

# Comparative Study of Nonoperative and Operative Methods of Treatment of Pilon Fracture

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Received: December 2019

Accepted: December 2019

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## ABSTRACT

**Background & Aim:** The ideal treatment of pilon fracture continues to be an unresolved dilemma and most challenging. Previously regarded as a rare fracture, now it has become relatively common comprising up to 7-10% of tibial fractures. This is a study comparing the outcome of nonoperative and operative treatment of pilon fracture. **Methods:** Present study was carried out in the Department of Orthopaedic surgery of a tertiary care hospital with total 31 patients. It was a prospective randomized study, with average follow up of 12 months. Patients diagnosed as recent closed pilon fracture were included in the study. According to computer based random numbers patients were treated either nonoperatively or operatively. Closed reduction, 3 weeks calcaneal pin traction and then cast immobilisation 3 weeks and later 6 wks of long leg brace followed by weight bearing at 12 week was done for conservative group. For operative group primary procedure of fibula fixation and ankle spanning external fixation followed by secondary definitive procedure of ORIF of tibia was done. Functional outcome was assessed using AOFAS score, radiological union and complication rate. These parameters of both group are compared using Chi square test. **Results:** Overall result is significantly better with staged ORIF method. For specific fracture types, with R.A (Ruedi Alloweger) type I results of nonoperative and operative methods are comparable where as with R.A type II and III result of staged ORIF is significantly better than conservative method. Fracture prognosis worsens as severity progresses through type I to type III irrespective of treatment method. **Conclusion:** In our study overall result with operative treatment by staged ORIF was better than non-operative treatment. Looking in to specific fracture types, Ruedi Alloweger Type I which is a undisplaced fracture has similar result in both groups. So for type I fracture non-operative method may be better choice. For type II and III operative treatment with staged ORIF is definitely better option as result with operative method is significantly better.

**Keywords:** Non-operative. Operative, pilon fracture.

## INTRODUCTION

Rapid industrialization and the fast pace of life have brought comforts as well as catastrophes like road traffic accidents and various other high velocity trauma. Patterns of fractures have become so diverse and unpredictable that it poses a great challenge in management to trauma surgeons. One such fracture is pilon fracture.<sup>[1]</sup> Ankle fractures that involve weight bearing distal tibial articular surface are known as pilon fracture. It has become more common at present due to increased incidence of road traffic accidents and high velocity trauma. Now it accounts for 7% to 10% of all tibial

fractures. Even with all advanced modalities of treatment, the definitive treatment is yet to evolve.<sup>[2]</sup> Till the early 1970s, there was a great reluctance towards operative management of these fractures because of high incidence of complications like deep infection, osteomyelitis, soft tissue devascularisation.<sup>[3]</sup> The accepted treatment options were conservative like skeletal traction, manipulation of fracture and external immobilization in the form of casts and cast bracings. These methods however, met with problems like deformity, shortening, prolonged bed rest, stiffness, angulation, malunion, muscle wasting, and post-traumatic osteoarthritis. Over last four decades, there has been substantial evolution in the trauma surgeon's approach towards this fracture. The initial picture of "always catastrophic result in pilon fracture" in surgeons mind has gradually changed during those years of research. After influential paper by Reudi in 1968 & 1973, the general approach was to do immediate

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ORIF.<sup>[4-6]</sup> However enthusiasm for immediate ORIF decreased after report of significant complication rate in subsequent studies. Later approach changed to combined external /hybrid external fixation with minimal internal fixation after successful reports. However this too was not devoid of significant complication and clinical outcomes were not consistent. The research continues, with constant effort to further improve clinical outcome in this difficult fracture, which has resulted in development of further alternative methods in recent years. These are use of MIPPO technique, modification of surgical approach, use of new implant like locking plate and anatomically contoured low profile plates etc. Still excellent long-term results of the treatment continue to elude patients sustaining these fractures, despite understanding the fracture anatomy and biomechanics.<sup>[7]</sup> Even with use of advanced operative treatment options, satisfactory outcome is not possible always in pilon fracture and in many studies significant complication rate continues to persist. So in our prospective study, we have used conservative method along with staged operative procedure in treatment of pilon fracture and compared their results to determine whether in selected cases conservative approach can be an equally good/better method of treatment, taking in to account the final functional score and complication rates in both groups.

