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Isolated Infected Pseudoarthrosis of the Middle Third Radius Treated by Transosseous Osteosynthesis - Case Report

Ivica Lalić[1], Marko Bojović[2], Marko Mladenović[3], Andrija Krstić[4]

[1]Orthopedic Trauma Clinic, Clinical Center of the University of Novi Sad + University of Novi Sad, Faculty of Medicine, Novi Sad, Serbia
Corresponding Author E mail: *laleort021[at]gmail.com*
Mob: +3816354194

[2]University of Novi Sad, Faculty of Medicine, Novi Sad, Serbia + Oncology Institute of Vojvodina, Sremska Kamenica, Serbia
E mail: *marko.bojovic[at]mf.uns.ac.rs*

[3]Orthopedic Trauma Clinic, Clinical Center of the University of Nis, Serbia
E mail: *mladenovicdmarko[at]gmail.com*

[4]Leskovac General Hospital. Department of Orthopedics and Traumatologyy, Serbia
E mail: *andrija1411[at]gmail.com*

Abstract: ***Isolated closed fractures of the middle third of the radius are extremely rare injuries in the pathology of forearm fractures. Treatment of infected pseudoarthrosis of the central part of the radius with or without bone defects is very demanding.We present the case of a 33 - year - old patient with an initial isolated closed fracture of the middle third of the radius created in a traffic accident. Initial the fracture was stabilized by the method of open fracture reduction and fixation (ORIF) with a dynamic compression plate (DCP). Six months afterstabilizationwere signs of infection, fistulization and pseudoarthrosis. After unsuccessful antibiotic therapypatient was admitted and underwent surgery to remove osteosynthetic material (OSM) and stabilize the fracture by transosseous osteosynthesis using the Ilizarov apparatus. Solid radius fusion was observed radiographically and clinically after removal. He wore protective plaster immobilization for another month after removing the device. Treatment of isolated fractures with pseudoarthrosisis very challenging. We believe that use of the apparatus according to Ilizarov in the treatment of these rare complications of radius injuries can contribute to the definitive solution of this problem.***

Keywords: Isolated infected pseudoarthrosis of the middle third radius, transosseus osteosynthesis, Ilizarov apparatus

1. Introduction

An isolated fracture of the diaphysis radius without ulna fracture is a very unusual injury in adults. The mechanism of this injury is often direct high-speed impact with strong forearm in pronation.[1,2] Significant loss of forearm function can occur if this injury is not treated adequately. The goal of treating such diaphysis radius fractures in adults is to restore length and provide axial and rotational stability.[3-5] The fracture type and localization, dislocation degree, patient age, and soft tissue injury size are important in determining treatment options in these injuries. Furthermore, assessment of distal radioulnar joint (DRUJ) is important to exclude Galeazzi fracture dislocation.[5,6] Open reduction and plate-screw osteosynthesis is recommended by most authors.[4,7] However, plate-screw osteosynthesis has some drawbacks, such as e.g. drainage of fracture hematomas, soft tissue damage, and periosteal blood supply disruption prevented by composite plates pressure.[3,4,8] Closed locked wedges are used for treating femoral, tibial, and humeral axis fractures.[9,10] However, intramedullary wedges are not routinely used in orthopedics for radius fractures treatment, because they cannot provide sufficient rotational and linear stability in this region. In fact, this trend has recently begun to change with introduction of newly designed interconnected IM wedges.[3,4,8,9,11] However, like plates that damage periosteal bone circulation, intramedullary fixation also damages intramedullary bone nutrition. The method of transosseous osteosynthesis is also applied to these types of fractures with a high rate of adhesion without damaging either of these two ways of supplying bones with blood.[12] Complications such as prolonged adhesion, non-healing, pseudoarthrosis and septic pseudoarthrosis are not excluded. Infectious pseudoarthrosis is the rarest, but also the most demanding for treatment and prognosis.

