Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(5), 320-328 | ISSN:2251-6727

The role of "hybrid external fixation" and MIPO in the management of proximal tibia fracture

[1]Dr. Swapnil Ranglani (Jr. Resident), [2]Dr. Ravindra Gunaki (Professor)

[1,2] Department of Orthopaedics, Krishna Institute of Medical Sciences,Krishna Vishwa Vidyapeeth (Deemed to be University) Karad, Maharashtra India.

*Corresponding Author- Dr. Swapnil Ranglani (Jr. Resident)

Department of Orthopaedics, Krishna Institute of Medical Sciences,Krishna Vishwa Vidyapeeth (Deemed to be University) Karad, Maharashtra India.

(Received: 02 September 2023 Revised: 14 October Accepted: 07 November)

KEYWORDS

"Proximal tibia fractures", orthopaedic trauma, "hybrid external fixation", "minimally invasive plate osteosynthesis (MIPO)", fracture classification, surgical techniques, biomechanical stability, soft tissue injury

ABSTRACT:

The goal of this study is to explore the significant issues that are linked with "Proximal tibia fractures" in the area of orthopaedic trauma therapy. More precisely, the purpose is to assess the effectiveness of "hybrid external fixation" with "minimally invasive plate osteosynthesis (MIPO)". This research examines the molecular and biomechanical complexities that are linked to different therapies. Both the content and procedures were approached systematically, including the synthesis of data from randomised controlled trials, cohort studies, and meta-analyses. These data were assessed by field specialists. The findings and remarks provide insight into an intricate storyline, indicating that hybrid fixation and MIPO exhibit similar efficacy in terms of fracture reduction and union rates. Additionally, they emphasise the potential of MIPO to expedite functional recovery. Several surgical methods, including open reduction and internal fixation, were investigated, with the primary focus being on patient-centred results. The result emphasises the need for individualised treatments that strike a balance between the negative effects of quick stability and infection risks and the positive effects of little disturbance to soft tissue and a more rapid recovery.

I. INTRODUCTION

For orthopaedic trauma therapy to be successful, "Proximal tibia fractures" present several complex challenges that need careful attention [5].

Figure 1: "Minimally Invasive Plate Osteosynthesis for Open Fractures of the Proximal Tibia" (Source: Kim et al. 2012)

Journal of Chemical Health Risks
www.jchr.org
JCHR (2023) 13(5), 320-328 | ISSN:2251-6727

The "hybrid external fixation" and "minimally invasive plate osteosynthesis (MIPO)" procedures have risen to the forefront of clinical debate as a result of the changing landscape of surgical treatments [4]. When dealing with the complex problem of "Proximal tibia fractures", it is of the utmost importance to strike a precise balance between anatomical repair, biomechanical stability, and the reduction of soft tissue injury [6].

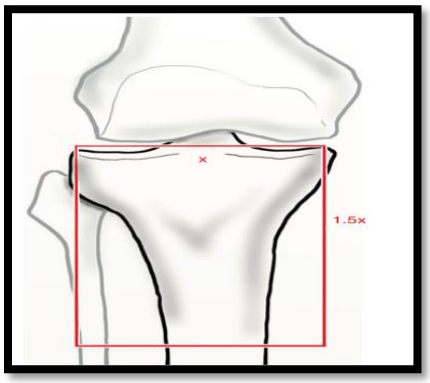

Figure 2: Proximal Tibia
(Source: Lindvall et al. 2009)

The section of the tibia that extends from the knee joint distally for a distance that is 1.5 times the breadth of the medial to lateral joint has been identified as the proximal tibia [7]. To provide rapid stability, "hybrid external fixation", which incorporates aspects of both external and internal fixation, provides a distinct biomechanical benefit. When it comes to fractures that include substantial comminution or bone quality that has been impaired, this is very important. On the other hand, MIPO, which is renowned for its indirect reduction procedures and little disturbance of soft tissue, seeks to make use of biological fixation in order to improve fracture healing [8].

