

The functional outcome of primary definitive internal fixation in open grade II and grade IIIA, IIIB fractures of long bones

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Abstract

Early stabilization of open fractures provides many benefits to the injured patient. It protects the soft tissues around the zone of injury by preventing further damage from mobile fracture fragments. It restores length, alignment, and rotation. All patients attending the orthopedic out-patient department and casualty of medical college and hospital with complaints of an open fracture grade II, IIIA, IIIB and meeting inclusion and exclusion criteria will be selected for the study. A written informed consent will be obtained from selected patients. Result was considered excellent in patients with full rom, and with no evidence of any complications. Result was considered good in patients with near to full rom, with no complications Result was considered fair in patients with restricted rom, with complications like infection and delayed union Result was considered poor in patients with non-union.

Keywords: Functional outcome, primary definitive internal fixation, fractures of long bones

Introduction

Fracture is defined as partial or complete break in the continuity of bone with bone may be broken into several pieces as a result of high force impact or stress ^[1]. Fractures are classified in various ways. Closed fractures are those in which the overlying skin is intact and open fractures are those in which wound communicate with the fracture as well as fracture hematoma is exposed. Open fractures are fractures that are associated with break in the skin and underlying soft tissue ^[2].

In deciding treatment strategy patient's condition, mechanism of injury and fracture type are considered. Some injury patterns are from high-energy mechanisms however commonly patients present with an open fracture from a simple low-energy mechanism such as a fall. Each fracture should be treated differently ranging from external fixation and delayed closure to fixation on immediate irrigation, debridement and primary closure. Soft tissues surrounding the fracture site is important in decision-making process which usually influences the initial management. Initial surgical intervention with irrigation and precise debridement of the injured zone is perhaps the most critical part of open fracture treatment. Surgeon should devote as much time as possible for the fixation, plan and executing

debridement. This initial debridement should entail a thorough cleaning of Skin, fat, fascia, muscle and bone are all should be evaluated in order ^[3].

Options for wound closure in the treatment of open fractures include primary closure of skin, split-thickness skin-grafting and use of either free or local muscle flaps. Immediate closure is defined as wound closure at the time of initial surgical intervention. Early closure is within the 24 to 72 hour window whereas delayed or late closure extends beyond 3 days. Surgeons opt for delay closure because of the perceived risks of clostridial infections and gas gangrene which is certainly present in the grossly contaminated open fracture. Current treatment strategies has allowed surgeons to consider earlier closure and immediate primary closure in some cases where certain criteria are met ^[4].

Early stabilization of open fractures provides many benefits to the injured patient. It protects the soft tissues around the zone of injury by preventing further damage from mobile fracture fragments. It restores length, alignment, and rotation. Surgeon has many choices for deciding on fixation like skeletal traction, external fixation, and intramedullary nails and plates. Choice of fixation involves the bone fractured, fracture location (intraarticular, metaphyseal, diaphyseal), extent of soft-tissue injury, degree of contamination and physiologic status of the patient ^[5]. External fixation is valuable for acute open fracture management. Indications for external fixation are grossly contaminated open fractures with extensive soft-tissue compromise, Type IIIA-C injuries and immediate fixation for physiologically unstable patients. Plate fixation is generally indicated for open upper extremity fractures and fractures where reconstruction of articular surface is paramount. However higher infections rates have been reported with plate fixation of open fractures ^[6]. Intramedullary nail fixation remains the mainstay of treatment for most open tibial shaft and selected femoral fractures with infection and non-union rates of 44 and 50% respectively. With this perspective present study was undertaken to analyze the functional outcome of primary internal fixation (intramedullary nail and/or plate) in open fractures of long bones grade II, IIIA, IIIB.

Methodology

Study Design

The present study is a Cross Sectional observation study.

Source of patient

All the patients admitted in the orthopaedic ward of medical college and hospital with open fractures of long bones grade II, IIIA and IIIB who fulfil the inclusion criteria.

Sample Size: N=30

Inclusion criteria

1. Open fractures of long bones (Humerus, Radius-Ulna, Femur, Tibia) grade II, IIIA, IIIB.
2. Presenting within 48hrs of sustaining injury.
3. Without vascular injury.
4. Patients who can be taken in OT within 12 hours of presentation.
5. Patients who give consent for surgery after counseling.

