EUROMEDITERRANEAN BIOMEDICAL JOURNAL
2018,13 (04) 015–020
(FORMERLY: CAPSULA EBURNEA)

**Original article**

# TREATMENT OF FRACTURES OF THE TIBIAL PLATEAU: THE ROLE OF ARTHROSCOPIC ASSISTANCE

*Luca Khalil El Jaouni[1], Pellegrino Ferrara[1], Giuseppe Rocco Talesa[1], Serena Parmeggiani[2]*

*1. University of Perugia, Perugia, Italy. Division of Orthopedics and Trauma Surgery.*
*2. University of Perugia, Perugia, Italy. Division of Anesthesiology, Reanimation and Pain Medicine*

**ARTICLE INFO**

*Article history:*
*Received 05 September2017*
*Revised 28 January 2018*
*Accepted 07 February 2018*

Keywords:
Artroscopy, tibial plateau, fractures

**ABSTRACT**

We present our experience in the treatment of fractures of the tibial plateau with arthroscopic assistance. Between January 1997 and September 2001, we evaluated 23 patients with fractures of the tibial plateau. After their clinical and radiological evaluation, we included 17 patients in this study. Fractures were classified using the Schatzker classification. 14 patients were treated with arthroscopic reduction and percutaneous fixation, while 3patients underwent open reduction and osteosynthesis with platelets under arthroscopic control. The arthroscopic technique allows for a better articular visualization, decreases dissection of the tissues, and allows for an adequate diagnosis and treatment of the associated lesions. Arthroscopic reduction and percutaneous fixation can be considered the treatment of choice in a select group of fractures of the tibial plateau (Schatzker I and III).



## 1. Introduction

Fractures of the tibial plateau area relatively frequent pathology, accounting for approximately 1% of total fractures, and 8% of fractures in the elderly. According to the different statistical series, the external tibial plateau is the most affected in 55 - 70% of cases, while the internal plateau comprises 10 to 23%, and between 10 - 30% of the cases are bilateral. The goal in the treatment is to achieve an alignment that is correctly aligned, painless, stable, and with an arch of mobility suited to the needs of the patient. Given the wide variety in these types of lesions, it becomes difficult to standardize a therapeutic protocol. Although orthopedic treatment has good results in non-displaced, low energy fractures, and especially in elderly patients, there is a consensus that the optimal function of a joint depends on a stable congruence of the articular surfaces, allowing a balanced transmission of loads through them. Therefore, open surgical treatment has gained popularity in cases of displaced, high energy fractures and in young patients requiring a restoration of the joint anatomy, followed by a firm stabilization, to allow for early mobilization. But while open surgical treatment has been widely accepted in recent years, it has not been free from complications or limitations. Extensive approaches are usually required to expose and reduce the fracture that often increases tissue devascularization. In addition, an arthrotomy and anterior meniscal deinsertion often must be performed, increasing the morbidity of the affected area. Other injuries frequently associated with these fractures, such as meniscales, ligamentarias, and osteochondral, can hardly be evaluated and solved through these open-surgical approaches. Considering all of this, assistance with arthroscopic techniques can offer important benefits in the treatment of some of these fractures due to the minimal approach, which allows for congruent joint restoration with direct visibility. Artroscopic techniques also allow for the diagnosis and treatment of associated pathologies during the same surgical procedure. This article presents our experience with the treatment of these fractures with arthroscopic assistance performed on our patients in the Orthopedics and Traumatology unit at the University of Perugia.

* *Corresponding author*: Luca Khalil El Jaouni, ortolavoriscientifici@outlook.it
DOI: 10.3269/1970-5492.2018.13.4

## 2. Methods

***Study Population***

17 patients with 17 closed fractures of the tibial plateau with a fracture displacement greater than 2 mm, all operated under arthroscopic control, were included in this study. Patient age ranged from 32 to 81 years old, with a mean of 66 years and a predominance of women (ten cases) over men (seven cases). The same surgeon operated on all of the patients. The post-operative evolution ranged from a minimum of 9 months to a maximum of 53 months (with an average of 31 months.) The exclusion factors in this study included patients with exposed fractures and/or polytrauma, associated vascular or neurologic lesions, fractures with severe in tegumentary lesions, or fractures that were surgically operated on 15 days post-injury (six cases). Fractures were grouped according to the Schatzker classification. The surgical protocol for fracture types I, II and III (14 cases) consisted in reduction and osteosynthesis with cannulated screws with washer or plate with screws (in cases of great comminution or osteopenia) under arthroscopic assistance (1,2). For fracture types IV, V and VI (3 cases), reduction and osteosynthesis with plate and screws under arthroscopic assistance was performed. After surgery, patients were rehabilitated following the same schedule of early mobilization and delayed loading, according to clinical and radiological evolution. Patient outcome was monitored by a Delamarter post-operative follow-up and follow-up record.

