

Original Article

Meniscal repair using fibrin clot from autologous blood: description of the surgical technique

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Abstract

The crucial role of the menisci in function and biomechanics of the knee has been increasingly recognized and well described during the past several years. Meniscectomy was a gold standard treatment for a torn meniscus. Reviewing the literature, shows that this procedure is deleterious for the chondral surface. In the last decades, orthopaedic surgeons give a battle to salvaging and repair a torn meniscus, when this is possible. Clinical studies have shown that the introduction of biological augmentation techniques has the potential to enhance meniscus repair especially in young active individuals. Fibrin clot is relative quick to reproduce and easy to use technique which promises encouraging results in repairing the torn meniscus and in the same time is considered one of the most cost effective solutions comparing with others. In this paper our aim is to present the surgical technique of preparation and use of the fibrin clot form autologous blood step-by-step in case series of 24 patients. However, despite the relative ease preparation of fibrin clot from autologous blood, the placement and stabilizing it into the gap of the meniscal rupture arthroscopically is challenging.

Keywords: Meniscus, Meniscus repair, Biological augmentation techniques, Surgical technique, Fibrin clot

Introduction

The meniscus plays an important role in the function and biomechanics of the knee. It is an essential part of the knee joint, increasing contact area and joint congruence, lubricating articular surfaces and at the same time decreasing contact forces and absorbing shock^{1,2}. Meniscal tear is the most common injury to the knee that requires surgery. Traumatic meniscal tears are common in young patients with sports-related injuries. Most tears are treated by partial meniscectomy³. However, patients who underwent meniscectomy noted long-term arthritic changes⁴⁻⁷. An in vitro study showed that the removal of 16% to 34% of the meniscus resulted in a 350% increase in contact forces⁸. So efforts have been made to preserve meniscus, and meniscal repair has become the preferred treatment of choice over meniscectomy^{9,10}, especially for young active patients and for peripheral longitudinal tears^{3,11}. Augmentation techniques, such as fibrin clot, synovial rasping, vascular access channels, platelet-rich plasma, fibrin glue, fascial – sheath

coverage, rasping of the intercondylar notch may extend the indication for repair and improve success rates after meniscal repair especially in the central avascular zone of the meniscus¹²⁻¹⁹.

Meniscal repair using a fibrin clot was first introduced by King in 1938 and became popular by Arnoczky and Warren in 1983²⁰. There have been a few experimental in animals as well as in human studies that show good results of meniscal repairs using fibrin clot²¹⁻²⁴. In this paper we explain in details, the procedure we follow treating a case

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series of 24 patients who underwent arthroscopic surgery for meniscal repair, using fibrin clot of autologous blood as enhancement of the repair.

Surgical technique

All surgeries were performed by the same surgeon, and for the meniscus repair, we used the inside-out or the all inside technique^{25,26}.

Patient positioning

The patient was placed in a supine position on the operating table. Then and when the procedure of general anesthesia was completed, a knee examination was performed. This included a range of motion and a thorough ligament examination. Thereafter, cotton cast padding was wrapped around the thigh-high a tourniquet was placed circumferentially around it, and the leg was placed into the leg holder device. The pressure of the tourniquet was set between 300-350 mm Hg for a normal adult. After the setup was completed the leg was prepped and surgical draping was performed in layers.

Surgical approach

After the arthroscopic portals establishment, we performed a thorough diagnostic arthroscopy. Meniscal tear was identified, and classification of the lesion was following. In case of a displaced bucket handle tear, or a displaced meniscal flap tear anatomically reduction of the tear using a probe was preceded. We proceeded with debridement of the central and lateral portion of the meniscal lesion using a rasp or a motorized shaver without the suction connected to prevent further injury (Figure 1). Synovial abrasion was also performed to enhance the meniscal repair in a similar fashion. At that stage, we calculated the size of the meniscal gap and the number of the sutures we would use for the repair taking consideration that the distance between them was approximately 1 to 1,5 cm.

Fibrin clot preparation

Although the meniscal repair is being undertaken, a nurse drawn with a syringe 60 ml blood from a peripheral vein after thorough disinfection of the area and placed it in a sterile metal beaker. The blood was poured in a metal beaker and stirred gently with a metal blunt stick by an assistant. After 15 minutes the adequate fibrin clot formation was achieved^{27,28} (Figure 2).

