DOI: 10.7860/JCDR/2022/52697.16188

Original Article

Orthopaedics Section

Functional Outcome of Monorail Fixator as a Primary and Definitive Mode of Fixation in Open Fractures of Tibia- An Interventional Study

KULDIP SINGH SANDHU[1], DHARM PAL[2], ARVIND KUMAR[3], JASPREET SINGH[4], ASHOK KUMAR SHARMA[5], KANWARJIT SINGH SANDHU[6]

ABSTRACT

Introduction: Open fractures of the tibia are associated with massive soft tissue injury and bone loss with high rates of infection and non union resulting in poor treatment outcome. The treatment goals include prevention of infection, soft tissue coverage, and fracture stabilisation with simultaneous mobilisation of nearby joints, enabling early return to function. The management in open fractures continues to be a topic of debate in orthopaedic traumatology with various treatment options, having their own set of complications.

Aim: To assess the functional outcome of open tibial fractures with a monorail fixator using Radiographic Union Scale in Tibial fracture (RUST) score and modified Johner and Wruh's criteria.

Materials and Methods: This prospective interventional study of 30 cases was conducted from November 2018-October 2020 in Government Medical College, Patiala, Punjab, India. The 30 patients of open tibial fractures of type 2, type 3A, 3B (male=27, female=3) as classified by Gustilo-Anderson were included in this study. Patients were operated for monorail system to assess the stability of monorail fixator, total time taken in fracture union and compliance with range of motion of joints. On follow-up patients were also assessed for pin track infection and postoperative surgical site infection by taking swab for culture and antibiotic sensitivity. Statistical analysis was performed using the statistical software Statistical Package for the Social Sciences (SPSS) 25.0. In this study, quantitative data was expressed as mean values with Standard Deviation (SD) and categorical data were expressed as frequencies with percentages.

Results: Present study had shown excellent to good results in 27 cases (90%) with minimum surgery time of 52.17±14.24 minutes. Full weight bearing with fixator was allowed in 5.37 days and fracture union occurred at 31.8±5.8 weeks. RUST score of 2 was seen in 33.33% and score 3 in 63.33% of patients respectively. Only one patient (3.33%) had shown score 1, which was treated with removal of fixator, debridement, sequestrectromy and fracture fixation with ring fixator and bone grafting. The bacteriology positivity was seen in six cases (n=2 was positive for *Escherichia coli* and n=4 was positive for *Staphylococcus aureus*).

Conclusion: Present study demonstrated the benefits of monorail fixator as a primary and definitive mode of fixation in open tibial fractures with early full weight bearing over a stable construct and minimal complications.

Keywords: Bone loss, Limb reconstruction, Non union

INTRODUCTION

In industrialised world, the incidence of open fractures have increased due to increase in number of road traffic accidents. These are associated with massive soft tissue injury and bone loss with high rates of infection as well as non union resulting in poor treatment outcome. Fractures of long bones constitute the majority of emergency operating room procedures. Tibial fractures are the most common among these fractures. In European countries, especially in United States (US) has shown in their registry an annual incidence of 4,92,000 fractures of both bone leg as reported by the National Centre for Health Statistics [1,2].

There are various complications of open fractures of tibia, most common being non unions and infections, these may be attributed to less soft tissue or muscular coverage around lower leg. Other complications include malunion, malalignment etc., that sometimes necessitate secondary operations. Management strategies are to minimise these frequent complications and reoperations [1,2]. These open fractures of tibia are commonly seen due to low energy trauma, but it could be caused by high energy mechanisms. There are various treatment modalities for these fractures like early or delayed and external or internal fixation. The decision for the management of open fractures should be considered on merits and demerits of patients profile, fracture pattern or type and mechanism of injury. Soft tissue coverage of traumatised leg is a predominant factor in deciding the management of these open fractures [2].

There are several surgical procedures [3] and every method has its own merits and demerits. Ring fixators have some disadvantages followed by dissatisfaction with patients. Limb Reconstruction System (LRS) through monorail system is superior to ring fixator [3]. Monorail system being light weight and uniplanar application is more advantageous to patients as well as for surgeons. This monorail device is cost-effective and provides axial compression which promotes fracture union [4]. The patient can start walking even though undergoing treatment. Monorail system is an external fixator which provides an easy access without excessive vascular injury to the soft tissues and to bone. It causes minimal anatomical loss or displacement, and minimal complications considering the both knee joint and ankle joint [4]. There are five principal causes of tibial diaphyseal fractures. These are falls, sports injuries, direct blows or assaults, motor vehicle accidents and gunshot injuries. The tibial fractures with simple pattern tend to result from simple falls [5]. However, falls from a height and motor vehicle accidents are associated with a much higher incidence of Gustilo-Anderson type 3A, B and C fractures [Table/Fig-1] which are more difficult to treat [6]. This classification system has prognostic significance for these patients.

