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Case report ■

Missile Injury of the Knee Joint

Zoran Golubović[1,4], Zoran Popović[2], Saša Milenković[1,4], Predrag Stojiljković[1], Goran Stevanović[3,4], Zoran Radovanović[4,5], Ivan Golubović[1], Milan Trenkić[3,4], Stevo Najman[4], Slađana Petrović[4,5]

[1]*Clinic of Orthopaedics and Traumatology, Clinical Center Niš, Serbia*
[2]*Clinic of Orthopaedics and Traumatology, Military Medical Academy, Belgrade, Serbia*
[3]*Clinic od Plastic and Reconstructive Surgery, Clinical Center Niš, Serbia*
[4]*University of Niš, Faculty of Medicine, Niš, Serbia*
[5]*Center for Radiology, Clinical Center Niš, Serbia*

SUMMARY

Penetrating injuries of the knee joint are among the most difficult groups of bone - joint system injuries. They are characterized by extensive destruction of all anatomical structures of the knee joint.

This paper presents two patients with penetrating wounds of the knee joint, of which one was injuried by shrapnel bomb, while another was wounded by a bullet from a gun. Both patients were treated by primary surgical treatment for penetrating wound of the joint. Arthroscopic surgery was performed in both patients to remove fragments of the bomb and bullet. Parenteral antibiotic and anti-tetanus therapy were administered in both patients.

Surgical treatment of penetrating wound of the knee joint is a two-stage procedure. The first act is the primary surgical treatment of penetrating wound of the joint according to the principles of war wounds treatment. Primary surgical treatment of penetrating, gunshot wounds to the knee joint is usually from the surface to deeper layers of the wound and involves the removal of the entire non-vital, necrotic tissue. Excision of the joint capsule should be extremely sparing, but the whole damaged joint capsule must be removed. Only the joint synovial membrane can be closed primarily. If this is not possible, then the joint capsule should be closed. Other structures are left open for delayed primary closure. The second act is a delayed closure of penetrating gunshot wound of the joint. Arthroscopic removal of fragments from the knee joint is a useful method to prevent complications and infection after this injury.

Key words: **missile injuries of the knee, surgical treatment of wound, knee arthroscopy**

Corresponding author:

Zoran Golubović •
phone: 063 109 43 44 •
e-mail: predragssss@gmail.com •

INTRODUCTION

Penetrating injuries of the knee joint are among the most difficult groups of bone - joint system injuries. They are characterized by extensive destruction of all anatomical structures of the joint. The function of the lower extremities is largely dependent on the function of the knee joint, so penetrating injuries to the knee joint are threatening to the function of the entire limb (1).

The outcome of treatment of the knee joint injuries is further hampered by the existence of associated injuries of main blood vessels and nerves. Injuries to the main blood vessels and circulatory interruption threatens the entire limb, and the main nerve injury often leads to permanent functional disability (2). During the war in the former Yugoslavia (1991-1995), 18.0% of all patients, who had extremity injuries treated at the Military Medical Academy in Belgrade, had penetrating injuries of the joints. Knee joint was affected in 31.0% of cases, compared to all the joints of the upper and lower extremities (3).

Arthroscopic removal of missile fragments from the knee joint cavity is a useful method to prevent complications and infection after this kind of injury (4, 5).

The aim of this paper was to present the way of treatment of two patients with penetrating wounds of the knee joint. One was wounded by shrapnel bomb, and another was wounded by a bullet from a gun. This paper analyzes the treatment of penetrating wound of the knee joint by high and small initial-velocity missiles, as well as the results of treatment and complications during treatment.