Exclusion criteria

- Patients with Head Injury

Study procedure

All patients attending the orthopedic out-patient department and casualty of medical college and hospital with complaints of an open fracture grade II, IIIA, IIIB and meeting inclusion

and exclusion criteria will be selected for the study. A written informed consent will be obtained from selected patients.

1. Patients will be stabilized hemodynamically in the casualty (BLS/ACLS guidelines)
2. X-rays of the injured limb will be taken and CT-scan will be done if indicated
3. Patients will be evaluated for pre-op fitness and will be optimized for early surgery (within 12 hours)
4. Appropriate internal fixation in the form of NAIL o PLATE will be done
5. Antibiotic cement beads to be used wherever necessary
6. Appropriate primary skin closure with suture if possible or a secondary or delayed wound closure with a flap or graft.
7. Broad spectrum antibiotics which are included:
 - a) INJ. PIPTAZ 4.5g IV TDS (Piperacillin + Tazobactam) for 5 days
 - b) INJ. METRO 100CC IV TDS(Metronidazole) for 5 days
 - c) After 5 days ORAL broad spectrum CEPHALOSPORINS to be administered till suture removal
1. Post op x-ray to be done
2. Follow-up visits after 2weeks (suture removal), 4 weeks, 6 weeks, 8 weeks, 12 weeks and 6 months after surgery. On each visit X-ray will be done, Skin condition and movements at adjacent joints will be assessed.

Results

Table 1: Distribution of Cases according to Complications

Sr. No.	Complications	Present N (%)	Absent N (%)	Total N (%)
1	Non-Union/Delayed Union	2 (6.66%)	28 (93.33%)	30 (100.0%)
2	Wound Infection	5 (16.66%)	25 (83.33%)	30 (100.0%)
3	Nerve palsy	0 (0 %)	30 (100.0%)	30 (100.0%)
4	Deep Vein thrombosis	0 (0 %)	30 (100.0%)	30 (100.0%)
5	Skin Complications	5 (16.66%)	25 (83.33%)	30 (100.0%)

Non-Union/Delayed Union was seen among 2 (6.66%) cases. Wound infections and skin infections were seen in 5 (16.66%) cases each. None of them had nerve palsy or DVT.

Table 2: Distribution of Cases according to Blood transfusion Unit

Sr. No.	Blood transfusion	Number of Cases (N)	Percentage (%)
1	1 Unit	26	86.66 %
2	2 Unit	4	13.33 %
Total		30	100 %

26 (86.66%) patients received 1 unit of blood transfusion.

Table 3: Distribution of Cases according to Hospital Stay

Sr. No.	Hospital Stay (Weeks)	Number of Cases (N)	Percentage (%)
1	≤ 1	2	6.66 %
2	1 to 2	24	80.0 %
3	> 2	4	13.33 %
Total		30	100 %

In majority (80%) of the patients, the duration of hospital stay was between 1-2 weeks. Four (13.33%) patients stayed beyond 2 weeks.

Table 4: Distribution of complications in patients based on comorbidity

Sr. No.	Comorbidity	Delayed union	Non-union	Infection	Skin complications
1	Addiction (Alcohol and tobacco)	0	1	0	0
2	Hypertension	0	0	0	0
3	Diabetes	1	0	2	2

One case of non-union which occurred, the patient was an alcohol addict and the one case of delayed union, patient was diabetic. Two cases of infection and skin complications were also seen in diabetic patients.

Table 5: Distribution of complications in patients based on Gustillo- Anderson type fracture classification

Sr. No.	Grade	Delayed union	Non- union	Infection	Skin complications
1	Grade II	0	0	0	0
2	Grade III A	1	0	3	3
3	Grade III B	0	1	2	2

Complication were seen in Gustillo- Anderson type fracture IIIA and B. One case of delayed union occurred in IIIA type, non-union in type IIIB. Three cases each of infection and skin complications occurred in IIIA type and two cases each in IIIB type.