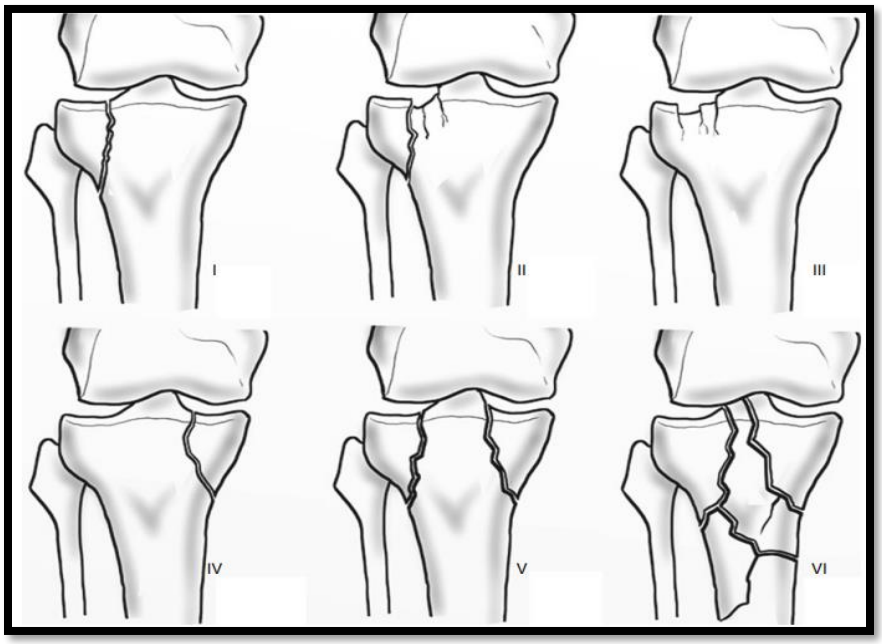

Figure 3: "2 Schatzker classi fi cation of intra-articular (tibial plateau) fractures"
(Source: : Lindvall et al. 2009)

Journal of Chemical Health Risks
www.jchr.org
JCHR (2023) 13(5), 320-328 | ISSN:2251-6727

The Schatzker categorization of fractures that occur inside the articular space (tibial plateau). The degree and complexity of the bone injuries are taken into consideration when determining the grades of the fractures, which range from I to VI [9]. This study aims to provide a thorough examination of the current body of literature, diving into the molecular and biomechanical complexities that explain the comparative effectiveness of "hybrid external fixation" and MIPO.

II. REVIEW OF LITERATURE

There is a vast amount of research on "Proximal tibia fractures", which matches the ever-changing landscape of surgical techniques. Among these techniques, "hybrid external fixation" and "minimally invasive plate osteosynthesis (MIPO)" stand out as particularly significant. A biomechanically complex approach is represented by "hybrid external fixation", which is a complicated fusion of restricted internal fixation and external fixation. In the general population, intra-articular proximal tibial fractures account for around one per cent of all fractures, and in the elderly population, they account for roughly eight per cent of all fractures. Males are more likely to be affected by these fractures than females [9]. Accidents involving motor vehicles account for 52% of the cases, falls account for 17% of the cases, and activities related to sports or leisure account for 5% of the cases [10]. It is estimated that between 55 and 70 per cent of tibial plateau fractures include just the lateral plateau, whereas between 10 and 25 per cent involve only the medial plateau, and between 10 and 30 per cent are bi-condylar fractures [9]. Approximately 90% of all tibial plateau fractures include some kind of soft tissue damage, and between one and three per cent of these fractures are open fractures [11]. There are about five to ten per cent of all tibial fractures are classified as extra-articular proximal tibial fractures [12].