CASE REPORT

Case report 1

Patient SV, 28 years old, was admitted to the surgical department of the Military Hospital in Niš for explosive wounds in the left knee joint and the left upper arm. He was wounded by shrapnels of aircraft bomb at the territory of Kosovo. First aid was given to him in Djakovica, and the patient was transferred to the University Hospital in Priština where the patient underwent primary surgical treatment of wounds and was given anti-tetanus and antibiotic therapy. The patient underwent puncture of the left knee joint and had plaster immobilization placed. From the Clinical Center in Priština, the patient was referred to the Military Hospital in Niš. On admission to hospital, the patient was conscious, oriented to time, place and person. On the anterior side of the left arm, an explosive wound was noted, of size 3x3 cm. An explosive wound was also seen on the anterior aspect of the knee region, with the size 2x2 cm (Figure 1).

On the left knee joint radiographs, a metal foreign body was registered in the projection of the knee joint. The wound in the left upper arm was primarily surgically treated. Below the left knee patella, there was an oval, surgically treated penetrating wound without signs of infection. Immediately after admission to hospital, the wound was again surgically treated, bandaged, and antibiotic therapy was included (Amp. Longacef a 2g/24h, Amp. Amicacin a g/24h 1.0) with analgesics when needed. The same treatment was continued the next day.

After complete preoperative preparation, the patient was operated. The left knee arthroscopy and removal of a shrapnel from a left knee joint were performed. Abundant hemarthros in the knee joint was present intraoperatively. Knee joint was rinsed abundantly. Synovium was partly hypertrophic. Within the left knee joint, there was a metalic foreign body sized 1x1 cm, which was removed (Figures 2 and 3).

Arthroscopy-created wound was primarily closed. Penetrating knee wound, after suturing of the synovial membrane was left open for delayed closure. Upon completion of surgery, the knee joint was bandaged.

The patient was dressed regularly, and antibiotic and analgesic therapy (Amp. Cephtriaxone 2g/24h, Amp. Amikacin 1g/24h, Amp. Diclofenak) as well as antiplatelet therapy were continued.

Four days later, under local anesthesia, the edges of the entrance, penetrating wound of the left knee joint were refreshed, the wound was well rinsed and delayed primary suture of the wound was performed. The wound was dressed. A physiotherapist was consulted, who indicated kinesiotherapy and physical activation of the patient. In the further course of treatment, parenteral antibiotic therapy was replaced with a peroral antibiotic therapy (Caps. Palitrex a 500 mg/8h). Analgesic and antiplatelet therapy were continued. Neurologist, after clinical examination, found a damage to the median nerve on the left arm.

The patient was presented to a lower military-medical commission and was declared unfit for military service for one year. The violation occurred during military service and led to the development of injury. The patient was sent to the Military Medical Academy in Belgrade for further treatment.

Figure 1. *Penetrating wound to the front side of the left knee joint caused by bomb shrapnel stuck in the knee joint*

Figure 2. *Arthroscopy of the left knee joint after injury. Bomb shrapnel in the knee can be seen on the screen*

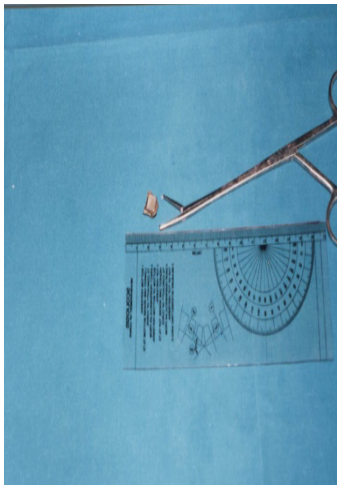

Figure 3. *Bomb shrapnel arthroscopically removed from the knee joint*

Case report 2

Patient MV, 46 years old, was wounded during the night at a railway station in Aleksinac. He reported that an unknown person fired a gun at him. He felt sharp pain in the left knee joint, after which he fell and could not get up. The patient was transferred to the Clinical Center in Niš by ambulance, early in the morning. By clinical examination of the left anterior aspect of the knee joint, the entrance wound was registered, with a diameter of about 1cm, which bled spontaneously, without the existence of an exit wound. The wound was bandaged and the patient was referred to x-ray imaging. X-ray images of the left knee joint in two directions were made (Figure 4).