Monorail is a simple, effective, adjustable, light weight and offers rigid stabilisation of fracture fragments along with access to wound dressing. It can induce and enhance fracture healing by compression and distraction osteogenesis as well as bone transport in case of

Type	Wound	Level of contamination	Soft tissue injury	Bony injury
1	<1 cm long	Clean	Minimal	Minimal comminution
2	>1 cm long	Moderate	Moderate, some muscle damage	Moderate comminution
3A	>10 cm long	High	Severe with crushing	Includes segmental comminuted fractures. Soft tissue coverage of bone possible.
3B	>10 cm long	High	Extensive soft tissue injury with periosteal striping	Bone exposed, soft tissue reconstruction required
3C	Regardless of size	High	Extensive soft tissue injury with vascular injury	Vascular repair and soft tissue reconstruction/ repair required.

[Table/Fig-1]: Gustilo-Anderson's classification system for open fractures [6].

bone loss [7]. In the present study, authors have used standard and short model of monorail fixator.

This study was conducted to assess the functional outcome of open tibial fracture patients treated with monorail fixator as a primary and definitive mode of fixation with following aims of: 1) To assess stability of monorail fixator and total time taken in fracture union; 2) To assess range of motion in operated patient; 3) To assess full weight bearing on follow-up and compliance of the patient; 4) To assess pin track infection and postoperative surgical site infection by taking swab for culture and antibiotic sensitivity.

MATERIALS AND METHODS

This prospective interventional study of 30 cases was conducted from November 2018-October 2020 in Government Medical College, Patiala, Punjab, India. The Institute Ethical Committee (IEC) approval was taken vide No. BFUHS/2K19P-TH/6934. Informed consent of the subjects was obtained.

Inclusion criteria: Patients with extra-articular and open fractures of tibia of type 2 and 3 (A and B) as classified by Gustilo-Anderson without bone loss in skeletally mature patients treated as well as followed-up with LRS were included.

Exclusion criteria: Skeletally immature patients and type 1 and 3C open fractures of tibia were excluded. Type 1 and 3 C fractures were excluded from study, because these cases had required inter lock nailing and vascular surgeons respectively.

Study Procedure

Primary management: All patients were made haemodynamically stable and then clinico-radiological evaluation was done. Primary wound debridement and irrigation was done under local anaesthesia with 5-6 litre of normal saline. Splint was applied to the affected limb and anti-inflammatory drugs/analgesics were given. Wounds were graded according to Gustilo-Anderson's classification [6].

Limb Reconstruction System (LRS): All patients were assessed for pain, deformity, shortening, range of motion at knee and ankle joints and radiological union. Pain was noted on Visual Analogue Scale (VAS) scale of 1-10 with none, moderate and severe in nature [8,9]. Deformity was noted as none, ante version- recurvatum, varus-valgus and rotational deformities in degrees. Range of motion of knee, ankle, and subtalar joints was noted in percentage. Hundred percentage (100%) was considered as normal, more than 80% for knee and more than 75% for ankle with more than 50% for subtalar joint was considered as good [10]. Radiological assessment was considered as excellent and good if fracture was consolidated. Fracture union was considered as fair results and which has not consolidated was called as poor results. Angular alignment was assessed by radiological examination.

The deformities of varus or valgus were decided on basis of line drawn along mechanical and anatomical axis of lower limb. On lateral radiographs, lines were drawn parallel to proximal and distal fragments and anteroposterior alignment was calculated on affected part of bone. Rotations were assessed clinically. Malunion was considered when varus-valgus angulation was more than 5°, anterior–posterior more than 10° and internal-external rotation of more than 10° with shortening more than 10 mm. Gait was assessed on one meter straight walk with LRS in situ. In present study, fracture union was considered when patient was weight bearing without pain, fracture site was not tender on palpation, and radiograph showed osseous union in anteroposterior and lateral views after removal of fixator [10].