Table 6: Distribution of re-operation / re-debridement in patients based on Gustillo- Anderson type fracture classification

Sr. No.	Grade	Cases needing Debridement	Cases needing re- debridement/ re- operation
1	Grade II	0	0
2	Grade III A	5	5 (3 times for each case)
3	Grade III B	2	2 (6 times for each case)

All cases in Gustillo- Anderson type fracture IIIA and B underwent debridement and re-operation.

Table 7: Average time for bone union in weeks in fractures based on Gustillo- Anderson type fracture classification

Sr. No.	Grade	8-10 weeks	10-12 weeks	12-16 weeks	>16weeks	No union
1	Grade II	20	3	0	0	0
2	Grade III A	0	0	4	1	0
3	Grade III B	0	0	1	0	1

Average time for bony union was longer in patients with group IIIA and IIIB. Average time for bone union was 8-12 weeks in patients belonging to grade II. Delayed union was seen in one patient belonging to group IIIA and non-union in one patient belonging to group IIIB.

Table 8: Range of movement (ROM) at adjacent joints

Range of movement at adjacent joints	Number	Percent
95-100% full range	20	66.66%
60-95%	4	13.33%
<60%	5	16.66%
Fully restricted	1	3.33%
Total	30	100.0%

Table 9: Case distribution according to End Results/ Outcomes

Result	Number of cases	Percent
Excellent	20	66.66%
Good	4	13.33%
Fair	5	16.66%
Poor	1	3.33%
Total	30	100.0%

Result was considered excellent in patients with full rom, and with no evidence of any complications. Result was considered good in patients with near to full rom, with no complications Result was considered fair in patients with restricted rom, with complications like infection and delayed union Result was considered poor in patients with non-union.

Discussion

In this study, interlocking Nail was used in all 90% of the cases. In Two cases TENS was done. In one case, a combination of intramedullary interlocking nail was used with a dynamic compression plate. In majority (76.66%) of the cases, time for surgery was between 8-12 hours. Kenganal et al.,^[7] reported using ILN in all cases. Rajagopal H. P et al.,^[8] used antegrade interlocking nail in all cases and mean duration of surgery was 52.3 minutes (range 40–74).

Non-Union/Delayed Union was seen among 2 (6.66%) cases. Would infections and skin infections were seen in 5 (16.66%) cases each. Delayed union and malunion occurred in patients of older age group (> 51 years). Infections and skin complications were present in patients of all age groups. None of them had nerve palsy or DVT. One case of non-union which occurred, the patient was an alcohol addict and the one case of delayed union, patient was diabetic. Two cases of infection and skin complications were also seen in diabetic patients. Complications were seen in Gustillo- Anderson type fracture IIIA and B. Average time for bony union was longer in patients with group IIIA and IIIB. Average time for bone union was 8-12 weeks in patients belonging to grade II. Delayed union was seen in one patient belonging to group IIIA and non-union in one patient belonging to group IIIB. All cases in Gustillo-Anderson type fracture IIIA and B underwent debridement and re-operation. 26 (86.66%) patients received one unit of blood transfusion. The overall rate of union is better than past studies with external fixation. Similarly, Shah RK et al, 9 reported four delayed unions and one non-union. They were eventually treated with good results with bone grafting. Two cases of superficial infections (grade II) and one case of deep infection were reported. No complications requiring implant removal or amputation were required. Mean time for bony unions are 22 weeks. They also reported that, time for union was greater in patients with type III B. Deepak MK et al 10 reported delayed union in two cases (6.6%), shortening of the limb in four cases (13.33%), superficial infection in 5 cases and one case of refracture with broken nail in situ, where exchange nailing was done. Mean time of bony union was reported as 16.5 weeks. Rajagopal H. P et al.,^[8] reported that all were closed injuries, with no radial nerve palsy. One case of superficial wound infection was seen. Mean time for union was 90 days (range 84–120).

