

INTRAMEDULLARY INTERLOCKING NAILING FOR LONG BONE
FRACTURES OF THE LOWER LIMB: OUR EXPERIENCE WITH FREE-HAND
LOCKING.

ABSTRACT

Lower limb shaft fractures are frequently seen in traumatic events from motovehicular accidents, fall from heights, contact sports and pedestrian injuries. The gold standard of treatment for most of the fractures remain the locked intramedullary nail. In our retrospective cross sectional study, most of such fractures where seen on the Right leg of male of productive age group. Most challenging aspect of the procedure were intraoperative radiography is not available is correct placement of the distal locking screws. Use of a distal targeting device is the main stay, why using the guide wire to sound the drill bit/screw increase the chances of accurate placement, about 92% in our study.

INTRODUCTION

Shaft Fractures of lower limb long bone are commonly from high energy injuries often associated with a significant traumatic event, such as motovehicle or motorcycle accident, fall from height, and motovehicle

16 striking pedestrian. Less common mechanism of femoral shaft fracture include pathological fracture, low
17 energy torsional fracture in elderly patients and biphosphonate related stress fracture¹. The gold standard
18 for treatment is placement of rigid statically locked intramedullary nail, which result in union in greater
19 than 93% of time¹. It has now become a standard treatment of long bone diaphyseal and selected
20 metaphyseal fractures².

21 They are introduced into the bone remote to the fracture site and share compressive, bending and
22 torsional loading with the surrounding osseous structure, acting as internal splint resulting to secondary
23 bone healing². The prepared technique is the closed nailing using indirect reduction techniques and
24 fluoroscopy to guide proper placement of entry point and locking screws. However, there is room for open
25 technique with direct reduction of fragment. It is shown to have a lesser infection rate, high rate of union,
26 faster return to weight bearing and activity compared to conservative treatment¹³. Thus, the general
27 agreement that intramedullary locking nail is justified in the treatment of comminuted and markedly
28 displaced fractures.

29 The number of patients in the developing countries who will need stabilization of high energy fractures due
30 to road traffic accidents are predicted to increase by 67% by the year 2020. This is as a result in the number
31 of fractures from global conflict³. Open fractures which are traditionally treated by initial external fixation
32 may be fixed with a nail after taking care of the soft tissue injury. There is still no consensus about the best

33 treatment for open fractures, but biomechanical studies show external fixation in two planes approaches
34 the rigidity of the bone. However, it produces statistically similar results compared to intramedullary locking
35 nail⁵.

36 In the Humerus, the choice between plating or nailing remains controversial since both can achieve similar
37 results, but plating may reduce the occurrence of shoulder problems⁴.

38 Open fractures fixed with antibiotic releasing core nails have a significantly lower infection rate, faster
39 consolidation and fewer complications as compared to standard interlocking nails⁷. Long term range of
40 motion at hip and knee for early treated uncomplicated fractures is comparable to the uninjured limb
41 regardless of fixation technique⁶.

42 There is no significant difference between reamed and unreamed nails for treatment of tibial fractures, only
43 reamed have lower fixation failure⁸. After giving due respect to soft tissue injury grade III shaft fractures can
44 be fixed early with reamed interlocking nails with resultant satisfactory alignment, good range of motion,
45 short rehabilitation period and low infection rate⁹.

46 The most challenging step in this procedure is the precise placement of locking screws that stabilize the
47 fragment¹¹. Various techniques are in use ranging from fluoroscopy guided free hand to the use of jig
48 with both proximal and distal targeting devices. Chances of successful locking especially of the distal screw

49 hole is increased by various ingenious techniques of confirming correct screw placement intraoperatively
50 where there is no luxury of intra operative fluoroscopy. We tried various ingenious techniques previously
51 without much satisfactory distal locking.

52 This article aims at seeing the pattern of interlocking nailing used for fractures of lower limb long bones in
53 terms of: bone affected, laterality ,age distribution, sex distribution, pattern of locking and early outcome.