Surgical technique: The patient was positioned supine with both lower limb in extension on a radiolucent table. The two surgeons performed this procedure on all patients. Under image intensifier, reduction was achieved and maintained with reduction clamps. After preparation of the part, three 6 mm Schanz pins [11,12] were introduced anteromedially on proximal fragment of fractured tibia. These three 6 mm pins were fixed to proximal clamp of LRS. Authors took the measurements of the distal fragment for application of Schanz pins depending upon the length of distal fragment. If distal fragment was two-thirds of tibia, two clamps and six 6 mm Schanz pins were used and for one-third part, one clamp and three Schanz pins were used. The compression distraction unit had to be fixed in between the distal clamp of proximal segment and distal first clamp of distal segment [Table/Fig-2,3].

[Table/Fig-2]: Showing intraoperative picture of limb with LRS in situ.

[Table/Fig-3]: Showing postoperative limb X-rays of patient.

Postoperative management: Passive range of motion exercises were started from postoperative day 1. Intravenous antibiotics (first generation cephalosporins) were given for five to seven days. Protected full weight bearing was allowed on postoperative day 5. Postoperatively, all patients were followed-up periodically at four weeks, eight weeks, 12 weeks, six months, and nine months and evaluated by RUST [Table/Fig-4] [13] score and modified Johner and Wruh criteria [Table/Fig-5] [14]. During follow-up, after clinical and radiological evaluation, fixator was removed. RUST score of 2 was used as criteria to switch over treatment modality. {LRS to Patellar Tendon Bearing cast (PTB)} All patient's having RUST score of 2 were immobilised with PTB cast for another three to four weeks to get complete union in these cases and to avoid pin track infection with good functional outcome.

Score per cortex	Callus	Fracture line
1	Absent	Visible
2	Present	Visible
3	Present	Invisible

[Table/Fig-4]: Radiographic Union Scale in Tibial fracture (RUST) [13] score.

Excellent	No non union, no infections, no deformity, no shortening, no pain, full range of ankle and knee movements, no neurological deficits and normal gait.
Good	No non union, mild infections, mild deformity, <10 mm shortening, occasional pain, range of ankle (>75%) and knee (>80%) movement, no neurological deficits and normal gait.
Fair	No non union, moderate infections, moderate deformity, shortening 10-20 mm, moderate pain, range of ankle (>50%) and knee (<75%) movements, no neurological deficits, and mild pain.
Poor	Non union, deep infection, significant deformity, >20 mm shortening, severe pain, range of ankle (<50%) and knee (<75%) movements, neurological deficit and significant limp.

[Table/Fig-5]: Modified Johner and Wruh criteria [14].

Modified 'Johner and Wruhs' criteria parameters of non union, neurovascular injury, pain, infection, knee and ankle range of motion and gait were used postoperatively to assess the functional outcome of patients [14].

STATISTICAL ANALYSIS

Statistical analysis was performed using the statistical software SPSS 25.0. Quantitative data were expressed as mean values (with SD) and categorical data were expressed as frequency (with %).

RESULTS

In present study, mean age was 42±10.09 years having male dominance in 93.33% of patients. Road traffic accident was most common cause of injury seen in 83.33 percent (n=25) of patients and fall from height was seen in 16.67 percent (n=5) of the cases. Most of the patients were having type 3A (53.33%) and type 3B of (33.33%) fractures [Table/Fig-6]. Right-sided limb involvement was seen in 73.33% of the patients.

Type of fractures (Gustilo-Anderson classification)	Number of patients (%)
2	4 (13.33)
3A	16 (53.33)
3B	10 (33.33)
Total	30 (100)

[Table/Fig-6]: Types of fractures.

Mean duration of surgery was 52.17±14.24 minutes (35 to max. 90 minutes) and secondary procedures (Skin Grafting) were done in 40 (n=12) percent of type 3A and 3B patients. Mean time of full weight bearing was 5.37±2.25 days. Mean time for fracture union was 31.8±5.8 weeks [Table/Fig-7]. RUST score is shown in [Table/Fig-8].

Time of fracture union (weeks)	Number of patients (%)
24-30	15 (50)
31-35	7 (23.33)
>35	8 (26.67)
Mean±SD	31.8±5.8

[Table/Fig-7]: Time of fracture union.

RUST score	Number of patient (%)
1	1 (3.33)
2	10 (33.33)
3	19 (63.33)

[Table/Fig-8]: Showing RUST score of LRS patients.