The final results were grouped according to the following scale: 90-100 excellent result, 80-89 good result, 70-79 regular result, and less than 70 bad result.

***Surgical Technique***

Surgery was performed with the patient in dorsal decubitus under spinal or general anesthesia. The patient was positioned with the knee flexed at 90°.First, ischemia of the injured limb, with a pneumatic cuff at the thigh root, was performed. The typical procedure for conventional arthroscopy involves preparing the surgical fields, but in these cases, the fields in the contralateral anterior superior iliac spine were also prepared for the bone graft. Before beginning surgery, possible ligament injuries were carefully evaluated while the patientwas under anesthesia. Surgery began with the arthroscopic examination of the knee (3). Three routine portals were performed: anterolateral and anteromedial for visualization, perfusion fluid, and instrumental and superointernal or superoexternal for aspiration of the fluid and detritus of the joint (sewer system). After performing a copious joint wash (eliminating hemarthrosis and free osteochondral fragments) lasting approximately 5 minutes, the existing intra-articular lesions were assessed. For meniscal lesions, sutures were performed if the lesion was peripheral,while partial menisectomy was performed if suture conditions were not present. The osteochondral lesions were treated with mesenchymal stimulation techniques, while the reconstrution of crossed ligament lesions was defered to a later, second surgical time. Once the fracture line was identified (location, dimensions, comminution, displacement of the fragments, etc.) treatment began. For sinking fractures, a metaphysiophyseal bone window (approximately 8 cm below the joint line ipsilateral to the fracture) was created through which ablunt impactor (double layered at 90°) was inserted, and then proceded to reduce the sunkenfragments by gentle strokes under arthroscopic vision. (The tibial anterior cruciate ligament guide was not used to locate the area of injury, since our impactors were bent and not cannulated.)

The healthy border of the cartilage and the lower face and free edge of the meniscus were used to reduce and repair the tibial plateau. As the sinking was corrected, the arthroscopy was used to verify whether or not any bone fragments were hypercorrect, reducing them with the probe or a curette. After the reduction, the existing bone defect in the tibial plateau was filled with bone graft obtained from the iliac crest of the patient, inserting it through the bony window made in the tibia. Arthroscopic control was used simultaneously when impacting the graft to verify that the fragments of the fracture did not move, and that the bone graft did not migrate in the joint. In the case of shear fractures, a longitudinal approach on the affected plate was implemented (avoiding the opening of the joint capsule and the meniscal deinsertion), through which the sheared fragments were deimpacted and elevated (4,5). Simultaneously, and through a laminar chisel or gouge scopus, the fractured articular fractures were disintegrated under arthroscopic vision, collaborating in the reduction maneuvers. Afterwards, osteosynthesis was performed depending on the characteristics of the fracture that was dealt with. If cannulated screws with were used, the placement was percutaneous close to the joint line, to support them, protecting the sinking of the fragments (type III fractures), or performing compression of the sheared fragment (some type I and II fractures). The plate with screws was used in fractures with a shear component, with important comminution, displacement or osteopenia of its fragments.

The position of the screws was controlled by an image intensifier. Arthroscopic assistance aided in verifying that the graft did not migrate into the joint. Lastly, evaluation confirmed that fracture fragments were not displaced when performing knee flexion-extension movements after osteosynthesis. Suction drains were routinely used, leaving them in place based on their flow for 24-48 hours. The operated limb was immobilized with a Robert Jones bandage that was withdrawn within 48 hours in order to begin active and passive rehabilitation exercises