54 PATIENTS AND METHODS

55 The study is a retrospective cross sectional study conducted over three years from April 2013 to march
56 2016 in a private hospital in kano. All patient that had intramedullary nailing for femoral and/or tibial
57 fracture within the period were recruited. There were a total of 86 patients of both sexes with age range of
58 19-70 years. 5 patients were excluded due to incomplete documentation. Other exclusion criteria are
59 multiple injuries, except lower limb fracture and patients lost to follow up.

60 All the procedures were done by direct open reduction and nailing with free hand locking by utilizing a
61 proximal and distal targeting device while confirming the presence of locking screw within the nail by use
62 of a guide wire to gauge the tip- end length of the nail and to sound the screw.

63 The surgery was done by the same team all through using different interlocking set but all with a proximal
64 and distal targeting device. Average operation time over time have drop to 90 minutes.

65 PROCEDURE: patients laying supine under anaesthesia, routine prep done depending on femoral or tibial.
66 Via lateral and anterior approaches for femur and tibia respectively, the fracture fragments were exposed
67 and ends prepared and trial reduction done to assess congruency. Entry point created retrogradely via
68 proximal fragment for femur and ante grade for tibia. Canal reamed, fracture reduced over the nail.

69 A nailing guide wire is passed down to the end of the bone and the wire marked with a Kocher's forceps as
70 it exit the jig. The wire is pulled up a little to allow drilling via the sleeve in the distal targeting device.
71 Metallic sound and incomplete descend of the marked guide wire confirm presence of drill bit within the
72 nail. Withdrawal of drill bit will allow descent of guide wire. When the hole is missed, gentle rocking of the
73 jig usually brings the hole to the drill bit. The process is repeated with the locking screw this time. Same is
74 repeated when there is need for extra locking distally. Similar process is done for the proximal after a
75 satisfactory alignment and compression of the fragments is achieved.

76 With perfection of this technique over the last one year success of locking both proximal and distally is
77 almost 100%.