Upon admittance to the Department of Orthopedics and Traumatology, the patient was bandaged and plaster immobilization was done. The patient was given antibiotic therapy (Amp. Cephtriaxone 2g/24h and Amp. Amikacin 1g/24h), analgesic therapy and anti-tetanus protection (Amp. Tetabulin and amp. Tetalpan). After preoperative preparation, the patient was operated. The patient underwent surgical treatment of penetrating wound of the left knee and underwent arthroscopic removal of missile from the left knee joint (Figures 5, 6 and 7).

A thorough debridement of the damaged articular cartilage was performed and the left knee joint was abundantly rinsed under pressure, using an arthroscopic pump. Penetrating wounds and arthroscopic wounds were primarily closed. During operation, a drainage system was set up. After surgery, the drainage system was activated with saline (with antibiotic added). After three days, the system was removed. After removing the stitches, the patient was discharged, with the recommendation to continue with physical therapy. On control examination, the patient complained of great edema of the left knee and ankle pain. Clinical examination revealed a large local edema and elevated temperature.

The patient was admitted to hospital. Immediate antibiotic therapy was prescribed (Amp. Cephtriaxon 2g/24h and Amp. Amikacin 1g/24h) and the patient underwent puncture of the left knee joint. The content obtained by puncture of the knee joint was yellowish – blurred (Figure 8).

The aspirate was sent for microbiological examination, biogram and antibiogram. Prescribed therapy led to improvement. The patient was discharged and continued with antibiotic therapy at home.

During further treatment, there was a recurrence-synovitis of the knee joint, which was solved by puncture and antibiotics again.

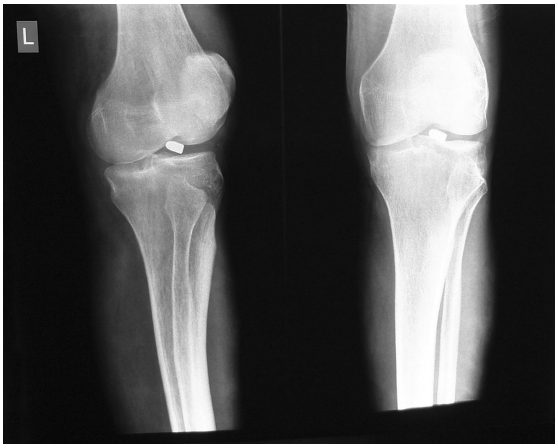

Figure 4. *X-ray radiograph of the left knee joint showing the projectile (bullet) in the knee joint*

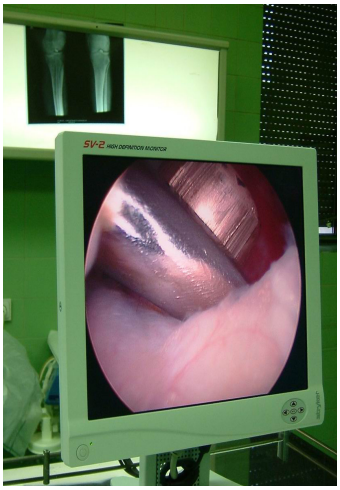

Figure 5. *Arthroscopic removal of the missile from the left knee joint*

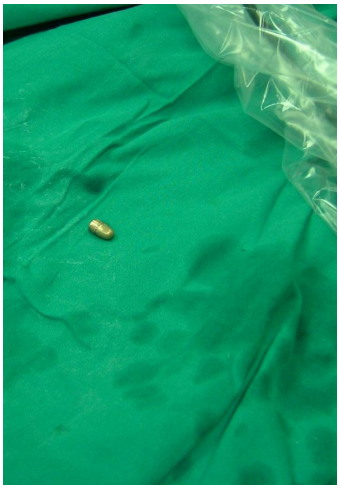

Figure 6. *Bullet, arthroscopically removed from the knee joint*

Figure 7. *Damage of the articular cartilage of the femoral condyle of the left knee joint*