## 3. Results

Patients grouped according to fracture type using the Schatzker classification were distributed as follows: Group I - 3 cases, Group II - 7 cases, Group III - 4 cases, Group IV -1 case, Group V - 2 cases, Group VI - O cases. The causes of fracture were: Falls from tripping at own height - 9 cases (2 cases of fracture types I, four type II, and three type III); Transit accidents - 3 cases (One case type II, one type III, and one type V);Sports accidents - 2 cases (one case type I and one case type V) Height falls - 2 cases (both cases type II); Work accidents: 1 case (1 case type IV, run over by machinery).Associated soft tissue injuries included: Five meniscal lesions ipsilateral to the fracture (all in the external tibial plateau), four of which were treated with partial menisectomy and the fifth, which presented a peripheral meniscal detachment, was sutured; 6 degenerative lesions of the internal meniscus (5 in fractures with involvement of the external plateau, and the sixth in a fracture with involvement of the medial tibial plateau);Numerous osteochondral lesions (grades 3 and 4 of the Outer-bridge classification) in both femorotibial compartments (6-8). In all cases, techniques of mesenchymal stimulation, regularization, perforations and abrasion of the lesion bed were performed.

Regarding ligamentous lesions, the most frequent was the medial collateral ligament injury (7 cases).

This lesion was evaluated routinely during the immediate and remote post-operative period, and did not require surgical treatment in any of the cases. Of these lesions, two cases were associated with shear fractures of the external plateau, and five were associated with mixed lesions (shear-sinking of the external saucer). One lesion of the anterior cruciate ligament was identified, which was treated in a bloodless manner (the patient was 57 years old, with sedentary habits and at 19 months post-surgery did not report symptoms of instability). No lesions of the external collateral ligament or posterior cruciate ligament were identified.

Regarding post-operative complications, there was one case of subacute infection in a patient with a mixed fracture of the external tibial plateau and osteosynthesis with plaque and screws. The patient required another surgery to remove the implant and was treated with antibiotics with good clinical evolution (9,10). The complications were due to premature loading of the leg (19 days after surgery), which resulted in a partial loss in the reduction in a patient with psychiatric pathology. Currently (at 21 months post-surgery), he presents a score of 67 points, which is considered a poor final result. Patients did not present consolidation delays, pseudoarthrosis, or compartmental syndromes.

Regarding rehabilitation, in all cases, isometric exercises of the quadriceps and twin muscle pump exercises were implemented immediately after the surgery. At 48 hours post-op, active and passive knee flexion-extension exercises were started, seeking to obtain a mobility arc for the first month of: 0 ° to 90 °. This rehabilitation was performed in sixteen patients, while it was delayed until the ninth week for the seventeenth patient due to psychiatric reasons. Loading, assisted with Canadian canes, was delayed until clinical and radiological parameters of bone consolidation were obtained (11). In the seventeen treated patients, a complete final extension of the joint was obtained, and while flexion was variable, in all cases, the 90° flexion was exceeded.

From the analysis of the results of the pre- and post-operative assessment table, the following data was collected: Excellent results (90-110 points) - 3 cases (1 case I, 2 cases type III); Good results (80-89 points) - 9 cases (2 cases type I, 4 type II, 2 type III, 1 type V); Regular results (70-79) - 4 cases (3 cases type II, 1 case type IV); Bad result (<70 points) 1 case (type V).

## 4. Discussion

The fractures of the tibial plateau constitute a heterogeneous group of lesions and their treatment must be defined taking into account not only the characteristics of the fracture, but also the age and general condition of the patient, their activity level, the associated existence of polytrauma, etc. It is known that anatomical reduction helps prevent loss of mobility and delays degenerative joint changes. However, there are still controversies in the treatment of many of these fractures, mainly given the potential complications of open surgery. In recent years, the use of arthroscopy has been extended to the treatment of these fractures, helping to bridge the gap between surgical and non-surgical treatment by providing the advantages of direct visualization, anatomical reduction, and rigid percutaneous fixation with minimum exposure, without the complications of open surgery.

When analyzing the literature and our cases, we observed that, although in all cases the arthroscopy facilitated the reduction of direct vision and the diagnosis of associated lesions, type III fractures were especially indicated for arthroscopy, since pure collapses do not require direct approaches on the fracture line to be reduced and stabilized.

In these cases, the arthroscopy gives a direct vision of the obtained reduction that is far superior to that granted by an image intensifier. Likewise, in type I fractures (frequent in the young population) that do not present significant osteopenia or comminution, the reduction can be achieved through a small extraarticular approach, and subsequent percutaneous osteosynthesis. Another advantage of arthroscopy in such lesions is the possibility of diagnosing and repairing meniscal deinsertions that are frequently present.