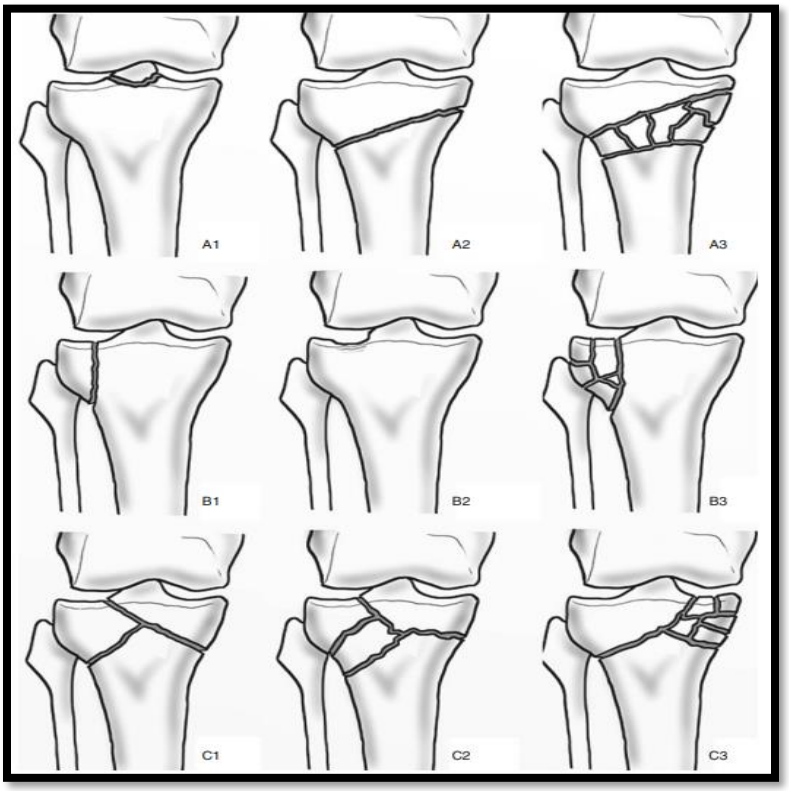

Figure 4: "AO/OTA classification of proximal tibial fractures"

(Source: : Lindvall et al. 2009)

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(5), 320-328 | ISSN:2251-6727

Proximal tibial fractures are classified according to the AO/OTA technique. (A1–A3) is comprised of fractures that do not affect the articular surfaces of the condyles, (B1–B3) is comprised of unicondylar fractures, and (C1–C3) is comprised of more complicated bi-condylar fractures. A significant number of intra-articular proximal tibial fractures are classified using the [13, 14], which also classifies extra-articular proximal tibial fractures (Fig. 3). Extra-articular fractures may also be classified using a more straightforward classification that we have only recently established (the Garnavos classification), and this classification can be used in routine clinical practise as a complement to the more sophisticated AO/OTA classification [15]. Both the Gustilo-Anderson and Tscherne-Gotzen classifications, which refer to the soft tissue injury of open or closed fractures respectively, should be considered in accordance with the severity of the soft tissue injury, as was mentioned earlier [16]. The severity of the soft tissue injury plays an important role in the planning and management of treatment.