In majority (80%) of the patients, the duration of hospital stay was between 1-2 weeks. Four (13.33%) patients stayed beyond 2 weeks. In Our study result was considered excellent in patients with full rom, and with no evidence of any complications, result was considered good in patients with near to full rom and with no complications, result was considered fair in patients with restricted rom, with complications like infection and delayed union and Result was considered poor in patients with non-union and 66.66 % patients had excellent results, 13.33% patients achieved good results, 16.66 % fair results and in 3.33% patients, the results were poor. Kenganal et al., 7 reported 43.33% patients had excellent results, 33.33 % patients achieved good results, 16.67 % fair results and in 6.67% patients, the results were poor. Aslan et al.,^[11] in 19 patients with open tibial fractures with definite treatment reported excellent

functional outcome in 31.57% patients, good in 42.10% patients, fair in 10.53% and poor in 15.78%. Rajagopal H. P et al.,^[8] used Constant–Murley shoulder score to assess functional outcome and reported excellent score in 70%, followed by good in 25%, and fair in 5%. The mean duration of hospital stay was 5 days (range 03–12). Quamar Azan et al.,^[12] used Katenjian criteria for assessing functional outcome and reported 62.85% good to excellent results.

Therefore, primary definitive fixation of open long bone fractures Gustilo-Anderson grade II, IIIA and B have favorable outcomes. It provides successful union and good functional outcome, especially in Gustilo-Anderson grade II and IIIA, grade IIIB fractures also only with extensive debridement and proper antibiotic treatment and prophylaxis.

Conclusion

The functional outcome ranges from excellent to good in cases of Gustilo-Anderson Grade II, but in Grade IIIA and IIIB it ranges from fair to poor. As the grade of open fracture increases the measures to be taken to avoid complications also increase. But with proper initial surgical debridement and wound care and with proper antibiotic prophylaxis and re-debridements if necessary, a favourable outcome can also be achieved in higher grades of Gustilo-Anderson. Therefore, we can conclude that primary definitive fixation of open long bone fractures Gustilo-Anderson grade II, IIIA and B have favorable outcomes. It provides successful union and good functional outcome, especially in Gustilo-Anderson grade II and IIIA, grade IIIB fractures also only with extensive debridement and proper antibiotic treatment and prophylaxis.

References

1. Katherine Abel. Official CPC Certification Study Guide. American Medical Association. 2013, 108.
2. Simple fracture | pathology". Encyclopedia Britannica. Retrieved 2021-05-19
3. Gustilo RB, Anderson JT. Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones: Retrospective and prospective analyses. *J Bone Joint Surg Am.* 1976;58:453-8.
4. Gustilo RB, Mendoza RM, Williams DN. Problems in the management of type III (severe) open fractures: A new classification of type III open fractures. *J Trauma.* 1984;24:742-6.
5. Tscherne H, Oestern HJ. A new classification of soft-tissue damage in open and closed fractures. *Unfallheilkunde.* 1982;85:111-5.
6. Johansen K, Daines M, Howey T, Helfet D, Hansen ST Jr. Objective criteria accurately predict amputation following lower extremity trauma. *J Trauma.* 1990;30:568-72.
7. Kenganal DPB, Nayak DAR, BB DD, Bagewadi DR, Kulkarni DSR, Kumar DA. Functional outcome of metaphyseal and diaphyseal fractures of tibia treated with expert tibial interlocking nail: A prospective study. *Int J Orthop Sci [Internet].* 2019 Jan ;5(1):48-52.
8. Rajagopal H, Mohan, MM, Pilar A, Tamboowalla KB. Functional outcome of antegrade interlocking intramedullary nailing for humeral shaft fractures. *Int J Res Orthop [Internet].* 2017 Oct 25;3(6):1127-31.
9. Shah RK, Moehring HD, Singh RP, Dhakal A. Surgical Implant Generation Network (SIGN) intramedullary nailing of open fractures of the tibia. *Int Orthop.* 2004 Jun;28(3):163-6.
10. Deepak MK, Jain K, Rajamanya KA, Gandhi PR, Rupakumar CS, Ravishankar R. Functional outcome of diaphyseal fractures of femur managed by closed intramedullary interlocking nailing in adults. *Ann Afr Med.* 2012;11(1):52-7.
11. Aslan A, Uysal E, Özmeriç A. A Staged Surgical Treatment Outcome of Type 3 Open Tibial Fractures. *ISRN Orthop.* 2014 Apr 15;2014:1-7.
12. Azam Q, Sherwani M, Abbas M, Gupta R, Asif N, Sabir AB, et al. Internal fixation in

Compound type III fractures presenting after golden period. IJO. 2007;41(3):204.