Regarding the use of the bone graft, the scope of its use is to fill in the bone defects produced by the compression mechanism of the fracture (in fractures with a mechanism of sinking), to collaborate in its stabilization, and to facilitate the consolidation. Bone-grafting was utilized on fourteen of the seventeen operated patients (it was not only used in type I fractures). Fowblereports that bone graft contribution has decreased when using the arthroscopic method, decreasing post-operative morbidity (12). We consider that the biological contribution depends fundamentally on the characteristics of the fracture and on the quality and quantity of existing bone capital, and not on the implementation of the arthroscopic method. Arthroscopy allowed for an adequate control of the location of the intra-articular fragments, as well as the confirmation of absence of bone graft or free osteochondral fragments at the articular level. It also allowed us to observe fracture stability after osteosynthesis was completed.

Soft-tissue injuries associated with tibial plateau fractures are common, but their incidence and severity are generally overestimated. Several studies indicate an overall lesion frequency of about 35% to 50%. In 1994, Vangsness studied 36 patients with fractures of the tibial plateau undergoing arthroscopic evaluation, and found that 47% of the patients had meniscal injuries (13-20). Of the 17 lesions found, 13 were on the lateral meniscus, five lesions were peripheral (one in bucket handle). He also diagnosed 3 radial lesions and 5 complex lesions that required menisectomies. All four medial meniscal injuries were associated with Hohl type IV fractures, and required menisectomies. He also found a significant association between the meniscal injury and the severity of the injury: of the 25 fractures requiring internal reduction, 64% had a meniscal injury, whereas only 9% of them had a meniscal compromise, if treated in a non-invasive manner. Given the high percentage of meniscal injuries, Bennett stresses the importance of arthroscopy in the treatment of these fractures, especially in type I and II, given the frequent interposition of the meniscus in the fracture line. This author also found the meniscal lesion as the second most frequent cause of associated lesion: 20% of the cases. In all of their published cases, the meniscal injury always settled on the fracture side. In our statistics, dividing the population according to age group, we observed that in all patients younger than 40 years old (3 cases with type I, II and V fractures) there were lesions of the external meniscus, requiring two menisectomies (1 radial lesion and 1 buccal loop lesion) and 1 meniscal suture (meniscal deinsertion). Ligament injuries, according to the different studies, occur in approximately 20% of fractures of the tibial plateau, and although they can occur in any type of fracture, they occur more frequently in shear fractures or in those with mixed mechanism. Their treatment is still a matter of discussion. Although there is a consensus that joint instabilities caused by ligament injuries or defects, and/or bone deformity cause poor results, there is still no consensus at the time for ligament repairs. Some authors support the need for ligament repair concomitantly with the fracture to obtain greater post-surgical stability and thus a satisfactory end result. Meanwhile, other authors do not consider repair necessary until the fracture is healed and the final stability of the knee is evaluated (21-30).

In our study, the ligament injury most frequently suspected before surgery was that of the medial collateral ligament, but the examination was performed under anesthesia prior to reduction and osteosynthesis. However, after the fixation, the semilogic maneuvers were frequently negativized, indicating that in these cases the movements by the fracture lines generated instability. On the other hand, it has been difficult to evaluate collateral ligament injuries when there is a fracture of the tibial plateau. Martin has suggested assessing the medial opening space by applying a valgus force. This space should not be exceeded by 10mm, since otherwise could cause a lesion of the medial collateral ligament. However, we agree with Moore, who maintains that there are other variables that alter medial space increase in addition to the lesion of this ligament, such as variations by radiographic magnification, ligament laxity, degree of knee flexion at the moment of exam, etc. On the other hand, the sinking or shearing of the fracture also alters the varus-valgus angulation of the knee. In cases of bone avulsion, we prefer to surgically treat acute lesions of the anterior cruciate ligament. Special care should be taken in type IV fractures requiring osteosynthesis with plaque, avoiding their placement in the perforation site of the tibial tunnel. With regard to osteochondral lesions, arthroscopic assistance allowed us to diagnose and repair 13 degrees III-IV injuries in 11 patients. Of these 13 injuries, 11 of them were in the femoral-tibial compartment contralateral to the fractured saucer, so open surgery would not have made it possible to diagnose and treat.