78

79

80

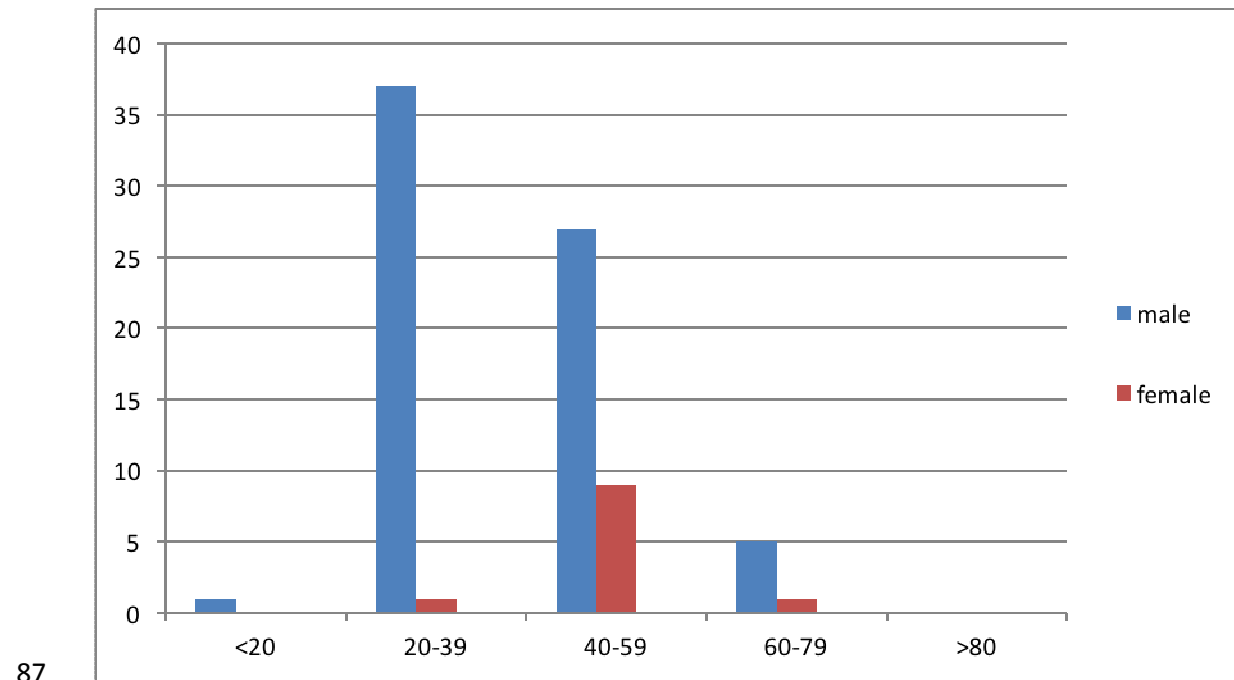
81 RESULT

82 The age ranges from 19 -70 years with a majority between 20-39 years. There is only one person below the
83 age of twenty and is in the male category.