Figure 8. *Puncture of the left knee joint. Yellowish turbid content was obtained by puncture of the left knee joint*

DISCUSSION

Any patient with penetrating wound to the knee joint must be thoroughly examined. Examination should determine: the appearance of the wound, condition of the skin layer and the articular capsule and neurovascular status of limbs. Arteriography is the method of choice in assessing the integrity of the arteries. Indications for urgent arteriography are: ischemia of the limbs and absence of pulsations distal to the injury, and gunshot fractures with greater displacement in the area of the knee joint. Normal findings on Doppler studies do not eliminate the need for arteriography (6).

Primary surgical treatment of penetrating gunshot wounds of the joint is a two-stage procedure and implements the unified principles of war surgical doctrine. The first act is the primary surgical treatment of penetrating gunshot joint wounds. The optimal time for the primary treatment of penetrating gunshot wounds to the joint is in the first six hours after sustaining an injury. The use of antibiotics may extend this period, but antibiotics are not a substitute for primary surgical treatment of gunshot wounds. Only synovial membrane of the joint can be closed primarily. If this is not possible, the capsule of the joint should be closed (7).

Typically, the primary surgical treatment of penetrating gunshot wounds to the joint should be done from the surface to deeper layers. All necrotic, avital tissues should be removed (8). During primary surgical treatment of articular capsule, it is necessary to be extremely frugal when it comes to the excision of the articular capsule. However, the injured joint capsule must be removed. Whenever possible, the synovial membrane should be maximally spared, because it is characterized by good vascularization, good regeneration ability, resistance to infection and is required for primary closure of

the stifle joint. The second act is a delayed closure of penetrating gunshot wounds of the joint (3, 9).

In case of punctiform penetrating wounds of the knee joint, primary surgical treatment should be done in layers, preferably in the first six hours after injury. Damaged articular capsule (fibrous and synovial layer) should be removed. Articular capsule should be opened on the uninjured part of the knee joint; arthroscopy should be done classically. The injured joint should be rinsed abundantly. The forceps should be introduced through the incision in the uninjured part of the joint and the projectile should be removed. From the knee joint, the residual foreign bodies and tiny particles of separated or damaged cartilage should be also removed. The joint should be abundantly rinsed with saline to remove small bone fragments, foreign bodies in the joints, blood clots and debris. Aspiration drainage should be performed. After surgical treatment of knee joint gunshot wound, only the knee joint synovial membrane should be closed with single sutures. The rest of the wound, above the synovial membrane (capsule fibrosis, muscle tissue, subcutaneous adipose tissue and skin), should not be closed, but left open for delayed closure of (7). If, due to defects, synovial membrane cannot be closed, joint capsule should be used to close the joint. Other layers of tissue wounds above the articular capsule should not be closed. The incisions that were because of arthroscopy and forceps introduction should be closed. If there is a defect in the synovial membrane and fibrous capsule, and if the closure is not possible, the joint may be temporarily closed by polyurethane sponge or immediately after surgical debridement, with local musculo-cutaneous flap and aspiration drainage of the knee joint, which is mandatory. Delayed closure of penetrating gunshot wounds of the knee joint should be done when a penetrating wound has no signs of infection and when laboratory tests are normal and the general condition of the wounded is good. For the delayed closure of penetrating knee joint wound, delayed primary wound closure can be performed, as well as secondary closure, free skin grafts, local and distant flaps.