## MATERIALS AND METHODS

The present study : “Comparative study of non-operative and operative treatments of pilon fracture” is a prospective randomized control trial which was carried out in the Department Orthopaedic surgery of a tertiary care hospital. Total 34 patients with pilon fracture were admitted to our hospital during this period. 3 patients were excluded from study on basis eligibility criteria. Rest 31 patients were followed up for average period of 12 months after receiving treatment at hospital. Among 31 patients there were twenty two males, nine females with age ranging from 22 -56 yrs (mean age 36.05yrs).

### Inclusion criteria:

1. Presented within 24 hrs
2. Age range: 16 years- 70 years
3. Closed fracture
4. Unilateral fracture.

### Exclusion criteria:

1. Open fractures,
2. Associated spinal injuries(paraplegia and quadriplegia),
3. Known case of bleeding disorders and sickle cell anaemia,
4. Patient with vascular compromise,

5. Associated fractures of other bones of the same limb,
6. Patient presenting after 24 hrs As soon as the patients were brought to the casualty a complete survey was carried out to rule out significant injuries. Then the patients radiograph's were taken, both anteroposterior and lateral views of the ankle joints. On admission to the ward detailed history was taken relating to the age, sex, occupation, address, mode of injury past and associated medical illness. Patients general condition was assessed and then they were put through a thorough clinical examination. Patients were examined giving special importance to whether the fracture was open or closed, presence of gross swelling, fracture blisters, features of compartment syndrome and presence of other associated injuries. Analgesics were given and patients were put on a above knee posterior POP slab to alleviate pain. Also antibiotics and tetanus toxoid and tetanus immunoglobulins were given as needed. The fractures were classified based on Ruedi-Allgower classification in adults. Routine investigations were done for all patients. Out of 31 patients with use of computer generated random numbers 16 patients were allocated operative treatment rest 15 patients treated conservatively. The patients under operative treatment were operated with staged ORIF method i.e primary fibula fixation & ankle spanning external fixation, then after soft tissue healing secondary definitive fixation with distal tibial plate by ORIF. Patients under conservative treatment were given calcaneal pin traction after reduction under fluoroscopy and after 3wks cast immobilization done.

**Conservative treatment:** Closed fracture reduction was performed under fluoroscopic guidance with patient under sedation. Then calcaneal pin traction was applied which was kept for 3wks. This provided time for soft tissue to heal. After that pin traction was removed and long leg cast was applied for another 3 wks. This was followed by hinged long leg brace for 6wks along with active, assisted and passive physiotherapy for range of motion of the ankle, subtalar and metatarsophalangeal joints. After that radiological assessment fracture was done. If in X ray union has been progressed, satisfactorily partial weight bearing was started at end of 12th week and progressed to full weight bearing in next 12 weeks along with continued active and passive physiotherapy.

**Operative treatment:** Operative procedure was carried out in two stages (1) primary procedure as damage control surgery (2) secondary procedure or the definitive procedure. Patients were followed up at 2wks interval for first 3 months and then at 3months interval. They were examined for presence of any residual swelling, deformity, and condition of wound, tenderness and ankle range of

movements. During follow up visit once patient started walking they were assessed according to AOFAS guidelines regarding any pain, any difficulty in walking (specially on uneven ground), change in daily activities and change in occupation. Patients were examined for any gait abnormalities (like antalgic gait or painless limping), and any neurological deficits in foot (E.g. sensory loss over lateral border of foot in operated cases). Follow up X-rays were taken to assess fracture union, the condition of implant (in operated cases), to look for ankle arthritis and any deformities.