84 There is a total of 87 procedures conducted on 81 patients of which 70(86.4%) male and 11(13.6%)
85 females.

AGE RANGE	SEX	
	MALE	FEMALE
20-39	1	0
20-39	37	1
40-59	27	9
80-79	5	1
≥80	0	0

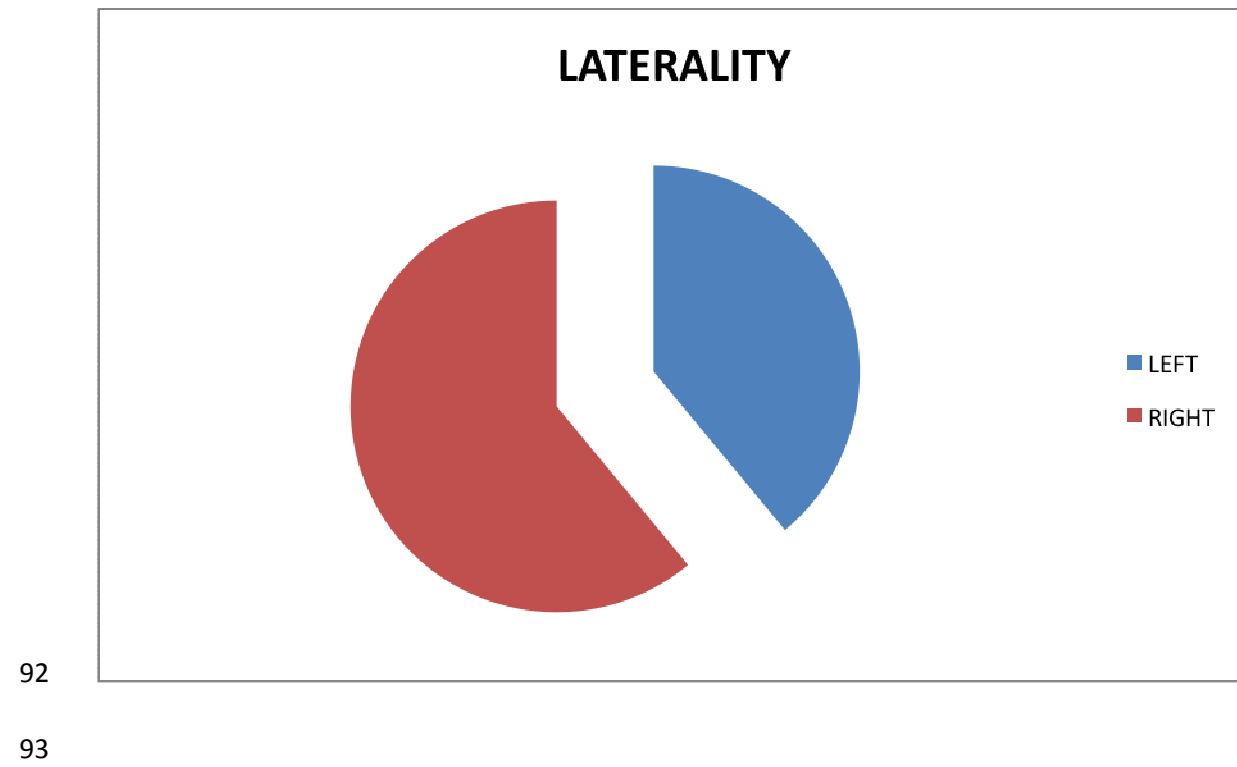
86

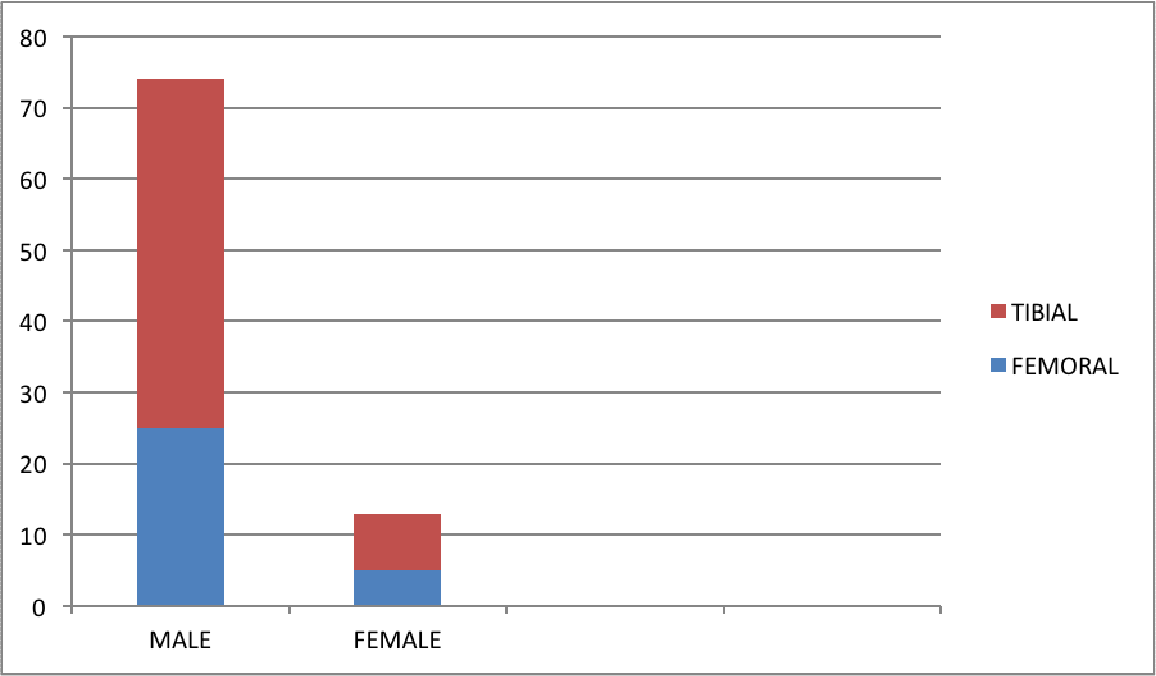


87

88 AGE/SEX DISTRIBUTION

89 There are thirty femoral and fifty-seven tibial nailing done of which 3 had a floating knee, 2 bilateral tibial
90 and 1 bi femora. Only 5 females have femoral fracture and 8 with tibial fracture. There are 34 fractures on
91 the left side(39%) and 56(61%) on the right side.