To prevent infection, especially anaerobic infections (gas gangrene) of penetrating wound of the knee joint, antibiotics should be prescribed immediately upon admittance and postoperatively (10). Benzylpenicillin (crystalline penicillin) should be given intravenously in a dose of 10 000 000 IU every six hours. In combination with Benzylpenicilin, aminoglycoside is usually given (Gentamycin and Amikacin 240mg/24h or a 1 g/24 h). In the event of extensive damage to the large muscle mass of the thigh and calf and soft tissue of the knee joint where there is a high risk of development of gas gangrene, metronidazole should be given (Efloran at a dose of 500mg every 12 hours or 500mg Orvagil every 8 hours) in combination with the above mentioned antibiotics. This treatment is carried out in the next three days following the injury. After the third day of therapy, Benzylpenicillin is discontinued and a third or fourth generation cephalosporins are introduced. After 7-10 days, antibiotic treatment is continued only if an infection of the knee joint is still present. Antibiotic therapy is adjusted according to the antibiogram findings, based on intraoperative and postoperative wound swab. Depending on the clinical picture, one can switch to oral antibiotics till the withdrawal of clinical and laboratory signs of infection (11). The use of antibiotics is not a replacement for the surgical treatment of penetrating wounds of the knee joint and excision of necrotic tissue. The use of antibiotics does not allow for non-compliance with the basic principles of management of war wounds "step by step"!

The best measure of prevention of tetanus: early primary surgical treatment of penetrating wounds of the knee joint and specific prophylaxis (vaccine and human anti-tetanus serum). Anti-tetanus protection is administered according to the classical anti-tetanus protocol depending on the immune status of the wounded.

The significance of arthroscopy in treatment of missile injury of the knee joint is not well described. However, all authors agree that the arthroscopic removal of foreign body and joint lavage after sustaining an injury is a safe and useful method to help prevent further complications (mechanical disorder, chronic synovitis and infection) (4, 5, 12).

Further postoperative treatment includes: local control and overall health of the injured, early physiotherapy to prevent joint contractures, and rehabilitation in specialized institutions and subsequent reconstructive surgeries.

Penetrating injuries of the knee joint by high velocity missiles lead to extensive destruction of both intraarticular and periarticular structures of the knee joint, and therefore there is a higher probability for the occurrence of complications, primarily infection (3, 7). Complications of penetrating wounds of the knee joint may be early and late. Early complications were: serous synovitis, empyema and phlegmona of the knee joint, and septic arthritis. Late complications include contractures of knee joint, chronic infections and painful knee joint (4).

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References

1. Golubović Z, Stanić V, Trenkić S, Stojiljković P, Stevanović G, Lesić A,Golubović I, Milić D, Visnjić A, Najman S.Penetrating injury of the lungs and multiple injuries of lower extremities caused by aircraft bombs splinters. Vojnosanit Pregl 2010;67(8):688-93. http://dx.doi.org/10.2298/VSP1008688G PMid:20845675
2. Golubović Z, Stojiljković P, Mitković M, Trenkić S, Vukasinović Z, Lesić A,Kosutić M, Milić D, Najman S, Golubović I, Visnjić A. Treatment of multiple fractures in a patient wounded by aircraft bombing. Srp Arh Celok Lek 2010;138(5-6):362-6. http://dx.doi.org/10.2298/SARH1006362G PMid:20607985
3. Nikolić D, Drašković V, Vulović R, Mladenović M. Missile injuries of the knee joint. Injury, Int J Care Injured 2000; 31: 317-24. http://dx.doi.org/10.1016/S0020-1383(99)00302-2
4. Nikolić D, Vulović R. Arthroscopy of the knee in war injuries. Injury 1996; 27(3): 175-6. http://dx.doi.org/10.1016/0020-1383(95)00118-2
5. Petersen W, Beske C, Stein V, Laprell H. Arthroscopical removal of a projectile from the intra-articular cavity of the knee joint. Arch Orthop Trauma Surg 2002; 122(4): 235-6. http://dx.doi.org/10.1007/s00402-001-0373-4 PMid:12029514
6. Golubović Z, Vidić G, Trenkić S, Vukasinović Z, Lesić A, Stojiljković P, Stevanović G, Golubović I, Višnjić A, Najman S. Treatment of open tibial shaft fracture with soft tissue and bone defect caused by aircraft bomb-case report. Srp Arh Celok Lek 2010;138(7-8):510-4. http://dx.doi.org/10.2298/SARH1008510G PMid:20842902
7. McAndrew PM, Johnson DK. Penetrating orthopaedic injuries. Surgical Clinics of North America 1991; 71 (2): 297-303. PMid:2003251
8. Dean L, Dvonch V. Gun shot wound to the knee. Orthopedics 1988;11(6): 963-5. PMid:3387343
9. Coupland MR. Technical aspects of war wound excision. Br J Surg 1989; 76: 663-7. http://dx.doi.org/10.1002/bjs.1800760704 PMid:2670049
10. Nikolić D. War injuries of the extremities. Vojnosanit Pregl 2004; 61(5); 547-56. http://dx.doi.org/10.2298/VSP0405547N PMid:15551808
11. Mellor GS, Cooper JG, Bowyer WG. Efficacy of delayed administration of benzylpenicillin in the control of infection in penetrating soft tissue injuries in war. J Trauma 1996; 40(3):128-34. http://dx.doi.org/10.1097/00005373-199603001-00028
12. Sclafani SJA, Vuletin JC, Twersky J. Lead arthropaty: arthritis caused by retained intra-articular bullets. Radiology 1985; 156(2): 299-302. PMid:4011890