When analyzing the post-operative complications, the most important was a subacute infection, which required removal of the implant and antibiotic treatment. In our study, we did not have compartmental syndromes. In the literature, there are few reported cases associated with fractures of the tibial plateau (31-40). We know that the existence of an intra-articular bone injury added to the damage of the joint capsule predisposes the patient to this complication. It is also known that this complication increases its frequency with the use of infusion pumps. To reduce the risks, we performed arthroscopy without a pump and with an important outflow of liquids through a third portal, which minimizes this complication (41-43). On the other hand, one must pay special attention to the state of the leg and the knee during the surgery, as well as to the mobilization of the same, since the flexion increases the intra-articular pressure and diminishes the drainingof fluids favoring the extravasation of liquids out of the articulation. We agree with Fowble, who reports the best functional and cosmetic results in cases of closed reduction under arthroscopic control, attributing it to a better visualization and therefore definition and reduction of the fracture. This method also allows for an adequate diagnosis of meniscal, ligamentous, and osteochondral lesions (44-54), frequently associated with these fractures, with the possibility of repairing some of them in the same operative act. On the other hand, by avoiding extensive arthrotomies or meniscal de-insertion, and by properly eliminating hemarthrosis and osteochondral detritus, post-operative morbidity, hospitalization time, and optimization of rehabilitation are reduced, allowing for a rapid recovery of mobility with low pain.

## References


1. Caspari RB, Hutton PMJ, Whipple TL, Meyers JF. The role of arthroscopy in the management of tibial plateau fractures. Arthroscopy 1985;1:76—82.
2. Jennings JE. Arthroscopic management of tibial plateau fractures. Arthroscopy 1985;1:160—216.
3. Duparc J, Ficat P. Fractures articulaires de l'extrémité supérieure du tibia. Rev ChirOrthop1960;46:399—486 [In French].
4. Gerard-Marchand P. Fractures des plateaux tibiaux. Rev ChirOrthop1939;26:499—546.
5. Muller ME, Nazarian S, Koch P. Classification AO des fractures. Berlin: Springer-Verlag; 1987, p. 71—6.
6. Schatzker J, MacBroom R, Bruce D. The tibial plateau fracture. The Toronto experience 1968—1975. ClinOrthop1979;138:94—104.
7. Hammadouche DD, Duparc F, Beaufils P. The arterial vascularization of the lateral tibial condyle: anatomy and surgical applications. SurgRadiolAnat2006;28:38-45.
8. Holzach P, Matter P, Minter J. Arthroscopically assisted treatment of lateral plateau fractures in skiers: use of a cannulated reduction system. J Orthop Trauma 1994;8:273-81. S218
9. Vangsness CT, GhaderiB, Hohl M, Moore TM. Arthroscopy of meniscal injuries with tibial plateau fractures. J Bone Joint Surg Br 1994;76:488-90.
10. Cassard X, Beaufils P, Blin JL, Hardy P. Osteosynthesis under arthroscopic control of separated tibial plateau fractures. Rev ChirOrthop1999;85:257-66 [In French].
11. Gill TJ, Moezzi DM, Oates KM, Sterett WI. Arthroscopic reduction and internal fixation of tibial plateau fractures in skiing. ClinOrthopRel Res 2001;383:243-9.
12. Le Huec JC. Fractures articulaires-récentes de l'extrémité-supérieure du tibia de l'adulte. In: Cahiers d'enseignement de la SOFCOT. Paris: Expansion Scientifique-francaise; 1996, p. 97-117 [In French].
13. Vadalà A, Lanzetti RM, De Carli A, Lupariello D, Guzzini M, Desideri D, Ferretti A. Latarjetprocedure:evolution of the bone block and correspondent clinical relevance-a clinical and radiologicalstudy. MusculoskeletSurg. 2017 Jul 29. doi: 10.1007/s12306-017-0482-z.
14. Lanzetti RM, Lupariello D, Venditto T, Rota P, Guzzini M, Vadalà A, Rota A, Ferretti A. The influence of playing surface on injury risk in italian elite rugby players. Muscles Ligaments Tendons J. 2017 May 10;7(1):180-185.
15. De Carli A, Fabbri M, Lanzetti RM, Ciompi A, Gaj E, Beccarini G, Vetrano M, Ferretti A. Functional treatment in rotator cuff tears: is it safe and effective? A retrospective comparison with surgical treatment. Muscles Ligaments Tendons J. 2017 May 10;7(1):40-45.
16. Monaco E, Mazza D, Redler A, Lupariello D, Lanzetti R, Guzzini M, Ferretti A. Segond's fracture: a biomechanical cadaveric study using navigation. J OrthopTraumatol. 2017 Jul 13.
17. Monaco E, Fabbri M, Lanzetti RM, Del Duca A, Labianca L, Ferretti A. Biomechanical comparison of four coupled fixation systems for ACL reconstruction with bone socket or full-tunnel on the tibial side. Knee. 2017 Aug;24(4):705-710.
18. Lanzetti RM, Lupariello D, De Carli A, Monaco E, Guzzini M, Fabbri M, Vadalà A, Ferretti A. Can the outside-in half-tunnel technique reduce femoral tunnel widening in anterior cruciate ligament reconstruction? A CT study. Eur J Orthop Surg Traumatol. 2017 Jul;27(5):659-664.
19. Monaco E, Lanzetti RM, Fabbri M, Redler A, De Carli A, Ferretti A. Anterolateral ligament reconstruction with autologous grafting: A biomechanical study. Clin Biomech (Bristol, Avon). 2017 May;44:99-103.