Assessment of outcome  
 1. Functional outcome  
 2. Union  
 3. complications

1. Functional outcome of two groups were assessed using AOFAS score. Then they were compared with each other using unpaired T-test to know significance of difference.
2. Union of fracture was assessed by radiological and clinical method and compared with each other. Radiologically it is defined as union of at least one cortex in AP and lateral view of X ray
3. Complications of both groups were assessed clinically and radiologically.

Final comparison between two groups were done by comparing the distribution of grades of functional outcome and complication in two groups.

## RESULTS

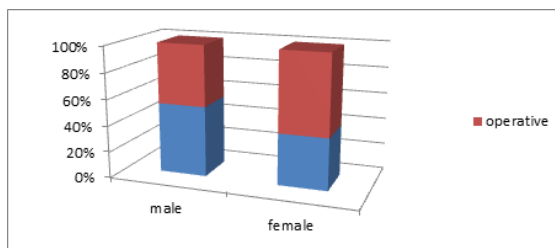


Figure 1: Sex distribution in two groups

There is no significant difference of sex distribution between two groups. In operative male: female =80:20 and in nonoperative group it is 69:31. Overall sex incidence is 74%:26%. [Figure 1]

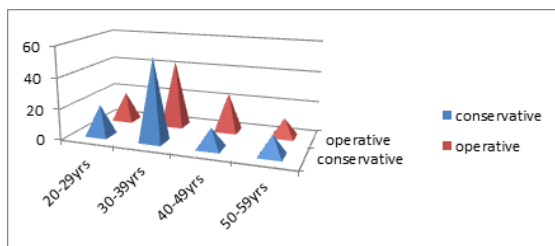


Figure 2: Age group distribution in two groups

There is no significant difference in age group distribution between two groups. Overall age group prevalence is 20-29yr=19%, 30-39yrs=49%,

40-49yrs=19%, 50-59yrs=13%. There is no significant difference in mean age between two groups. The mean age of operative group is 37.88 yrs and nonoperative/conservative group 36.yrs. [Figure 2]

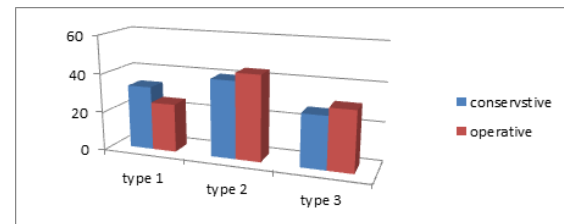


Figure 3: Fracture types in two groups

There is no significant difference in distribution of Ruedi Allgower fracture types between two groups. Overall distribution is R.A type I=29%, type II=42%, type III=29%. [Figure 3]

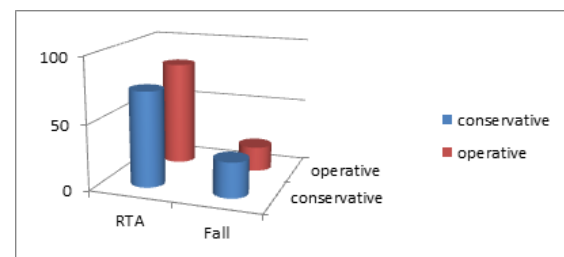


Figure 4: Type of injury distribution in two groups

There is no significant difference in distribution of fracture aetiology between two groups. In both RTA is the most common cause. [Figure 4] There is no significant difference of side of fracture distribution between two groups. Overall prevalence ratio is R:L=58%:42%.