USTRELNE RANE KOLENOG ZGLOBA

Zoran Golubović[1,3], Zoran Popović[2], Saša Milenković[1,4], Predrag Stojiljković[1], Goran Stevanović[3,4] Zoran Radovanović[4,5], Ivan Golubović[1], Milan Trenkić[3, 4], Stevo Najman[4], Slađana Petrović[4,5]

[1]Klinika za ortopediju i traumatologiju, Klinički centar Niš, Srbija
[2]Klinika za ortopediju i traumatologiju, Vojnomedicinska akademija, Beograd, Srbija
[3]Klinika za plastičnu i rekonstruktivnu hirurgiju, Klinički centar Niš, Srbija
[4]Univerzitet u Nišu, Medicinski fakultet, Niš, Srbija
[5]Centar za radiologiju, Klinički centar Niš, Srbija

Sažetak

Strelne povrede kolenog zgloba projektilima spadaju u grupu najtežih povreda koštano-zglobnog sistema. Karakteriše ih obimno razaranje svih anatomskih struktura zgloba kolena.

U radu se prikazuju dva bolesnika sa ustrelom kolenog zgloba, pri čemu je jedan ranjen gelerom avionske bombe, a drugi metkom iz pištolja. Oba pacijenta su rešena primarnom hirurškom obradom rane, dok su geler i projektil iz zgloba kolena odstranjeni artroskopski. Kod oba povređena ordinirana je antibiotska pareneteralna terapija i antitetanusna zaštita.

Hirurško lečenje ustrelne, penetrantne rane kolenog zgloba je dvovremenska procedura i sprovodi se po principima jedinstvene ratno-hirurške doktrine. Prvi akt predstavlja primarnu hiruršku obradu penetrantne ustrelne rane zgloba. Primarna hirurška obrada penetrantne strelne rane zgloba radi se po pravilu od površine ka dubljim slojevima rane i podrazumeva odsranjenje svih avitalnih, nekrotičnih tkiva. Neop-

hodno je da ekscizija zglobne kapsule bude krajnje štedljiva, ali sva oštećena zglobna kapsula mora biti odstranjena. Primarno se može zatvoriti samo sinovijalna membrana zgloba. Ukoliko to nije moguće, potrebno je zatvoriti samo kapsulu. Ostale strukture ostavljaju se otvorene za primarno odloženo zatvaranje. Drugi akt predstavlja odloženo zatvaranje strelne rane zgloba.

Artroskopsko odstranjenje stranih tela (šarpnela, gelera) i obilno ispiranje zgloba kolena nakon ranjavanja je uspešna metoda lečenja, koja znatno smanjuje komplikacije i opasnost od infekcije kod ovih povreda.

Ključne reči: **ustrelna rana kolena, primarna hirurška obrada rane, artroskopija kolenog zgloba**