Modified Johner and Wruh's criteria parameter:

a. **Non union:** Among 30 cases, majority (96.67%) of the cases has united and delayed union was seen in three cases. Only one case (3.33%) had shown non union.

b. **Postoperative neurovascular injury:** No neurovascular injuries were seen postoperatively.

c. **Pain:** The final follow-up of pain on VAS scale of 1-10 was noted at time of fixator removal. Among 30 cases, 6.67% cases were having moderate pain and 10% cases were having occasional pain, where as 80% cases were fully recovered with no residual pain. One patient (3.33%) having severe type of pain.

d. **Infection:** In present study, among 30 cases, only three cases (10%) of patients were presented with mild pin tract infection and only 2 (6.67%) were having moderate infection. Only one patient (3.33%) was presented with severe deep bone infection [Table/Fig-9,10].

Complications	Number of patients (%)
Isolated Pin tract infection	2 (6.67)
Surgical site infection	1 (3.33)
Delayed union	3 (10)
Pin tract infection+Non union	1 (3.33)
Pin tract infection+delayed union	2 (6.67)

[Table/Fig-9]: Complications.

Infection	Number of patients (%)
Mild	3 (10)
Moderate	2 (6.67)
Severe/ Deep	1 (3.33)
No	24 (80)
Total	30 (100)

[Table/Fig-10]: Infection profile [15,16].

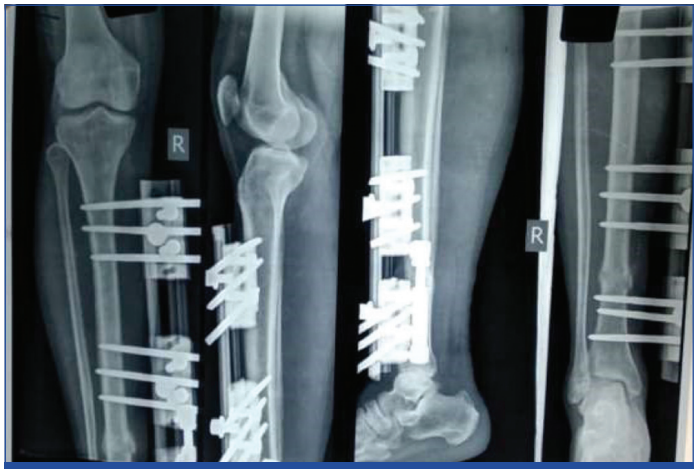
e. **Knee range of motion:** At end of this study, all patients were having full range of motion.

f. **Ankle range of motion:** Present study had shown full range of motion in 76.66% (n=23) of the patients. In 13.33% (n=4) cases range of motion was more than 75% while 6.67% (n=2) of the patients had shown >50% range of motion at ankle. Only one patient (3.33%) had shown <50% movements.

h. **Gait:** During one meter straight walk gait analysis, 90% (n=27) of patients had shown normal gait and minimal limp was seen in two cases (6.67%). Only one patient (3.33%) had significant limp.

Outcome according to modified Johner and Wruh's criteria: Excellent results were seen in 76.67% (n=23) of the patients, and 13.33% (n=4) had shown good outcome. Only 6.67 (n=2) percent of the patients showed fair results and 3.33 (n=1) percent was shown poor outcome.

In present study, after three consecutive follow-up X-rays [Table/Fig-11,12]. The PTB cast was applied which is shown in [Table/Fig-13].



[Table/Fig-11-12]: Follow-up X-ray of patients showing callous with LRS. (Images from left to right)

[Table/Fig-13]: PTB cast after fixator removal.

Microbiological profile: Microbiological examination in the form of pus culture and sensitivity was done in six patients which were having infections [15,16]. Among these *Escherichia coli* were seen in two patient (33.33 percent) while *Staphylococcus aureus* was seen in four patients (66.67 percent). Antibiotic sensitivity of *Escherichia coli* was seen for amikacin, gentamicin, ceftriaxone, and cotrimoxazole. Antibiotic resistance of *Escherichia coli* was seen for ciprofloxacin, ampicillin. Antibiotic sensitivity of *Staphylococcus aureus* was seen for amikacin, clindamycin, vancomycin, ampicillin and ceftriaxone while resistance was seen for erythromycin, gentamicin and ciprofloxacin.