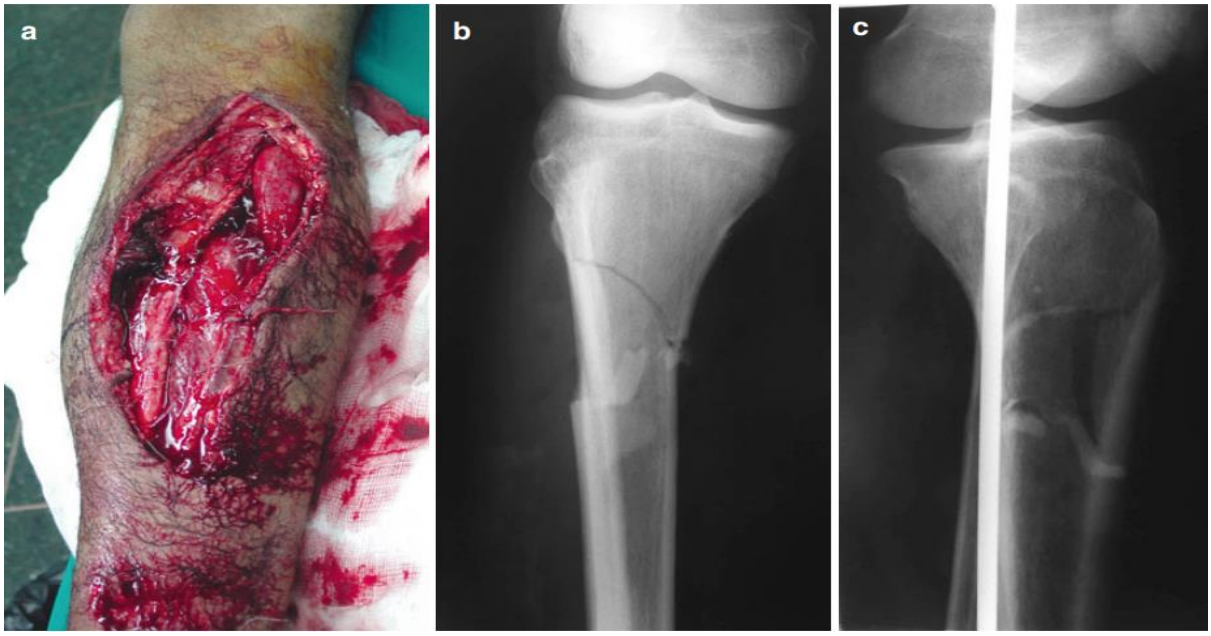

Figure 5: “Open fracture of the proximal tibia. (a) Clinical presentation. (b) Antero-posterior x-ray. (c) Lateral x-ray”

(Source: Lindvall et al. 2009)

Regardless of the kind of proximal tibia fracture that is present, there is a risk that the soft tissues that surround the knee joint might incur injuries of varied degrees of severity [9]. The management of open fractures should begin immediately with a clinical assessment of the neurovascular status of the leg and foot, the administration of antibiotics, adequate irrigation, debridement, provisional reduction and immobilisation of the fracture, and coverage of exposed bone with healthy soft tissues, using plastic surgical procedures that are either simple or more complex.

III. MATERIAL AND METHODS

This secondary study makes use of a methodical approach to knowledge synthesis by conducting a comprehensive assessment of papers that have been subjected to peer review. These studies include randomised controlled trials (RCTs), cohort studies, and meta-analyses with many participants. A firm basis for evidence-based comparisons is ensured by the methodological rigour that is inherent in randomised controlled trials (RCTs), while cohort studies add vital

Journal of Chemical Health Risks
www.jchr.org
JCHR (2023) 13(5), 320-328 | ISSN:2251-6727

insights into long-term trends and consequences [17]. Additionally, the incorporation of meta-analyses makes it easier to conduct a quantitative synthesis of the data that is already available, therefore providing a thorough perspective of the whole research environment. The selection criteria for research are quite severe, and the emphasis is primarily on investigations that directly evaluate the effectiveness of "hybrid external fixation" and "minimally invasive plate osteosynthesis (MIPO)" in the management of "Proximal tibia fractures". An all-encompassing assessment of the clinical effect of the therapies is carried out, with a particular focus on endpoints such as patient outcomes, complications, and postoperative recovery [16]. It is necessary to conduct systematic searches using databases that are well-known for their academic rigour, such as PubMed, the Cochrane Library, and Google Scholar, in order to guarantee the inclusion of evidence of high quality. This method is in accordance with the gold standard in evidence-based medicine, which guarantees the dependability and quality of the data that serves as the foundation for our compare-and-contrast research.

IV. RESULTS AND DISCUSSION

There is a varied narrative that emerges from the full review of relevant publications about the comparative efficacy of "hybrid external fixation" and "minimally invasive plate osteosynthesis (MIPO)" in the treatment of "Proximal tibia fractures".

Figure 6: "Indirect reduction by MIPO technique and relative stabilisation using multifragmentary plate fracture 42C. MIPO, Minimally Invasive Plate Osteosynthesis"

(Source: J. M. C. Sandova et al. 2017)

A research has shed light on the effectiveness of hybrid fixation by demonstrating that it is equivalent to MIPO in terms of fracture reduction and union rates. On the other hand, a more nuanced picture has emphasised a tendency towards quicker functional recovery with MIPO, even though infection outcomes are similar [1]. Furthermore, the focus placed on functional recovery highlights the potential of MIPO to optimise patient-centric outcomes, which is in line with the larger trend in orthopaedics towards reducing postoperative morbidity.