Carefully we removed the fibrin clot from the metal blunt stick and posted it on sterile gauze. Courteously was picked with an anatomical pair of forceps and wash with saline (2-3 ml) in order to remove the rest of the peripheral blood which was not formatted resulting further concentration of the clot and also enhance the visibility during the placement of the fibrin clot arthroscopically (Figure 3).

Following, the fibrin clot was shaped using a blade No

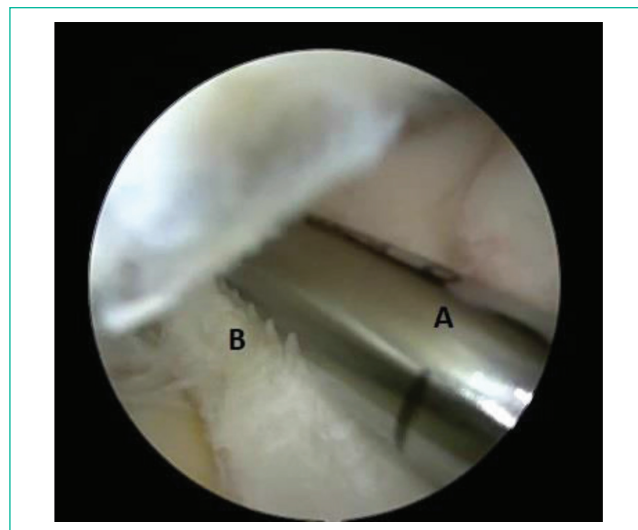


Figure 1. Meniscal lesion debridement. A) Shaver, B) peripheral part of the lesion (arthroscopic view).



Figure 2. 60 ml of peripheral blood is poured into the metallic beaker and gently stirring for 15 minutes in order fibrin clot to be formatted.

11 to best fit the gap of the meniscal rupture (Figure 4A). At that point, we placed sutures on both ends of the fibrin clot for best handling during its placement into the meniscal rupture (Figure 4B).

At that stage and after finished the preparation of the meniscal lesion, which was essential for the repair, we proceeded with the fibrin clot insertion in to the defect of the meniscus via an arthroscopic cannula using a grasper or rod and place it in the site of the meniscal gap, followed by its