DISCUSSION

Open fractures of tibia are associated with massive soft tissue injury with bone loss. The treatment goals include prevention of infection and early mobilisation of joints with enabling early function. In general, external fixators provide stability to fractured bone as well as preserves bone vascularity. This also gives accessibility to wound for soft tissue procedures and less blood loss during procedure [4,5]. In present study, mean age of the patients was 42±10.09 years which was in concordance with studies of Kale AB et al., and Singh AK et al., having mean age 35.6 years and 38 years [17-19]. Male dominance of 93.33 percent was in concordance with studies conducted by Kale AB et al., Thakur AJ et al., and Mahajan NP et al., in which 93.33% 83.5% and 65%, of the patients were males respectively [17,18,20]. Present study injury pattern of road traffic accident in 83.33 percent cases were in concordance with studies by Kale AB et al., Mahajan NP et al., and Singh P et al., in which road traffic accidents were aetiologic factors in 100% 65% and 80%, of the cases, respectively [17,19,20].

The mean duration of surgery was 52.17 minutes having minimum and maximum duration of surgery about 35 minutes and 90 minutes respectively and similar results were found in a study conducted by Singh P et al., having operation time 45 minutes in 16 (80%) cases while in the rest 4 (20%) cases it was about one hour due to difficulty in achieving proper reduction and placement of implant [21].

Secondary procedures (Skin Grafting) were done in 40% of the patients having Gustilo-Anderson classification 3A and 3B. In a study, conducted by Singh P et al., adequate soft tissue coverage was done with split skin grafts for two patients (10%) and local flaps for one patient (5%) after three to four weeks [21].

Present study had shown mean time of full weight bearing was 5.37 days and similar results were seen in studies conducted by Kale AB et al., and Singh P et al., having mean time to full weight bearing was 10.45 days and 6.3 days respectively [17,21]. Mean time of fracture union of 31.8 weeks which was in concordance with Singh P et al., and Ajmera A et al., showing similar fracture union in 23.26 weeks and 52 weeks, respectively [21,22].

In present study, overall complications were seen in nine patients. Ajmera A et al., and Sandhu KS et al., in his study had reported pin tract infection in five cases and one patient had a deep infection which required frame removal [22,23]. Excellent results were seen in 76.67% of the patients, and 13.33% showed good outcome. Only 6.67% of the patients showed fair results. 3.33% showed poor outcome. Present study results were in concordance with study conducted by Ajmera A et al., having excellent results in 84% (21/25), good in 8% (2/25) and fair in 8% (2/25) [22].

Limitation(s)

The study was limited by its heterogeneous fractures along with less number of patients. Long term follow-up in terms of restoration of pre-injury ambulatory status and mortality was not done. Only 30 cases were included due to ongoing pandemic.

CONCLUSION(S)

Monorail fixation as a primary and definitive mode of fixation has benefited open tibial fractures patients having Gustilo-Anderson types 2, 3A and 3B. This study had shown an easy accessibility on performing soft tissue procedures with external fixator in situ and patient's satisfaction on early full weight bearing over a stable construct with minimal complications. Patients had good range of movements at both knee and ankle joints.

Acknowledgement

Authors would like to thank all employees and supporting staff of department of orthopaedics, Government Medical Patiala, for their support and coordination without which this study have not been possible.

REFERENCES

[1] Gray, Henry. Anatomy of the Human Body. 20th ed Philadelphia: Lea & Febiger, 1918; Bartleby.com, 2000.
[2] Puno RM, Teynor JT, Nagano J, Gustilo RB. Critical analysis of results of treatment of 201 tibia shaft fractures. Clin Orthop Relat Res. 1986;(212):113-21.
[3] Cross WW, Swiontkowski MF. Treatment principles in the management of open fractures. Indian J Orthop. 2008;42(4):377-86.
[4] Madadi F, Eajazi A, Madadi F, Daftari Besheli L, Sadeghian R, Nasri Lari M. Adult tibial shaft fractures- different patterns, various treatments and complications. Med Sci Monit. 2011;17(11):640-45.
[5] Brown CCM. Fractures of the tibia and fibula. 6th ed. In: Rockwood and Green's Fractures in adults, Robert BW, James HD, eds. Philadelphia: Lippicott Williams and Wilkins; 2006. 2113-18.
[6] 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;24:742-46.