Journal of Chemical Health Risks
www.jchr.org
JCHR (2023) 13(5), 320-328 | ISSN:2251-6727

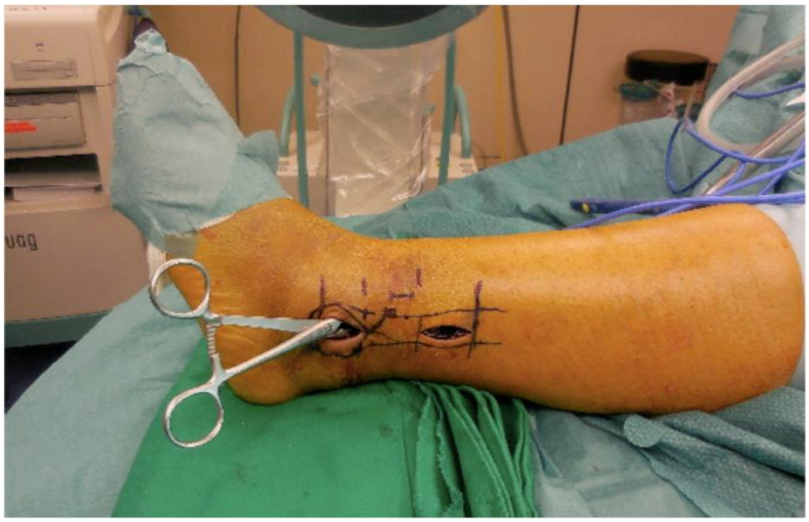

Figure 7: Fracture reduction with the assistance of a toothed reduction forceps

(Source: Marazzi et al. 2020)

Open reduction and internal fixation (ORIF) and "minimally invasive plate osteosynthesis (MIPO)" were both procedures that were performed in accordance with the surgical instructions provided by the AO Foundation [3]. Following the reduction of edoema in the soft tissues, surgery was performed. A technique consisting of two steps was carried out in the event of high-energy trauma or subluxated fractures with noticeable oedema. This strategy included the use of an external fixator with the purpose of providing temporary fracture stabilisation. Patients belonging to both groups were positioned on a radiolucent table in a supine posture, with a bump put beneath the ipsilateral hip and the knee at a modest flexion. The removal of all the bars and pins was performed in the event that an external fixator was in place. If more access to the anterior syndesmosis was necessary, the skin incision was made somewhat anterior to the fibula and lateral to the point where the fibula is located. After uncovering the region of the fracture, one or two Weber clamps were used to gently minimise the size of the fracture. A lag screw was added if it was necessary to do so. Following that, a plate was positioned in accordance with the AO method. We used either a 1/3 tubular plate (DePuy Synthes, Oberdorf, Switzerland), a 1/3 tubular locking compression plate (LCP) (DePuy Synthes, Oberdorf, Switzerland), a Sidewinder Plate System (Trimed, Santa Clarita, California), or a preformed distal fibula LCP (DePuy Synthes, Oberdorf, Switzerland) to treat the fracture. This was determined by the fracture morphology and the quality of the bone [2] [3].

About the MIPO group, the appropriate dimensions of the plate were selected on the basis of preoperative radiographic planning. In these particular instances, the LCP 1/3 tubular plate or the prefabricated distal fibula LCP was exclusively used. Throughout the whole of the surgery, a tourniquet was applied to the patient at a pressure that was 100 millimetres of mercury higher than the patient's systolic arterial pressure [2] [3]. Following the identification of the tip of the malleolus by the use of fluoroscopic control, a gently curved incision of two centimetres in length was performed distally close to the tip. A drill sleeve with a distal locking mechanism was inserted into the plate and utilised as a grip as well. After that, the plate was moved subcutaneously down the fibula in a retrograde direction, taking care not to create any false paths in the middle of the procedure. This was followed by the placement of a second locking drill sleeve distally and the centring of the plate onto the fibula while maintaining excellent bone contact. Finally, a locking screw was put into the hole in the most distal part of the plate.