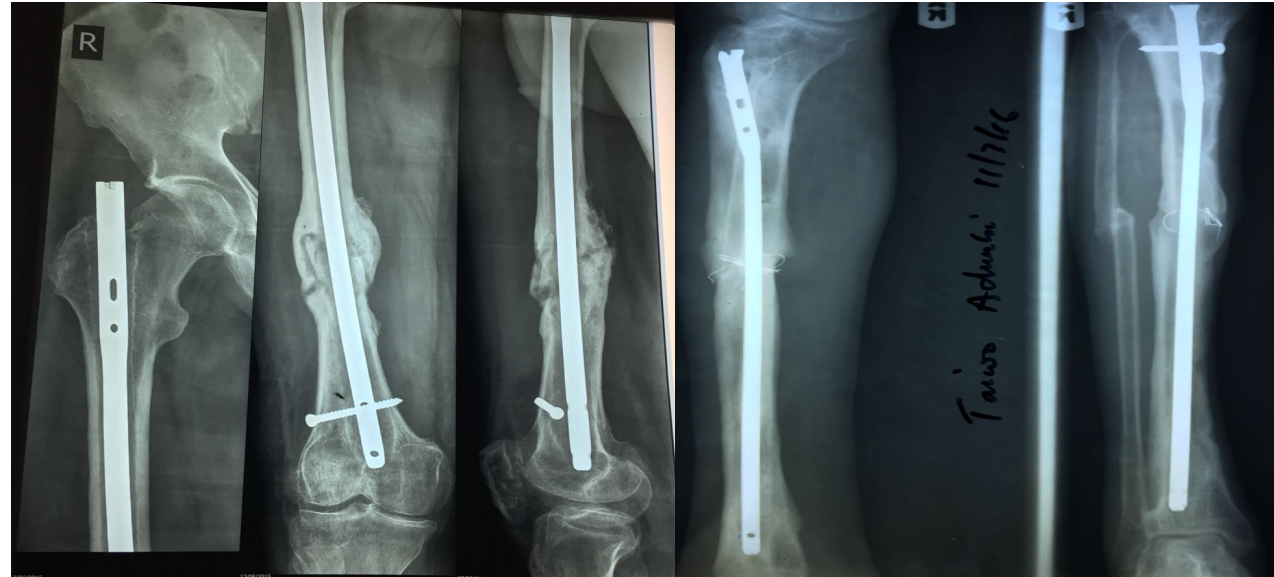
94

95 SEX/ BONE DISTRIBUTION

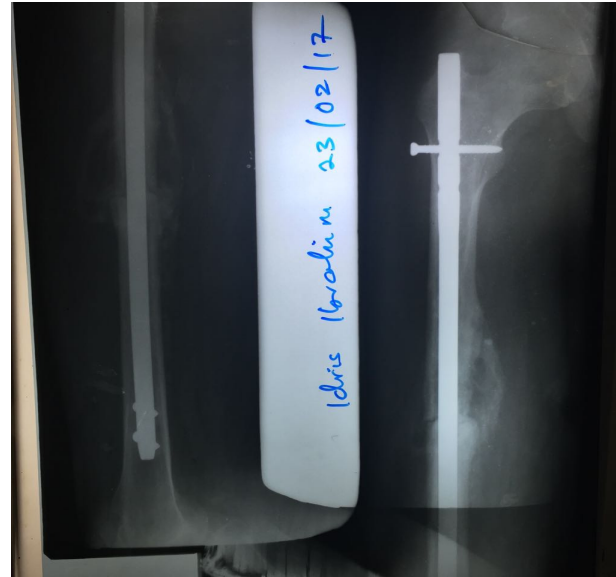
96 Only 77% of the interlocking nail were locked at both ends, the remaining are locked at one end with the
97 other end abandoned due to difficulty in getting the hole or actually not attempted. Of the 87 nailings, 5
98 were inappropriately locked outside by the side of the distal nail and 2 locked distal to the tip of the nail.