20. Guzzini M, Lanzetti RM, Lupariello D, Morelli F, Princi G, Perugia D, Ferretti A. Comparison between carbon-peek plate and conventional stainless steal plate in ankle fractures. A prospective study of two years follow up. Injury. 2017 Jun;48(6):1249-1252.
21. Guzzini M, Lanzetti RM, Proietti L, Mazza D, Fabbri M, Monaco E, Ferri G, Ferretti A. Interlocking horizontal mattress suture versus Kakiuchi technique in repair of Achilles tendon rupture: a biomechanical study. J OrthopTraumatol. 2017 Mar 15.
22. Guzzini M, Mazza D, Fabbri M, Lanzetti R, Redler A, Iorio C, Monaco E, Ferretti A. Extra-articular tenodesis combined with an anterior cruciate ligament reconstruction in acute anterior cruciate ligament tear in elite female football players. Int Orthop. 2016 Oct;40(10):2091-2096.
23. Fabbri M, Monaco E, Lanzetti RM, Perugia D, Guzzini M, Labianca L, Ferretti A. Single harvesting in the all-inside graft-link technique: is the graft length crucial for success? A biomechanical study. J OrthopTraumatol. 2017 Mar;18(1):17-22.
24. Fabbri M, Ciompi A, Lanzetti RM, Vadalà A, Lupariello D, Iorio C, Serlorenzi P, Argento G, Ferretti A, De Carli A. Muscleatrophy and fatty infiltration in rotator cufftears: Can surgery stop muscular degenerative changes? J Orthop Sci. 2016 Sep;21(5):614-8..
25. Lanzetti RM, Monaco E, De Carli A, Grasso A, Ciompi A, Sigillo R, Argento G, Ferretti A. Can an adjustable-loop length suspensory fixation device reduce femoral tunnel enlargement in anterior cruciate ligamentreconstruction? A prospective computer tomography study. Knee. 2016 Oct;23(5):837-41.
26. Godenèche A, Freychet B, Lanzetti RM, Clechet J, Carrillon Y, Saffarini M. Should massive rotator cuff tears be reconstructed even when only partially repairable? Knee Surg Sports Traumatol Arthrosc. 2017 Jul;25(7):2164-2173.
27. Lanzetti RM, Ciompi A, Lupariello D, Guzzini M, De Carli A, Ferretti A. Safety of third-generation artificial turf in male elite professional soccer players in Italian major league. Scand J Med Sci Sports. 2017 Apr;27(4):435-439. doi: 10.1111/sms.12654.
28. De Carli A, Lanzetti RM, Ciompi A, Lupariello D, Vadalà A, Argento G, Ferretti A, Vulpiani MC, Vetrano M. Can platelet-rich plasma have a role in Achilles tendon surgical repair? KneeSurg Sports TraumatolArthrosc. 2016 Jul;24(7):2231-7.
29. De Carli A, Lanzetti RM, Monaco E, Labianca L, Mossa L, Ferretti A. The failure mode of two reabsorbable fixation systems: Swivelock with Fibertape versus Bio-Corkscrew with Fiberwire in bovine rotator cuff. J Orthop Sci. 2012 Nov;17(6):789-95.
30. Lanzetti RM, Vadalà A, Morelli F, Iorio R, Ciompi A, Vetrano M, Argento G, Vulpiani MC, Di Sanzo V, Ferretti A. Bilateral quadriceps rupture: results with and without platelet-rich plasma. Orthopedics. 2013 Nov;36(11):e1474-8.
31. Vadalà A, Lanzetti RM, Ciompi A, Rossi C, Lupariello D, Ferretti A. Functional evaluation of professional athletes treated with a mini-open technique for achilles tendon rupture. Muscles Ligaments Tendons J. 2014 Jul 14;4(2):177-81. eCollection 2014 Apr.