This technique has previously been shown to lessen the fracture in certain situations in an indirect manner. In the

Journal of Chemical Health Risks
www.jchr.org
JCHR (2023) 13(5), 320-328 | ISSN:2251-6727

event that this was not the case, closed reduction was performed with the use of toothed reduction forceps.

Figure 8: Fluoroscopic control of fibula length and rotation

(Source: Marazzi et al. 2020)

An evaluation was performed under fluoroscopic control to determine the appropriate length of the fibula as well as its rotation in regard to the talus and the distal tibia [2]. A bicortical lag screw measuring 2.7 millimetres was inserted via a stab incision in the skin and then put perpendicular to the fracture to lessen the severity of the fractures on the frontal plane.

Figure 9: Inserted plate with two drilling sleeves after lag screw placement

(Source: Marazzi et al. 2020)

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(5), 320-328 | ISSN:2251-6727

A tiny incision measuring two centimetres was created across the proximal section of the plate, and then locking head screws were used to secure the plate in place once it had been reduced [2]. On the other hand, the pendulum swings in the other direction when it comes to damaged soft tissue problems. The "hybrid external fixation" technique is an appealing alternative in situations when the soft tissue envelope is in jeopardy since it reduces the amount of internal intervention that is required.

V. CONCLUSION

The contradiction between "hybrid external fixation" and MIPO in "Proximal tibia fractures" requires careful integration of clinical, biomechanical, and patient-centred factors. In conclusion, this duality is necessary. Hybrid fixation, which places a focus on rapid stability and lowers infection risks, is a complementary treatment option for patients whose soft tissues have been affected. On the other hand, MIPO, which is distinguished by fewer problems and more rapid recovery, is advantageous in fractures that need less disturbance of soft tissue. It is very necessary, to get the best possible results, and to tailor therapies to the specific patient profiles. The refinement of patient selection criteria and the execution of thorough, long-term studies should be the top priorities for future research routes. This will allow for the identification of the technique that is most appropriate for certain fracture types.

REFERENCES

[1] J. M. C. Sandoval, J. L. O. Rueda, and A. S. Daza, "Management of diaphyseal tibial fractures by plate fixation with absolute or relative stability: a retrospective study of 45 patients," *Trauma Surgery & Acute Care Open*, vol. 2, no. 1, p. e000029, Mar. 2017, doi: https://doi.org/10.1136/tsaco-2016-000029.

[2] C. Marazzi, M. Wittauer, M. T. Hirschmann, and E. A. Testa, "Minimally invasive plate osteosynthesis (MIPO) versus open reduction and internal fixation (ORIF) in the treatment of distal fibula Danis-Weber types B and C fractures," *Journal of Orthopaedic Surgery and Research*, vol. 15, no. 1, pp. 1–9, Oct. 2020, doi: https://doi.org/10.1186/s13018-020-02018-5.

[3]N. Gottschalk, "AO Principles of Fracture Management," *Georg Thieme Verlag eBooks*, Jan. 2018, doi: https://doi.org/10.1055/b-0038-160811.

[3]С. В. Донченко, В.Э. Дубров, L. Yu. Slinyakov, A. V. Chernyaev, А.Ф. Лебедев, and Дмитрий Владимирович Алексеев, "Surgical Treatment for Unstable Pelvic Ring Injuries," *Vestnik travmatologii i ortopedii imeni N.N. Priorova*, vol. 20, no. 4, pp. 9–16, Dec. 2013, doi: https://doi.org/10.17816/vto2013049-16.

[4]J.-W. Kim, C.-W. Oh, W.-J. Jung, and J.-S. Kim, "Minimally Invasive Plate Osteosynthesis for Open Fractures of the Proximal Tibia," *Clinics in Orthopedic Surgery*, vol. 4, no. 4, p. 313, 2012, doi: https://doi.org/10.4055/cios.2012.4.4.313.