2. Case Study

A 33-year-old male patient was injured in a car accident as the motor vehicle driver. After admission to Emergency Center of the Clinical Center of Vojvodina, diagnosis of fracture was performed - isolated closed fracture of the right radius middle third (AO / OTA classification 2R2-A1) .[13] The patient had no other serious injuries. After preoperative preparations, ORIF operation and fracture stabilization with 8 screws DCP plate were performed. Orderly postoperative course and discharge from the Clinic was an encouraging sign of a good prognosis. Good postoperative period lasted until the fifth month, when clinical and radiographic examination showed signs of fracture non-healing with appearance of infection and fistulization signs on operative scar. Causative infection agent (Staphylococcus aureus) was isolated by microbiological analysis and the patient had targeted treatment with oral antibiotics and daily dressings with antiseptics. Microbiological analyzes were repeated in three occasions, and only in the last one absence of infection

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was noticed. Radiographic findings in the ninth postoperative month were in favor of loosening and migration of the 4th and 5th screw on the plate. The patient is admitted to the Clinic for reintervention.After extensive preoperative preparation, surgery was performed under general anesthesia to remove loose OSM, infectious pseudoarthrotic center debridement, fistulectomy, and Ilizarov apparatus placement (Figure 1). The operative technique involved placing two hoops with Kirschner needles proximal and distally about 10 cm above the pseudoarthrosis radius center, connecting them with spacers and then setting up two mechanisms for monolocal lateral encountering compression with two obliquely placed needles with olives and tension in opposite directions (Figure 1).

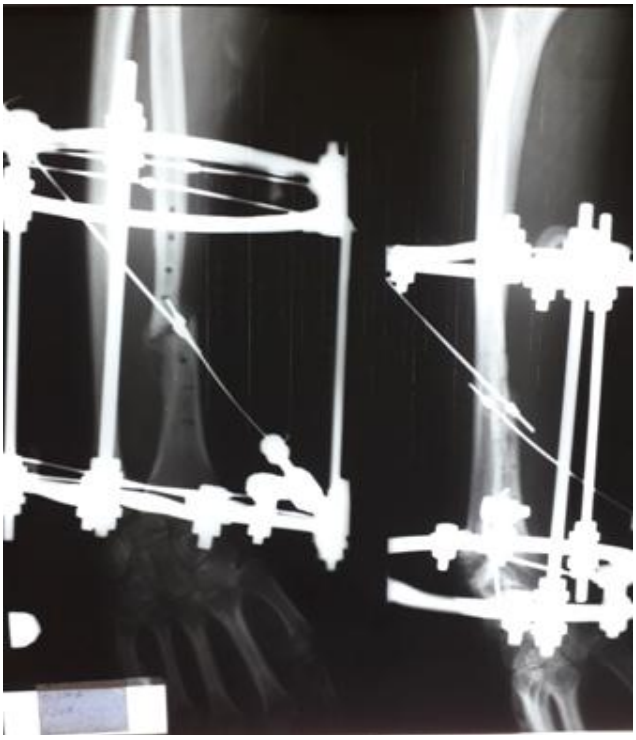

Figure 1: AP and LL projection of postoperative setting of Ilizarov apparatus

Such obliquely placed needles for lateral encountering compression are caused by the substrate of pseudoarthrosis without major bone osteolysis, as well as direction and shape of original radius fracture (AO/OTA, 2R2-A1).[12,14,15] A C-arm fluoroscope was also used. Staphylococcus aureus was isolated again using intraoperative swab taken from the focus, and was treated with high doses of sensitive antibiotics parenterally.Daily dressings of the operative wound and apparatus needles around their exit from the skin were performed, as well as working on sustainability of apparatus stability and lateral - encountering compression. On the eighth postoperative day, the patient was discharged from the Clinic in good general and local condition, the drainage system was removed and he was switched to oral antibiotics. Polyclinic controls with clinical and radiographic follow-up were performed periodically every two weeks (Figure 2).