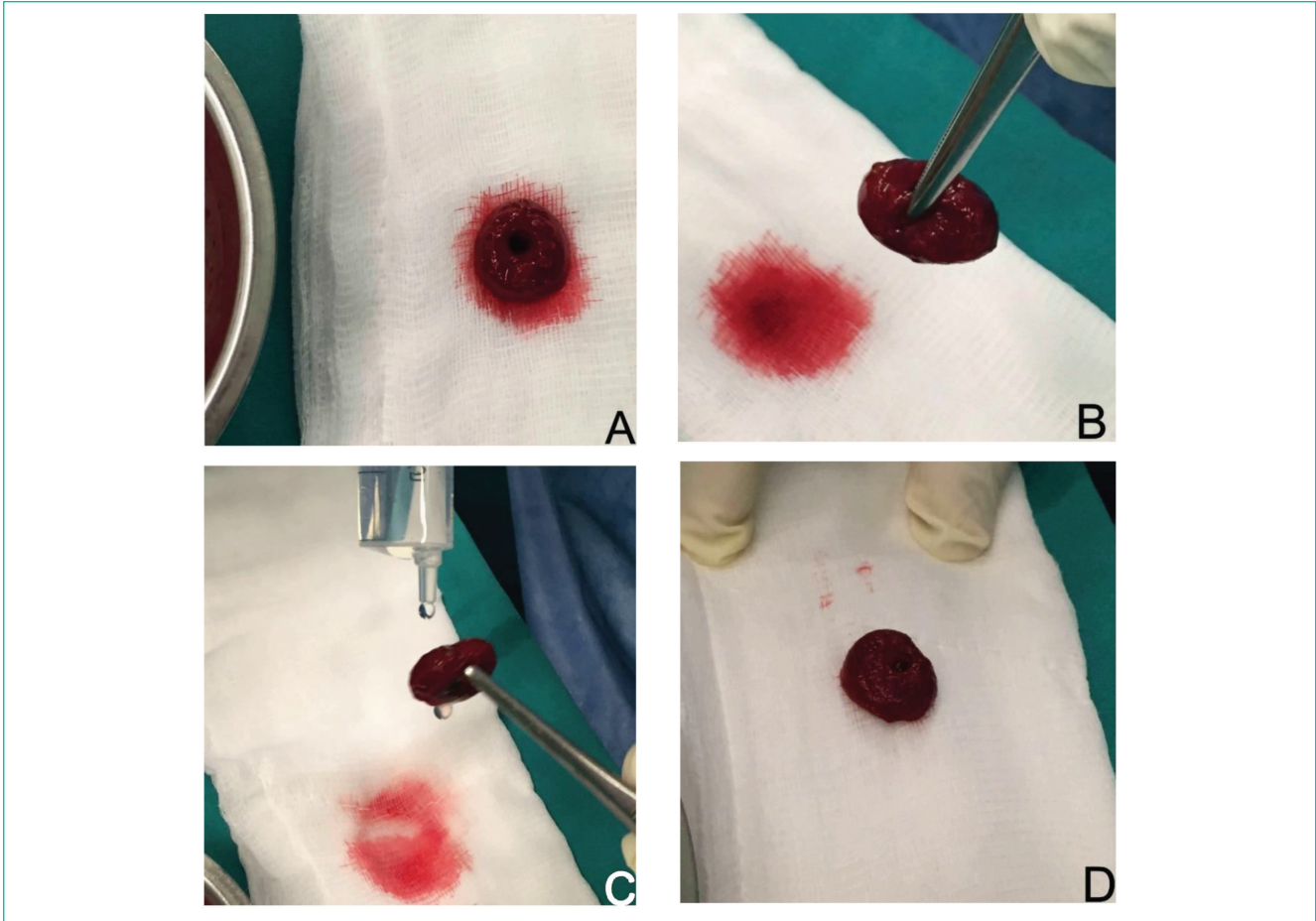


Figure 3. A) After gentle stirring the fibrin clot is formatted and placed on to a sterile gauze, B) gently is picked with an anatomical forceps, C) rinsed with sterile water, D) placed on a gauze to dry and further concentrate.

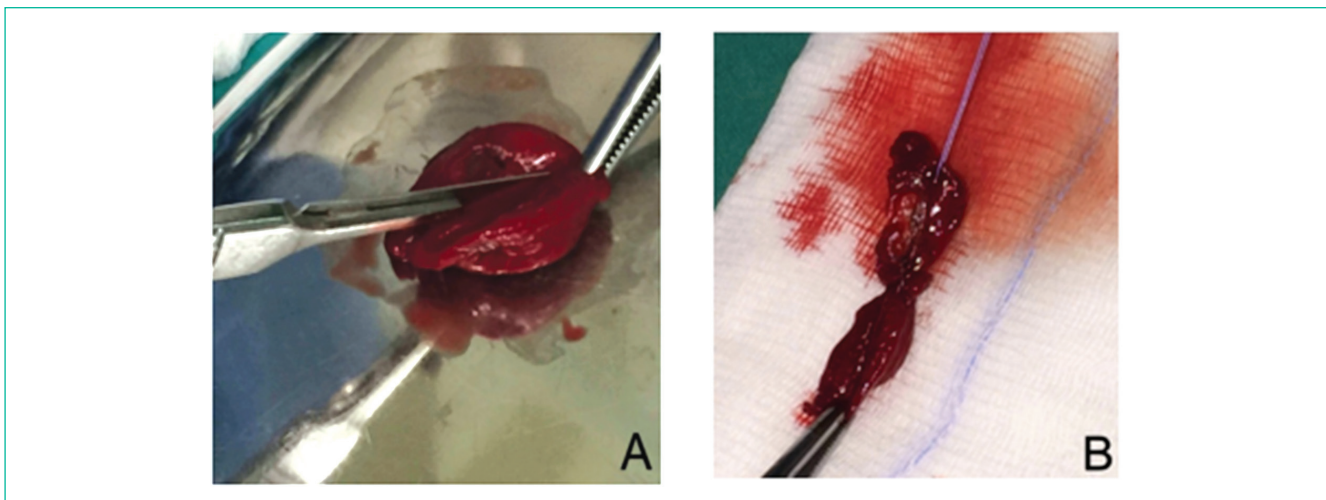


Figure 4. A) Carefully using No 11 blade and after placing the fibrin clot on the back of the metal beaker, we shape it to best fit the gap, B) holding one end gently with mosquito forceps we place on both ends No 2 Vicryl stitches for best handling.