99 1 femoral and 3 tibial developed non union requiring exchange nailing with a larger diameter nail and
100 cancellous bone graft. 6 patients develop surgical site infection which were managed successfully with
101 antibiotics and wound care with only 2 tibial nails requiring conversion to external fixation using Linear Rail
102 system for compression.

103 70(86%) of the patients were satisfied with their treatment with very good-excellent range of motion, while
104 11(14%) patients have either of reduced range of motion, anterior knee pain or abnormal gait.



105



106

107 DISCUSSION

108 There are various studies conducted on various aspect of Inter-Locking Nail(ILN) for shaft fractures in long
109 bone. Since all the patients in the study have shaft fracture that is closed or not more than Gustillo 2, one
110 can relates pattern of nailing with such categories of fracture.

111 Most of the nailing are done in male and within the class range of 20-39, and 40-49 in the female group.
112 This is similar to what is documented by Courl-Brown et al(14) with average male age of 36.9years and
113 56.2 for the female. This is not surprising as most of the fracture cases we see are related to motovehicular

114 accident. The male to female ratio is 6.4 :1 which is similar to result by Z. Gugala et al(15) as 4.8 :1,
 115 however, contrary to what was obtained by Courl-Brown(14), 1.9 :1. This may be partly explained by lifestyle
 116 difference where majority of the females in our locality are full time house wives with minimal activity on
 117 the major roads.

118 Unilateral nailing was done in 93% where 3.4%, 2.3% and 1.2% are floating knee, both tibia and both
 119 femora respectively. This is similar to 96.5% and 3.5% unilateral and bilateral respectively by Z. Gugala et
 120 al(15). Majority of nailing was done for tibial shaft fractures and this accounts for almost all the open
 121 fractures in the study, 57 against 30 femoral fracture. This is the documented picture seen considering the
 122 modal age group and the common mechanism of injury as motor vehicular accident[S. Nayagam(12)]. 39%
 123 of all the procedures were carried on the left side with right having a majority, 61%. No similar comparison
 124 was found in the literature and we have no explanation for such occurrence.

125 Regarding the locking of the nail, the distal locking is much more challenging and time consuming
 126 compared to the proximal. The standard practice is locking both fragments with one or two screws. Even
 127 though similar results in terms of rate of union have been obtained with locking of shorter of the fragment or
 128 the less stable fragment. This may not have place in unreamed and comminuted fractures. 77% of the nails
 129 were locked at both ends while the 23 were locked only at one end was either due to difficulty attributed
 130 to deformation of the nail or perceived to be unnecessary in press fit and rotationally stable fractures

131 intraoperatively. Correct placement of distal screw confirmed with post operative x-ray is 92% with the
132 remaining percentage missed usually to the side of the nail. This is similar to findings by Yvan, A(16) and G.
133 Anastropoulos(17) with locking rates of 96% and 100% respectively.

134 Union was achieved in 97.7% of the cases with only 1 femoral(segmental) and 3 tibial develop known union
135 requiring exchange nailing and bone grafting to achieve union.This is similar to work by Eric Kubiak(13).
136 Infection rate stood very low in our study with only 6 cases of which four were superficial infections
137 resolving with antibiotics and local wound care, while 2(open fractures) require conversion to external
138 fixation, with interfragmentary compression using Linear Rail system to control infection. Low Infection
139 rates is a documented fact especially in close fractures fixed by close technique as shown by Eric Kubiak(13)
140 and Nuno C-L(7).

141 70 patients(86%) have very Good to Excellent out come based on recovery of range of motion of hip
142 and/or knee, anterior knee pain, gait. Similar result is reported for long term outcome of femoral fracture as
143 excellent by M. El-Moumni(6).

144 CONCLUSION

145 Fracture of lower limb long bones shaft that are amenable to interlocking nail should be manage as such
146 despite the challenge of intraoperative radiograph in most of our centre. Unavailability of intra operative

147 radiograph should not discourage use of inter locking nail, which is the gold standard; since use of proximal
 148 and distal targeting device with various ingenious manoeuvres have produce similar success to standard
 149 techniques in terms of success of distal locking and union rates.