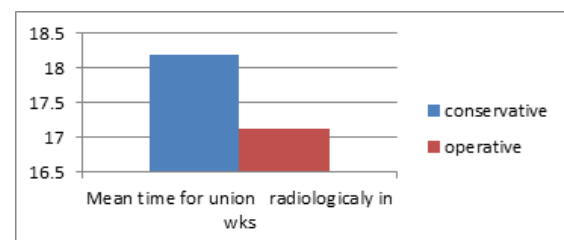


Figure 5: Comparison of mean time for radiological union

There is no significant difference of time for radiological between two groups. In operative group mean is 17.13 wks and in nonoperative group it is 18.19wks. [Figure 5]

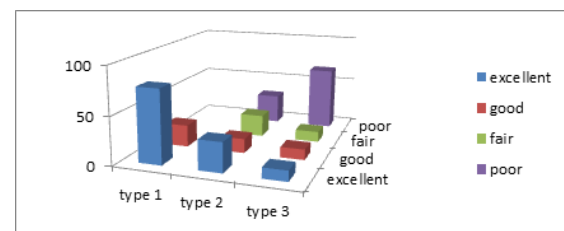


Figure 6: Outcome of different types of fractures

Outcome of R.A type I fracture is favourable where is in severe injuries of type II and type III outcome is less favourable irrespective treatment method. This indicates prognosis worsens as it progresses through type I to type III. [Figure 6]

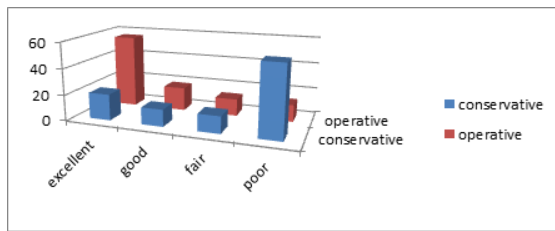


Figure 7: Final outcome in two groups

The outcome in operative group is significantly better than nonoperative/conservative group with p value < 0.0001. [Figure 7]

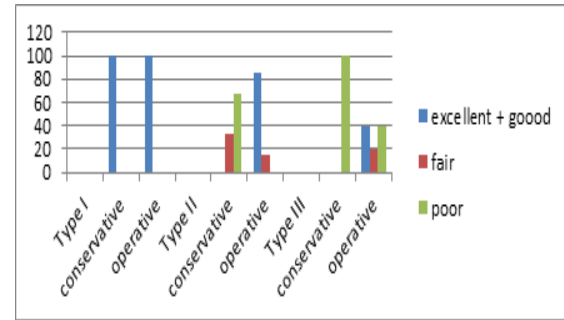


Figure 8: Fracture specific outcome in two groups

The outcome for R.A type I fracture are comparable in both groups where as for type II and III fracture outcome is significantly better. This signifies type I fracture can be managed nonoperatively but type II and III fracture definitely needs operative intervention. [Figure 8]

Table 1: Complications

Group	Superficial Infection	Deep Infection	Osteomyelites	Stiffness	Malunion	Delayed/ Nonunion	Total
Conservative	-	-	-	6	3	-	7* 47%
Operative	2	1	1	-	-	-	4 25%

\*In conservative group 2 patients had both malunion and stiffness, making total number of patients 7.

## DISCUSSION

Management of fractures of the tibial plafond continues to be challenging and controversial. Although multiple treatment modalities and protocols have been described, there is no common agreement regarding the optimal treatment of these challenging injuries. Much of the controversy resides in treatment methods & techniques and balancing the benefits of surgical restoration of anatomy versus the potential risk of further soft tissue injury and iatrogenic complication. The severity of these injuries, complexities of a variety of treatment methods, and limitations of different methods management have been well documented in the literatures, but excellent long-term results of treatment still continue to elude patients sustaining these fractures.