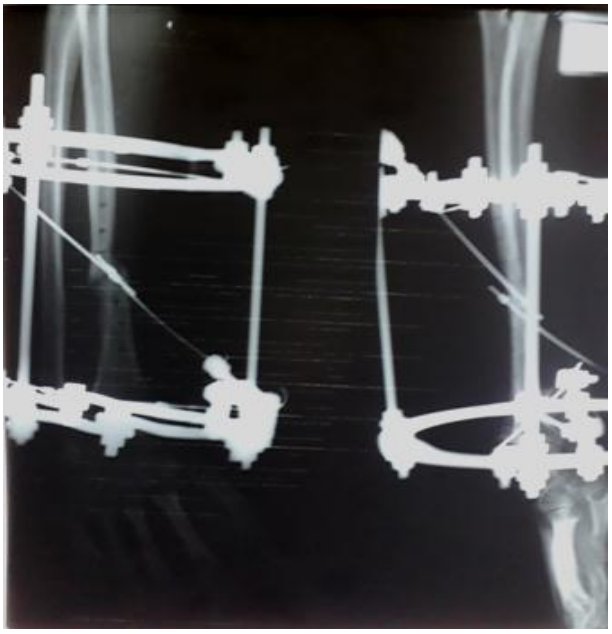

Figure 2: AP and LL projection after one month from the setting of the apparatus

The apparatus was removed in polyclinic after 14 weeks under short-term anesthesia.Plaster protective immobilization was applied for another month. Anteroposterior and lateral radiography of the forearm were used during follow-up. Adhesion was clinically assessed as a fracture site without pressure sensitivity, while radiographic adhesion involved evident bridging callus on anteroposterior, lateral, and oblique image. Postoperative hand and forearm strength was estimated using dynamometer (basic hydraulic hand dynamometer, Hixon, TN, USA).Grip strength was measured while patient was sitting with shoulder adducted and in neutral rotation, with elbow bent 90°, and forearm and fist in neutral position. Three measurements were performed. All measurements were performed within 2 minutes in order to avoid muscle fatigue. Healthy forearm was used as control. All measurements were performed at least 12 months after surgery as well as the final radiography (Figure 3).

Figure 3: AP and LL projection one year after the aplication of the apparatus. Complete healing of the radius

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Functional assessment was estimated according to Grace and Eversmann's assessment system.[16] Hand and shoulder disability reported by patient were recorded in the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire score.[17] Flexion and extension of the wrist were measured using goniometer. Operating time was 75 min. and use of the fluoroscope lasted for 35 sec. The callus was visible after 6 weeks and complete radiographic adhesion was noted after 14 weeks. The range of pronation movement was 85 degrees and supination 83 degrees. The functional result according to Grace and Eversmann was excellent. The DASH score was 5.1. Flexion and extension in the elbow were in full range while flexion in the wrist was 85° and extension 80°. No neurovascular lesions or coarser injuries of muscles and tendons were observed in the patient.

3. Discussion

Isolated radius diaphysis fractures are relatively rare injuries. The concept of treating these injuries is not uniformly accepted as in e.g. Galeazzi fractures - dislocations.[1,2,18] It is generally accepted that surgical treatment of isolated radial diaphysis injuries in elders is justified. Plate osteosynthesis is the most common surgical procedure of choice in treating radius diaphysis fractures.[3,4] In forearm fractures treatment with plate and screws, different rates of adhesion have been reported.Anderson and associates treated 258 patients with 330 forearm fractures with compression plate and screws method, and achieved result of 96.3% ulnar fusions and 97.8% radius fusions.[19]Moed et al. in 50 patients with mostly open fractures treated with plate and screws reported adhesion of 91%.[20] Some other studies describe adhesion in range of 87% - 98%.[21-23] Saka et al. recorded adhesion of 100% in sample of 23 patients with isolated radius diaphysis fractures treated with intramedullary wedge.[24] Also, views on type and length of plates that should be applied to certain types of fractures, refraction after removing plate, as well as the bone grafting itself in acute fractures are controversial.[25-26] Benefits of fixation with plate and screws are achieving good anatomical and safe reconstruction of bone, which, by the way, provides all conditions for early mobility of accompanying joints. ORIF complications include infection, prolonged adhesion, non-adhesion, compartment syndrome, nerve lesions, hemorrhage, synostosis, and limited joint function.[27] Massive published cohort studies have shown a non-adhesion rate of 2-10% in ORIF-treated forearm fractures.[28, 29] The causes of non-adhesion are multifactorial, combining: a) fracture characteristics (high versus low-energy fractures, multi-fracture injuries, locality, soft tissue damage, open versus closed fractures), b) patient characteristics (age, comorbidities), and c) surgeon-dependent causes (surgical technique and strategy). Literature states that intramedullary wires, K-needles, using plateless screws and tertiary tubular plates carry high risk of non-adhesion.[30] Treatment of pseudoarthrosis of both forearm bones, including isolating fracture of one of them, is also very diverse. Kloen et al. in their study, observed that there was higher number of oligotrophic adhesions than atrophic, and that they were equally distributed to both forearm bones.[31] We have also observed the same phenomenon in our case. In their cohort study of 47 patients with 51 radius or ulnar non-adhesion, these authors applied the ORIF AO technique with or without grafting, and noted complete adhesion at median time of 7 months. Their follow-up time was 75 months (12-315), functional results according to Anderson: 29 excellent, 8 satisfactory and 10 unacceptable. They had complications in 6 patients. For bone defects up to 6 cm, bone autologous non-vascularized graft is recommended, while for defects over 6 cm and with combination of poor surrounding soft tissue, using osteocutaneous free flap is recommended. Vascularized fibular grafts were also used to fill large defects caused by resection of infectious pseudoarthrosis of both or only one forearm bone. Several papers considering this technique with more or less successful results were presented.[32]Ilizarov's method of transosseous osteosynthesis with all its varieties (distraction osteogenesis, compressive osteosynthesis, compression-distraction osteosynthesis) is very effective in treating all types of infectious, non-infectious and pseudoarthrosis defects of forearm bones.

