posterior tibial artery was associated with an increased risk of both delayed union and nonunion of tibial shaft fractures especially in lower 1/3rd tibia #s. This is mostly because, an injury to this vessel could lead to poorer perfusion of the soft tissue envelope about the fracture site and, thereby, have a deleterious effect on fracture healing [8]. Brinker *et al*. [1] in his series showed that an unrepaired posterior tibial artery leads to delayed or non union of the tibia fracture. However, Dickson *et al*. [12] did not report any significant relationship between the specific vessel injured and the rate of fracture healing.

Joint stiffness is the chief morbid condition following vascular repairs. 16 of 36 patients had knee or ankle stiffness. None of the patients treated with IMIL nailing had stiffness. Patients with knee dislocation & those who required extenal fixator for longer time and those who were treated with cast had joint stiffness. 13 of 36 patients were treated definitively with external fixators and 6 patients with cast. As after the vascular repairs around the knee the knee is immobilisaed in flexion on external fixator for a longer duration & hence resulted in knee stiffness. 6 patients had very poor range of movements which hindered their activities of daily living and also had to change their occupation.

Conclusion

Lower limb vascular injuries mostly affects young, complications are many. Functional disabilities prevent patients from performing activities of daily living & hence requires intense rehabilitation protocols after prolonged immobilizations which are generally required in the healing of vascular repair & flaps or to do internal fixation as early as possible.

When done earlier (<12hrs) the limb salvage rates are good. Thorough debridement and early wound cover reduces the risk of infection. But assessing outcome after a vascular injury just by limb salvage underestimates the functional consequences of these injuries.

Outcomes are poorest in older patients and those with an injury to the posterior tibial artery (who are at increased risk of delayed union and nonunion). Good early vascular repair, adequate stabilization of the fractures & early rehabilitation gives good results.

References

1. Brinker Mark R, Bailey MD, Daniel Jr, MDE. Fracture Healing in Tibia Fractures with an Associated Vascular Injury. The Journal of Trauma: Injury, Infection, and Critical Care. 1997; 42(1):11-19.

2. Odland M, Gisbert V, Gustilo R *et al*. Combined orthopaedic and vascular injury in the lower extremities: Indications for amputation. Surgery. 1990; 108:660.
3. McNutt R, Seabrook GR, Schmitt DD *et al*. Blunt tibial artery trauma: Predicting the irretrievable. J Trauma. 1989; 29:1624.
4. Segal D, Brenner M, Gorczyca J. Tibial fractures with infrapopliteal arterial injuries. J Ortho Trauma. 1987; 1:160.
5. Gustilo R, Mendoza R, Williams D. Problems in the management of Type III (severe) open fractures: A new classification of Type III open fractures. J Trauma. 1984; 24:742.
6. Rainiero DIMD, Ney ALMD, West MAMD PhD, Jacobs DMMD, Van Camp JMMD, Odland MD MD *et al*. Functional Outcome Following Lower Extremity Vascular Injury (LEVI) The Journal of Trauma: Injury, Infection, and Critical Care Issue: Volume 1998; 45(1):198.
7. Panetta TF, Hunt JP, Buechter KJ *et al*. Duplex ultrasonography versus arteriography in the diagnosis of arterial injury: an experimental study J Trauma. 1992; 33:627-636.
8. Trueta J, Caladias AX. A study of the blood supply of the long bones. Surg Gynecol Obstet. 1964; 118:485.
9. Gustilo R, Simpson L, Nixon R *et al*. Analysis of 511 open fractures. Clin Orthop. 1969; 66:148.
10. Seligson D, Ostermann PAW, Henrh SL *et al*. The management of open fractures associated with arterial injury requiring vascular repair. J Trauma. 1994; 37:938.
11. Flint LM, Richardson JD. Arterial injuries with lower extremity fracture. Surgery. 1983; 93:5.
12. Dickson K, Katzman S, Delgado E *et al*. Delayed unions and nonunions of open tibial fractures. Clin Orthop. 1994; 302:189.