150 REFERENCES

- 151 1. Sahmir Sadic, Svemir Custovic, Mahir Jasarevic et al. Complication and Functional Recovery in
 152 treatment of femoral shaft fractureswith unreamed intramedullary Nail. Med arch. 2014;68(1):30-33.
- 153 2. Bong, Mathew R; Kumner Frederic J; Koval Kenneth, et al. Intramedullary nailing of the lower
 154 extremity: Biomechanism and biology. Journal of American academy of orthopedic surgeon.
 155 2007;15(20):97-106
- 156 3. Lewis G. Zirlde, Faseeh Shahab. Interlocked intramedullary nail without fluoroscopy. Orthopaedic
 157 clinic north America. 2016;47:57-66
- 158 4. Hanbin Ouyang, Jun Xiong, Peng Xiang et al. Humeral shaft fracture: an updated meta analysis. J.
 159 Shoulder and elbow surgery. 2013;22(3):387-395.
- 160 5. Fabio Lucas Rodrigues, Luiz Carlos de Abreu,Victor E. Valenti. Et al. Bone tissue repair in patients with
 161 open diaphyseal tibial fracture treated with biplane external fixation or reamed locked intramedullary
 162 nail. Injury. 2014;45(5):32-35.

- 163 6. Mostafa el Moumini, Emma Heather Voogd, Henk Jantan Duis et al. Long term functional outcome
164 following intramedullary nailing of femoral shaft fractures. Injury. 2012;43(70):1154-1158
- 165 7. Nuno Craveiro-Lopez. Treatment of open tibial fracture with locked intramedullary nail with a core
166 release of antibiotic: comparative study with standard intermedullary nail. Revue de chirurgie
167 orthopedique et traumatologique. 2016;102(7):112-115.
- 168 8. Yu Guangshu, Wang Yu, Xu Zhiging et al. Reamed or unreamed intramedullary nailing for tibial
169 fracture; A meta analysis. Chinese journal of traumatology. 2014;17(4):229-234.
- 170 9. D.Singh, R. Garg, JL Bassi et al. Open grade III fractures of the femoral shaft:outcome after early
171 reamed intramedullary nailing. Orthopaedic and traumatology: surgery and research.
172 2011;97(5):506-511.
- 173 10. Vilmos vecsei, Stefan Hajdu, Lukas L Negrin. Intramedullary nailing in fracture
174 treatment:History, science and kuntscher's revolutionary influence in Vienna, Austria. Injury.
175 2011;43(4):1-5.
- 176 11. Z. Kamariarakis, I Buliev, N Pallikarakis. Robust identification and localization of intramedullary
177 nail holes for distal locking using CBCT: A simulation study. Medical engineering and physics.
178 Distal locking with mechanical 2011;33(4):479-489.
- 179 12. David Warwick, Selvadurai Nayagam. Fracture of tibia and fibula. Apley's systems of
180 orthopaedic and fracture. 2010;9th edition:897-904.

- 181 13. Eric Kubiak. Intramedullary nailing of femoral shaft fractures. Clinical trial. Gov. 2016.
- 182 14. C.M. Court-Brown, S Rimmer, U Prakash et al. The epidemiology of open long bone fractures.
- 183 Injury. 1998;29(7):529-534.
- 184 15. Zbigniew Gugala, Arvind Nana, Ronald W. Linssey. Tibial intramedullary nail distal interlocking
- 185 screw placement; Comparism of the free hand versus distally based targeting device technique.
- 186 Injury ,2011;32:21-25.
- 187 16. Yvan Arlettaz, Alexander Domminguez, Alain Farron. Distal locking of femoral nail: evaluation of
- 188 a new radiation-independent targeting system. Journal of trauma. 2012;0(0).
- 189 17 .G Anastropoulos. Distal locking with mechanical jig. Injury .1994