[5] W. M. Ricci, J. R. Rudzki, and J. Borrelli, "Treatment of Complex Proximal Tibia Fractures With the Less Invasive Skeletal Stabilization System," *Journal of Orthopaedic Trauma*, vol. 18, no. 8, pp. 521–527, Sep. 2004, doi: https://doi.org/10.1097/00005131-200409000-00007.

[6] B. McKibbin, "The biology of fracture healing in long bones," *The Journal of Bone and Joint Surgery. British volume*, vol. 60-B, no. 2, pp. 150–162, May 1978, doi: https://doi.org/10.1302/0301-620x.60b2.350882.

[7] E. Lindvall, R. Sanders, T. DiPasquale, D. Herscovici, G. Haidukewych, and C. Sagi, "Intramedullary Nailing Versus Percutaneous Locked Plating of Extra-Articular Proximal Tibial Fractures: Comparison of 56 Cases," *Journal of Orthopaedic Trauma*, vol. 23, no. 7, pp. 485–492, Aug. 2009, doi: https://doi.org/10.1097/bot.0b013e3181b013d2.

[8] D. G. Kline, D. Kim, R. Midha, C. Harsh, and R. Tiel, "Management and results of sciatic nerve injuries: a 24-year experience," *Journal of Neurosurgery*, vol. 89, no. 1, pp. 13–23, Jul. 1998, doi: https://doi.org/10.3171/jns.1998.89.1.0013.

[9] T. M. Moore, M. J. Patzakis, and J. P. Harvey, "Tibial plateau fractures: definition, demographics, treatment rationale, and long-term results of closed traction management or operative reduction.," *PubMed*, vol. 1, no. 2, pp. 97–119, Jan. 1987.

[10] C. M. Court-Brown and B. Caesar, “Epidemiology of Adult fractures: a Review,” *Injury*, vol. 37, no. 8, pp. 691–697, Aug. 2006, doi: https://doi.org/10.1016/j.injury.2006.04.130.

[11] K. A. Egol, E. Su, N. C. Tejwani, S. H. Sims, F. J. Kummer, and K. J. Koval, “Treatment of Complex Tibial Plateau Fractures Using the Less Invasive Stabilization System Plate: Clinical Experience and a Laboratory Comparison with Double Plating,” *The Journal of Trauma: Injury, Infection, and Critical Care*, vol. 57, no. 2, pp. 340–346, Aug. 2004, doi: https://doi.org/10.1097/01.ta.0000112326.09272.13.

[12] J. F. Kellam, E. G. Meinberg, J. Agel, M. D. Karam, and C. S. Roberts, “Introduction,” *Journal of Orthopaedic Trauma*, vol. 32, no. 1, pp. S1–S10, Jan. 2018, doi: https://doi.org/10.1097/bot.0000000000001063.

[13] J. L. Marsh *et al.*, “Fracture and Dislocation Classification Compendium - 2007,” *Journal of Orthopaedic Trauma*, vol. 21, no. Supplement, pp. S1–S6, Nov. 2007, doi: https://doi.org/10.1097/00005131-200711101-00001.

[14] J. Schatzker, R. Mcbroom, and D. Bruce, “The tibial plateau fracture. The Toronto experience 1968--1975.,” *PubMed*, no. 138, pp. 94–104, Jan. 1979.

[15] C. Garnavos, N. K. Kanakaris, N. G. Lasanianos, P. Tzortzi, and R. M. West, “New Classification System for Long-bone Fractures Supplementing the AO/OTA Classification,” *Orthopedics*, vol. 35, no. 5, pp. e709–e719, May 2012, doi: https://doi.org/10.3928/01477447-20120426-26.

[16] R. Gustilo and J. Anderson, “Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones,” *The Journal of Bone & Joint Surgery*, vol. 58, no. 4, pp. 453–458, Jun. 1976, doi: https://doi.org/10.2106/00004623-197658040-00004.

[17] “Randomized Controlled Trials: Questions, Answers, and Musings,” *Birth*, vol. 35, no. 3, pp. 255–255, Sep. 2008, doi: https://doi.org/10.1111/j.1523-536x.2008.00251_1.x.