[7] Singh P, Singh SK, Gill SPS. Management of compound fractures of tibia by Limb Reconstruction System (LRS). Journal of Bone and Joint Diseases. 2020;35(1):29-34.
[8] Boonstra AM, Sciphorst Preuper HR, Posthumus JB, Stewart RE. Reliability and validity of the visual analogue scale for disability in patients with chronic musculoskeletal pain. Int J Rehabil Res. 2008;31:165-69.
[9] Couper M, Tourageau R, Conrad F, Singer E. Evaluating the effectiveness of visual analogue scales: A web experiment. Soc Sci Compt Rev. 2006;24:227-45.
[10] Ross A, Fawdington, Johnson B, Nigel T. Lower limb deformity assessment and correction. Orthopaedics and Trauma. 2014;28(1):33-40.
[11] Behrens F. External fixation. 3rd ed. In: Manual of internal fixation, Muller ME, Allgower M, Schneider R, Willinegger H, eds. Berlin: Springer-Verlag; 1999.367-68.
[12] Colton C, Texhammer R. AO/ASIF instruments and implants. A technical manual. 2nd ed. Berlin: Springer-Verlag. 320-52.
[13] Leow JM, Clement ND, Tawonsawatruk T, Simpson CJ, Simpson AH. The radiographic union scale in tibial (RUST) fractures: Reliability of the outcome measure at an independent centre. Bone Joint Res. 2016;5(4):116-21.
[14] Johner R, Wruh O. Classfication of tibial shalft fractures and correlation with result after rigid fixation. Clin Orthop. 1983;178:07-25.
[15] Byrd HS, Spicer TE, Cierney G. Management of open tibial fractures. Plast Reconsrt Surg. 1984;24:742-46.
[16] Burwell HN. Plate fixation of tibial shaft fractures. A survey of 181 injuries. J Bone Surg Br. 1971;53(2):258-71.
[17] Kale AB, Patole VV, Argekar HG, Sharan S, Goregaonkar AB. Limb reconstruction system as a primary and definitive mode of fixation in open fractures of long bones. Int J Res Orthop. 2017;3(2):167-71.
[18] Thakur AJ, Patankar J. Open tibial fractures. Treatment by uniplanar external fixation and early bone grafting. J Bone Joint Surg. 1991;733(3):448-51.
[19] Singh AK, Parihar M, Bokhari S. The evaluation of the radiological and functional outcome distraction osteogenesisin patients infected gap non unionwith limb reconstruction system application. Intl J Med Res Prof. 2018;4(4):256-60.
[20] Mahajan NP, Mangukiya HJ. Extended use of limb reconstruction system in management of compound tibia diaphyseal fracture as primary and definitive tool. Int J Res Orthop. 2017;3:1157-64.
[21] Singh P, Singh SK, Gill SPS. Management of compound fractures of tibia by Limb Reconstruction System (LRS). JSM Bone and Joint Dis. 2020;35(1):29-34.
[22] Ajmera A, Verma A, Agrawal M, Jain S, Mukherjee A. Outcome of limb reconstruction system in open tibial diaphyseal fractures. Indian J Orthop. 2015;49(4):429-35.
[23] Sandhu KS, Sahni G, Brar BS, Kahal KS, Singh G. Comparison of illizarov and rail fixator in non union of long bones. Indian J Ortho Surg. 2018;4(2):109-14.

PARTICULARS OF CONTRIBUTORS:
1. Assistant Professor, Department of Orthopaedics, Government Medical College, Patiala, Punjab, India.
2. Senior Resident, Department of Orthopaedics, Government Medical College, Patiala, Punjab, India.
3. Assistant Professor, Department of Orthopaedics, Government Medical College, Patiala, Punjab, India.
4. Assistant Professor, Department of Orthopaedics, Government Medical College, Patiala, Punjab, India.
5. Associate Professor, Department of Microbiology, Government Medical College, Patiala, Punjab, India.
6. Professor, Department of Orthopaedics, Government Medical College, Patiala, Punjab, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Kanwarjit Singh Sandhu,
#4202, Urban Estate, Phase-2, Patiala, Punjab, India.
E-mail: kd27sand@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Oct 05, 2021
- Manual Googling: Feb 21, 2022
- iThenticate Software: Mar 01, 2022 (15%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Oct 02, 2021**
Date of Peer Review: **Oct 23, 2021**
Date of Acceptance: **Feb 26, 2022**
Date of Publishing: **Apr 01, 2022**