In the modern era advanced implants and techniques failing to avoid significant post-operative complications as well as lagging to achieve excellent long term result, several authors have studied to ascertain if conservative treatment can be a better alternative. Our study aims to find in which circumstances conservative treatment can be used keeping functional outcomes as good as ORIF while avoiding complications of ORIF. So it was not until Ruedi's paper in 1969 & later in 1973 that changed the conventional idea about ORIF, who for the first time reported good results using ORIF based on AO principles. His paper lead to basic understanding of pilon fracture; it's mechanism, morphology & important role of soft

tissue. In 1979 Ruedi again reported achievement of 75% good & excellent result with ORIF.<sup>[4-6]</sup> Following his principles Ovadia and Beals,<sup>[7]</sup> also subsequently reported good results. Nonetheless, the enthusiasm for open treatment of these injuries soon faded by reports of substantial rates of wound complications, particularly deep sepsis, osteomyelitis, and, ultimately, poor outcomes. Bourne,<sup>[8]</sup> in 1983 reported 80% satisfactory result with type I & II fracture while type III has only 44% satisfactory result. Nonanatomic reduction, unstable fixation, infection, nonunion, and/or angulation were the usual causes of failure of this form of treatment. In 1986 Dillin,<sup>[9]</sup> reported infection rates as high as 55% and wound sloughing rates of 36%. A few patients in multiple studies eventually required arthrodesis or amputation.<sup>[8,9]</sup> This led several authors to reconsider again conservative management for pilon fracture like Bourne.<sup>[10]</sup> These devastating outcomes germinated third way of thinking in many surgeons to adopt the principle of tibial articular reconstruction without exposing the fracture. Thus, external fixation with limited ORIF was evaluated to try to achieve articular surface realignment with fewer complications. Multiple studies have shown that comparable results could be achieved with external fixation while minimizing the rate of infection and skin sloughing. However the method of external fixation was not panacea of treatment. Studies by Marsh et al,<sup>[11]</sup> Bone et al,<sup>[12]</sup> Pugh et al,<sup>[13]</sup> and Koulouvaris et al,<sup>[14]</sup> reported that external fixation too has



consistently been associated with high rates of pin-tract infections, malunion, and nonunion. This too is basis for the conduction of our study to find out where conservative management can be worthy option to choose, by comparing functional outcomes and complication of both method with each other and also with previous studies. We have compared our results with both newer and older studies. In 2003 Othman<sup>15</sup> reported in 30 cases of distal tibia epiphysis fractures (pilon fractures), including 4 cases of open fractures, were treated by conservative technique. According to the Rüedi-Allgöwer AO classification, there were 13 patients with type I fractures, 9 type II and 8 type III fractures Long-term results (mean 3 years) have been assessed in 8 cases as good, 12 as fair and 10 as bad. In 23 cases osteoarthritis of talotibial joint has been found. In 16 cases there were deviations of bone axis (15 degree of varus). The range of movement of the joint was limited in all patients. In 18 cases there was no dorsiflexion. In one case shortening of the treated leg 2 cm has occurred. They concluded that conservative treatment is effective for pilon fractures type I and II. The majority of bad results was found in type III due to the severe destruction of the articular surfaces. Bhattacharyya,<sup>16</sup> found in 2006 while using staged ORIF with posterolateral approach found 47% complication rate including infection, nonunion and post traumatic arthritis. In 2009 Kline AJ,<sup>17</sup> got 19% infection rate and 16% nonunion rate in normal group while comparing them with DM group which very high rate of infection (71%) and nonunion (43%). Boraiah S,<sup>18</sup> in 2010 achieved only 8% infection with no other complication and good SF-36 score of 40 with use of an individualized treatment algorithm including the use of staged procedures, meticulous soft-tissue management, liberal use of temporizing external fixation, and a patient-specific approach to fixation and soft-tissue coverage. Similarly in 2010 Lisa k. Cannada<sup>19</sup> found 2% deep and 5% superficial infection while treating 55 pilon fracture in 43 patients.