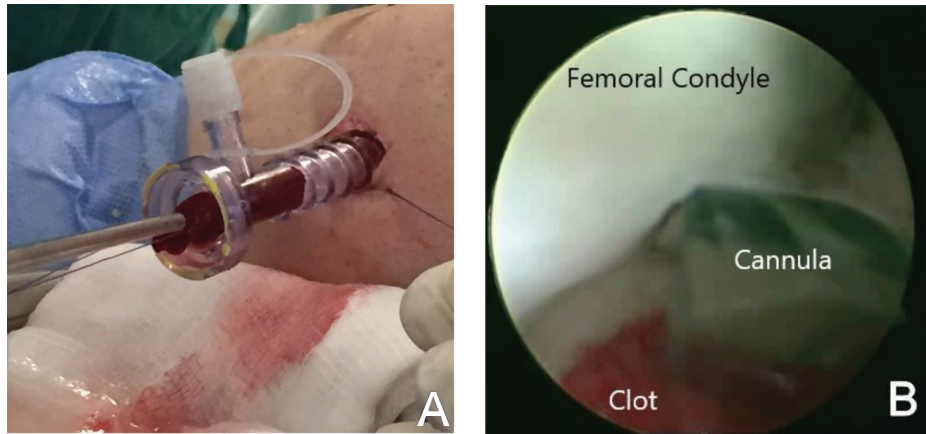


Figure 5. Fibrin Clot insertion steps 1 (A) & 2(B). A) One end of the fibrin clot is grasped gently with a grasper. Using the free stitches we maneuver the fibrin clot as we insert it intraarticular, B) fibrin clot is placed into the joint through the cannula.

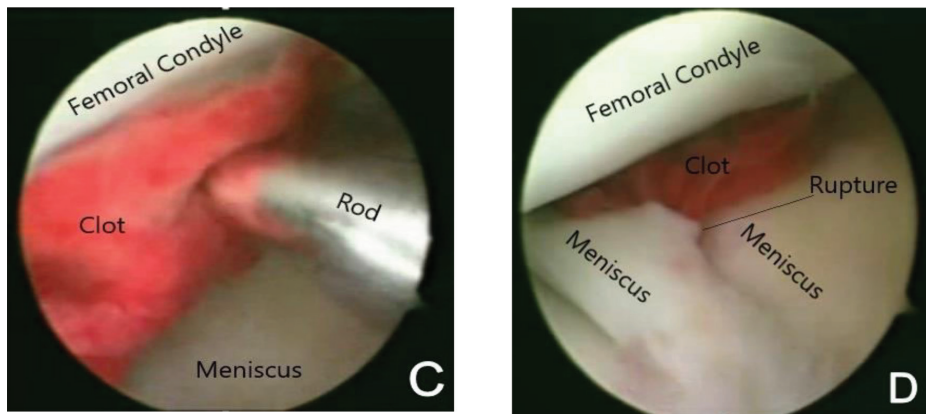


Figure 6. Fibrin Clot insertion steps 3(C) & 4(D). C) Fibrin clot is pushed gently with the rod to the meniscal gap, D) fibrin clot is placed into the meniscal gap firmly.