32. De Carli A, Lanzetti RM, Ciompi A, Lupariello D, Rota P, Ferretti A. Acromioclavicular third degree dislocation: surgical treatment in acute cases. J OrthopSurg Res. 2015 Jan28;10:13.
33. Bisaccia M, Manni M, Colleluori G,Falzarano G, Medici A, Meccariello L, Rinonapoli G, Schiavone A, Ibáñez Vicente C, Ferraro A, Caraffa A. The management of pin-care in externalfixationtechnique: povidone-iodine versus sodium hypochlorite 0,05% (amukina-med®) medications. EuroMediterranean Biomedical Journal 2016, 11 (10):81-87.
34. Maiettini D, Bisaccia M, Caraffa A, Rinonapoli G, Piscitelli L, Bisaccia O, Rollo G, Meccariello L, Ceccarini P and Rebonato A. Feasibility and Value of Radiographic Union Score Hip Fracture after Treatment with Intramedullary Nail of Stable Hip Fractures. Acta InformMed. 2016 Dec; 24(6): 394–396 doi: 10.5455/aim.2016.24.394-396
35. Bisaccia M, Rinonapoli G, Bisaccia O,Meccariello L, IbáñezVicente C, Ceccarini P, Colleluori G, Schiavone A, Caraffa A. Articular fractures of distal radius: comparison of treatment and clinical and radiological outcomes with volar plate versus Hoffmann bridging external fixator. EuroMediterranean Biomedical Journal 2017,12 (06) 023–028
36. Bisaccia M, Meccariello L, Rinonapoli G, Rollo G, Pellegrino M, Schiavone A, Ibáñez Vicente C, Ferrara P, Filipponi M and Caraffa A. Comparison of Plate, Nail and External Fixation in the Management of Diaphyseal Fractures of the Humerus. Med Arch. 2017 Apr; 71(2): 97–102.
37. Petruccelli R, Bisaccia M, Rinonapoli G, Rollo G, Meccariello L, Falzarano G, Ceccarini P, Bisaccia O, Giaracuni M, Caraffa A.Tubular vs Profile Plate in Peroneal or Bimalleolar Fractures: is There a Real Difference in Skin Complication? A Retrospective Study in Three Level I Trauma Center. Med Arch. 2017 Aug; 71(4): 265–269.
38. Pellegrino M, Trinchese E, Bisaccia M, Rinonapoli G, Meccariello L, Falzarano G, Medici A, Piscitelli L, Ferrara P and Caraffa A. Long-term outcome of grade III and IV chondral injuries of the knee treated with Steadman microfracture technique. Clin Cases Miner Bone Metab. 2016 Sep-Dec; 13(3): 237–240.
39. Falzarano G, Piscopo A, GruborP, Rollo G, Medici A, Pipola V, Bisaccia M, Caraffa A, Barron ME, Nobile F, Cioffi R and Meccariello L. Use of Common Inflammatory Markers in the Long-Term Screening of Total Hip Arthroprosthesis Infections: Our Experience. Advances in Orthopedics. Volume 2017, Article ID 9679470, 7 pages.
40. Rollo G, Pellegrino M, FilipponiM, Falzarano G, Medici A, Meccariello L, Bisaccia M, Piscitelli L and Caraffa A. A case of the management of Heterotopic ossification as the result of acetabular fracture in a patient with traumatic brain injury. International Journal of Surgery Open 1 (2015) 30–34.
41. Di Giacomo LM, Khan MS, Piscitelli L, Bisaccia M and Caraffa A. Management of Cyclops Syndrome: A case report. J Pak Med Assoc. 2016 Oct;66(10):1330-1333.
42. Mercurio U, Troiano G, Manfreda F, Piscitelli L, Schiavone A, Bisaccia M, Nante N, Rinonapoli G and Caraffa A.Tertiary prevention in athletes' diseases: new challenges for the clinical medicine and the public health. Ann Ig. 2017 Jul-Aug;29(4):336-337.