In 2012 Justin E. Richards,<sup>20</sup> reported only 3.7 infection rate & 3.7% of nonunion rate with patients treated with ORIF in staged procedure compared to 11% infection and 22% nonunion in external fixation group. Also staged ORIF group has significantly higher Iowa ankle function score. They reported use of staged procedure & newer surgical techniques compared to old studies is key to successful result in ORIF group. In 2014 Lomax,<sup>21</sup> in retrospective study of 76 patients reported 23% wound complication rate. On follow up rate of nonunion was 9.7 %, rate of post traumatic arthritis was 9.9%, and reoperation was required 28% patients. The likelihood of developing post-traumatic arthritis and of requiring further surgery is high. In our study with average

follow up period of 12 months(4-23 months) we got 75 % (12 out of 16) excellent and good results in staged ORIF group while poor and fair result are 13% each. So our result is accordance with results of previous studies on staged ORIF of pilon fracture while comparing on basis of functional outcome. These are 75% good result of Rüedi<sup>7</sup> in 1979, 79% good result of Angeln,<sup>22</sup> in 1999 and 81% good result of Torrenta,<sup>23</sup> and 75% of Blautha.<sup>24</sup> But in the conservative group result was unsatisfactory with excellent and good results only 33% (5 out of 15) and poor results 54%. So on the basis of overall functional outcome in all type of fractures conservative management shows poorer outcome which is statistically significant. (P value 0.0001) Similarly comparing conservative method with previous staged ORIF studies, the current result is unacceptable. However comparing outcome of specific fracture types with each other in both groups shows in R.A Type I result is 100% excellent and good in both conservative and staged ORIF group. In R.A type II 33% shows fair result and 67% poor result in conservative group while in operative group 85% has excellent and good result only 15% has fair result with no poor result. In R.A type III in conservative group uniformly the result was poor(4 out of 4:100%) while for operative group 40% show poor result, 20% good, 20% excellent and 20% fair result. This shows for Type I fracture result is comparable in both groups, for Type II conservative group has significantly poorer outcome(P value <0.0001), for Type III also conservative group has significantly poorer outcome (p value <0.0001).The mean time for radiological union was 1wk lower in ORIF (17.19wks vs 18.13wks) group but statistically insignificant making no difference. The mean functional outcome score by AOFAS score is significantly higher in staged ORIF group (85.38 vs 70.13) well correlating with overall outcome. Comparing the complications, we got high rate of overall complications of 47% in conservative group. In staged ORIF group it's lower, but still 25% which is quite unfavourable. So in both groups overall complication is high with conservative group nearly two times higher of operative group. However if complications in each fracture type are compared, in Type I fracture of both group there no complication. In Type II of conservative group complication rate is 50% but for operative group it is 15%. Similarly for Type III in conservative group all patients had complication while in operative rate was 60%. Out of the above discussed studies about ORIF and external fixation of pilon fracture, the complication rates and outcomes of some are given below in tabulated form including our study. Now it's evident that in past few decades with advancement in techniques, implants and better understanding of fracture, overall outcome of operative treatment has

improved significantly and far exceeded previous mainstay of treatment i.e conservative treatment. Similar trend is reflected in complication rates also, which has greatly decreased in operative treatment to become far below the conservative therapy.<sup>[25]</sup> The current study also reports similar result with outcome significantly better in staged ORIF group and complication being significantly lower. So overall staged ORIF is better method of treatment with significantly better result than conservative group. However looking in to specific fracture types, Type I fractures in both group has comparable outcome and complication. Whereas for Type II & III fracture in staged ORIF has significantly better functional outcome and lower complication than nonoperative group.

## CONCLUSION

Our study shows overall result with staged ORIF is much better than conservative method. However comparing result of individual fractures between both groups, type I fracture has comparable outcome in both staged ORIF and non-operative method without any associated complication .For R.A type I pilon fracture which are undisplaced, non-operative treatment may be regarded as better choice because it gives outcome similar to operative method but avoids inherent complications of surgery. For R.A type II and type III fracture staged ORIF is definitely the choice of treatment as conservative method has very poor functional out come as well as very high complication rate.

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**How to cite this article:** Pal SC, Das B. Comparative Study of Nonoperative and Operative Methods of Treatment of Pilon Fracture. *Ann. Int. Med. Den. Res.* 2020; 6(1):OR06-OR11.

**Source of Support:** Nil, **Conflict of Interest:** None declared