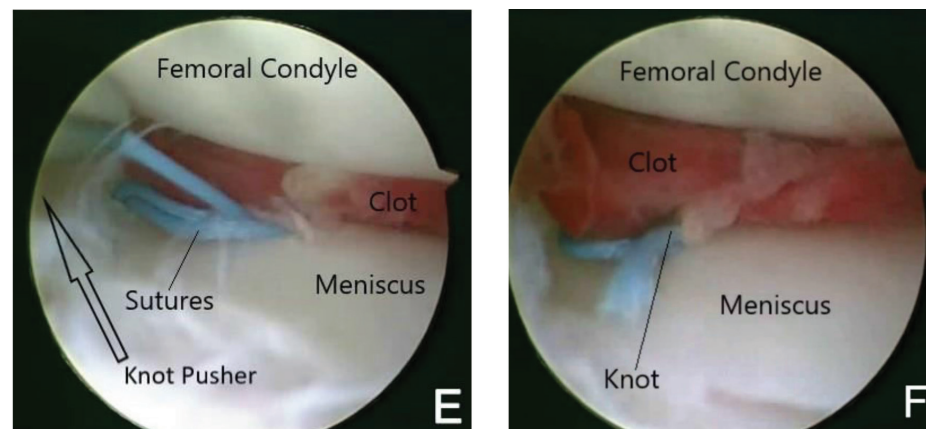


Figure 7. Closing the gap – meniscus suture steps 5(E) & 6(F). E) Meniscal gap is reduced by tightened the sutures (push-pull technique) and fibrin clot is stabilizing, F) finally result.

stabilization by tightened the sutures (*push-pull technique*) (Figures 5, 6, 7). This final stage was considered the most crucial for the success of repairing the meniscus and was strongly connected with firmly placed and stabilized the fibrin clot into the meniscal gap.

Postoperative rehabilitation

Immediately postoperatively, a functional brace was applied allowing knee flexion up to 60° for the first two weeks, increasing to 0-90° after the second week and 0-120° at 4th week time. The patient for the first 3 weeks used crutches as weight-bearing wasn't permitted. Partial weight bearing was allowed from the third week and full weight bearing after the end of the fourth week. Physiotherapy program starts from the first postoperative day emphasizes the strengthening of the quadriceps femoral muscle as well as passive and active exercises to increase the ROM. Full extension of the affected leg has to be achieved in 1 week. The patient's return to sedentary work was allowed after 1 to 2 weeks from the surgery, while in heavy work after 3 months. Light running was allowed at 3 months postoperatively, and higher levels of activity including sports were permitted after 4 to 5 months.

Discussion

The most crucial function of the meniscus is its protective role, including shock absorption and force transmission across the knee joint, by increasing the contact area, which avoids contact stress on the articular cartilage²⁹. The use of fibrin clot from autologous blood enhances the repair of longitudinal tears of the middle or posterior part of the meniscus, shows better results than the meniscus repair without fibrin clot but the most important is that avoids long-term consequences of partial meniscectomy (increased risk of osteoarthritis)³⁰⁻³². Many authors reported good to excellent results using this technique^{22-24,33,34}.

Reviewing the literature, fibrin clot has been used by many authors for salving a meniscus tear and reported good to excellent results. Arnoczky et al. have managed to show in their studies the way of fibrin clot works histologically and acts as scaffolding and stimulus for the proliferation of cells and tissue. It is not the direct vascular supply, but the hematoma that brings the factors leading to tissue formation, which cannot be formed in the avascular zone of the meniscus after its traumatic rupture³⁵⁻³⁹. The presence of fibroblasts in the fibrin clot appeared to help further the repair of the meniscal tissue⁴⁰.

Van trammel et al. (1998) in 5 cases of patients with a complete radial split of the posterolateral aspect of the lateral meniscus adjacent to the popliteus tendon, which is devoid of vascular supply, repaired them with sutures enhanced with a fibrin clot. All patients at a second – look arthroscopy performed at 4 months post showed full peripheral healing of the ruptured meniscus, with all patients returning to their initial level of sports activities. It is worth to mention that the above-mentioned authors

abraded the borders of the meniscal tear in all cases, assuming that such a procedure promotes the vascular reaction⁴¹. Similarly, in a series of 12 complete radial tears of the meniscus (9 lateral and 3 medial menisci) Ra et al. (2013) utilized after arthroscopic inside-out repair, fibrin clot to fill the meniscal defect⁴². The authors previously abraded the torn margins of the meniscus as well as the adjacent synovium with a rasp and a shaver to improve the vascularity at the site of repair. Moreover, these authors in order to enhance the meniscal healing abraded the bony surface at the intercondylar notch surface with a burr. The healing rate was 92% (11 out of 12 patients) as recorded in follow up MRI 11±3 months postoperatively. Seven of 12 patients underwent a second-look arthroscopy, with the six of them displaying complete healing and one showing partial healing.

We believe that this procedure produces better results than other possible procedures and is a promising alternative for young and middle-aged patients, who wish to return to sports activities, but further studies needed to support long-term outcomes determine the specific indications and optimal candidates for this procedure.

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