43. Falzarano G, Piscopo A, Rollo G, Medici A, Grubor P, Bisaccia M, Pipola V, Cioffi R, Nobile F, Meccariello L. Tantalum in type IV and V Paproskyperiprosthetic acetabular fractures surgery in Paprosky type IV and V periprosthetic acetabular fractures surgery. MusculoskeletSurg. 2017 Sep 30.
44. Meccariello L, Cioffi S, Franzese R, Cioffi R, Petrucci C, Errico G, Olivieri M, Mugnaini M. Intraarticular knee joint injection:hyaluronic acid vs polynucleotides. EuroMediterranean Biomedical Journal 2013; 8(7):35-41.
45. Grubor P, Falzarano G, Grubor M, Piscopo A, Franzese R, Meccariello L: Treatment of the chronic war tibial osteomyelitis, Gustilo type IIIB and Cierny-Mader IIIB, using various methods. A Retrospective study. EuroMediterranean Biomedical Journal 2014;9(2):7-18.
46. Medici A, Meccariello L, Falzarano G. Non-operative vs. percutaneous stabilization in Magerl's A1 or A2 thoracolumbar spine fracture in adults: is it really advantageous for a good alignment of the spine? Preliminary data from a prospective study. Eur Spine J. 2014 Oct;23 Suppl 6:677-83.
47. Meccariello L, Cioffi S, Franzese R Olivieri M, Mugnaini M Percutaneous reduction with k-wires of a bimalleolar Salter Harris III: a case report. EuroMediterranean Biomedical Journal 2012; 7(18) 84 : 87.
48. Falzarano G, Medici A, Mottola D, Roberto VL, Pironti A, Pica G, Bibiano L, Stamboltsyan G, Falzarano A, Meccariello L. Incidentaloma found in a metal-on-metal revision total hip arthroplasty: a case report. EuroMediterranean Biomedical Journal 2014, 9(10):69-74. DOI: 10.3269/1970-5492.2014.9.10
49. Grubor P, Mitković M, Milan Grubor M, Mitković M, Meccariello L, Falzarano G. Biomechanical Stability of Juvidur and Bone Models on Osteosyntesic Materials. Acta Inform Med. 2016; 24(4): 261-265.
50. Rollo G, Tartaglia N, Falzarano G, Pichierri P, Stasi A, Medici A, Meccariello L. The challenge of non-union in subtrochanteric fractures with breakage of intramedullary nail: evaluation of outcomes in surgery revision with angled blade plate and allograft bone strut. Eur J Trauma Emerg Surg. 2017 Dec;43(6):853-861.
51. Carta S ,Fortina M, Riva A, Meccariello L, Cataldi C, Colasanti GB,Ferrata P. Is there a rationale in the use of the bone strut allograft formanagement and internal fixation in periprosthetic humeralfractures? A case report. EuroMediterranean Biomedical Journal 2017; 12(24): 115–118.
52. Meccariello L, Muzii VF, Falzarano G, Medici A, Carta S, Fortina M, Ferrata P. Dynamic corset versus three-point brace in the treatment of osteoporotic compression fractures of the thoracic and lumbar spine: a prospective, comparative study. Aging ClinExp Res. 2017 Jun;29(3):443-449.
53. Rollo G, Rotini R, Pichierri P, Giaracuni M, Stasi A, Macchiarola L, Bisaccia M, Meccariello L. Grafting and fixation of proximal humeral aseptic non union: a prospective case series. CCMBM 2017; 14(3):298-304.
54. Rollo G, Pichierri P, Marsilio A, Filipponi M, Bisaccia M, Meccariello L. The challenge of nonunion after osteosynthesis of the clavicle: is it a biomechanical or infection problem? CCMBM 2017; 14(3):372-378