This method is completely different from classical schools of orthopedic surgery that use already mentioned techniques in their approach to this problem (bone rheosteosynthesis using plates and screws with or without grafting, use of locking intramedullary wedges, free bone transplants, vascularized bone grafts, etc.). The concept of distraction osteogenesis, which was first applied in practice by G.A. Ilizarov, enables us to replace bone tissue in case of pseudoarthrosis defect using patients own bone tissue at the defect site according to bone osteoclase principle and its permanent distraction until the defect is filled. This is performed strictly controlled, daily, in dynamics of 0.25 - 0.5 - 1 mm per day. After the two bones meet and compression at the junction emerges, a period of time is allowed for distraction regenerate maturation. This period depends on size of bone defect.[14,15,33-35] Performing Ilizarov's technique requires a highly trained surgeon for this procedure, bearing in mind that this procedure is not widespread in our area. It is demanding, it includes constant monitoring over the patient and apparatus monitoring.

Tomić S. et al. describes treatment of infectious forearm pseudoarthrosis with bone defects (diastasis defect) where the fusion rate was very high (90%).[15] In his presentations of results, he used various operative techniques (bilocal alternating distraction-compression osteosynthesis, monolocal compression osteosynthesis). In our case report was used technique of monolocal compressive osteosynthesis (absence of radius defect and oligotrophic pseudoarthrosis). Orzechowski et al. show 6 patients operated using Ilizarov method in period 2001-2005, with infectious forearm pseudoarthrosis (radius 5 cases; 1 case ulna and radius).[36] In all cases with non-adhesion, he had accompanying shortening of the radius of 2 to 3 cm and radius valgization with deformity in sagittal plane in 4 patients (2 antecurvatures, 2 retrocurvatures). All patients had limited forearm rotation (ROM) and limited hand movement. In most patients, the author's modification of Ilizarov apparatus was used (with mini-Schanz wedges, enabling forearm rotation). In 3 cases, monolocal slow distraction with prolongation within non-adhesion was performed. In 2 cases, bifocal, one-step light deformity correction and compression within non-adhesion with extension was performed.

In the remaining case, ulnar mismatch compression and compression with correction of radius mismatch deformity

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were performed. Distraction and correction were initiated on the 7th postoperative day at rate of 0.25 to 1 mm / day. The correction and distraction time averaged 63.3 days (40-90 days). Total stabilization time was on average 25.4 weeks (20-35 weeks). Bone fusion was achieved in all patients. In all cases, significant recovery of limb function was achieved. All patients had superficial infection around the pin site. One patient had staphylococcal soft tissue infection with skin necrosis and pin tract infection, so the needle was removed and the infection receded 3 weeks after introduction of antibiotic therapy. We did not have a recorded pin tract infection, while the superficial infection around the pin site was treated with broad-spectrum oral antibiotics and regular dressing.

4. Conclusion

In infectious forearm pseudoarthrosis treatment with or without large bone deficits, with or without deformities and disorders of the bone axis, Ilizarov's method allows us to correct existing deformities, compensate for lost bone on distraction osteogenesis principle and tight bone adhesion at the meeting point using compression effect. Possible control of deformation axis distraction and correction is one of the benefits of this method. After bone fusion, complete apparatus is removed without any metal parts remaining. Osteolysis of bone regenerates has not been observed in comparison with graft osteolysis in plating and compensation of bone defects using ORIF technique. Our opinion is that this is the method of choice in treating such severe complications of bone fusion.

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