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Disruption of the knee extensor apparatus complicating anterior cruciate ligament reconstruction

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rezime

Disruption of the knee extensor apparatus, after harvesting the central third of the patellar tendon for a bone-tendon-bone autograft, is a rare complication. We made 2215 reconstructions of the anterior cruciate ligament of the knee using bone-patellar tendon-bone technique, and 10 patients had fracture of the patella (0.45%), and fore patients had rupture of the patellar tendon(0.18%). The fracture of the patella in two patients was treated non-operatively and 8 patients was treated with operative reduction and osteosynthesis. Reconstruction of the patellar ligament in four patients with a rupture of patellar tendon (0.18%) was performed by a technique previously published with BTB allograft taken from the local bone bank. The mean Lysholm score was 90 (85-100), and all of them have continued to engage in sporting activities. In all patients the Lachman test was with the firm stop compared to the other leg. X-ray changes in the patella were found in 2 patients, who had multifragmentary fractures of the patella. Disruption of the knee extensor apparatus, after harvesting the central third of the patellar tendon for a bone-tendon-bone autograft, can be prevented by avoiding to take too much bone graft, by using the most precise tools for cutting, while rehabilitation must be carefully planned. The optimal treatment disruption of the knee extensor apparatus after the reconstruction of the anterior cruciate ligament is a operative reconstruction, which allows continuation of the rehabilitation program.

Key words: arthroscopy, anterior cruciate ligament reconstruction, complication, patellar fracture, patellar tendon rupture

INTRODUCTION

Bone-patellar tendon-bone (BTB) remains the most common graft material for anterior cruciate ligament (ACL) reconstruction, and has several advantages compared with soft tissue grafts. The BTB graft is the strongest of all biological substitutes; it achieves strong initial graft fixation using interference screws, and offers rapid bony integration at the fixation points of the reconstruction[1,2,3,4,5].

The results of its application are excellent in 80-90% cases with sporadic complications of the knee extensor mechanism, that is, BTB harvest site morbidity and disruption of the knee extensor apparatus[6,7,8,9].

Since 1983, when McCarrol[10] reported the first case of patella fracture that occurred 6 months postoperatively during a golf swing, few other authors have reported this complication[11,12,13,14,15,16].

Rupture of the patellar tendon after harvesting a bone-tendon-bone (BTB) autograft occurs very rarely. Up till now avulsion of the lower pole of the patella[8,17,18,19,20] or tibial tuberosita[21,22] have been reported several times, but mid-third of the patellar tendon rupture[23,24] only twice.

Patients with disruption of the knee extensor apparatus after ACL reconstruction have significant pain and are unable to actively extend their knee. A palpable defect is ge-nerally present, as the patella or piece of patella usually contracts proximally.

Patients experience weakness, instability, and pain. There is a loss of active knee extension, quadriceps muscle atrophy, and proximal patella migrati-on. Although the diagnosis is based mainly on clinical examination, X-ray, MRI and ultrasound examination can be a helpful, non-invasive and accurate tool to obtain additional important information for planning operative treatment[25].

The aim of this paper is to present the results of anterior cruciate ligament reconstruction in the patients in whom patellar fracture and rupture of the patellar ligament complicating arthroscopic anterior cruciate ligament recons-truction, and to show the underlying causes of these complications and possibilities of prevention.

MATERIAL AND METHODS

In the period from January 1996 to July 2012, 2215 reconstructions of the anterior cruciate knee ligament were done at the Department of Orthopaedic Surgery, Clinical Centre of Vojvodina using the bone-tendon-bone (BTB) technique which was similar for all the patients. A vertical incision was

made from the middle of the patella to the inferior portion of the tibia tubercle with the knee flexed. Skin flaps were created and the incision was sharply carried down through the transverse fibres of the paratenon. The paratenon was incised at its midpoint, and scissors were then used to extend proximally and distally and to expose the entire width of the patellar tendon. Next, the tendon was maintained in a stretched position by flexing the knee to incise the tendon first on one side of the graft followed by the other side to yield a 10-mm wide graft. Then, a blade oscillating saw was used to create the tibial bone plug by scoring the tibial cortex and removing an equilateral triangle of bone with the saw. The tibial bone block was temporarily left in place while we harvested the patellar bone plug. We cut the patellar plug as a trapezoidal shape, no more than 6 or 7 mm deep, and then we used a curved osteotome to lift the tibial bone plug carefu-lly from its bed onto a lap pad followed by gentle removal of the patellar bone plug. The scissors were then used to remove any remaining soft tissue attachments, and the graft was removed by the harvesting surgeon. The BTB graft was prepared on a side table by an assistant. A stan-dard anterolateral portal was used as a viewing portal and an anteromedial one was used as a working portal. The ACL stump was debrided. In the period from 1996 to 2005 we created a femoral tunnel with a limited notchpla-sty using the TT technique. Since 2005, we have been ma-king a femoral tunnel through the AM portal. The femoral tunnel was created first in order to avoid excess fluid loss. The knee was placed in flexion between 110 and 120°. The femoral guide (Karl Storz, Tutlingen, Germany) with an appropriate offset was introduced into the joint through the anteromedial portal. With the help of a femoral guide, a drill-wire was placed into the centre of the anatomic insertion of the ACL at 10 o'clock position and was overdrilled with a 10-mm diameter reamer. A suture was retri-eved and a guide pin was drilled into the joint followed by a cannulated reamer with an equal diameter to the graft to create the tibial tunnel. A grasper was then placed through the tibial tunnel to retrieve the suture. Then the graft was passed through the tibia into the femoral socket, and once the graft was properly positioned in the tunnel, it was fix-ed with RCI - round cannulated interference screws (Grujic & Grujic, Novi Sad, Serbia). Firm traction was applied to the tibial bone block while the full range of knee moti-on was being performed in order to pretense the graft and observe if the full extension caused any impingement. The graft was then tensioned using 60 N force (Karl Storz, Tu-tlingen, Germany) and fixed into the tibial tunnel with RCI - round cannulated interference screws (Grujic & Grujic, Novi Sad, Serbia). The knee stability was checked using Lachman and anterior drawer tests. Two drains we-re placed, the operative wound was closed in a usual way and the patient was taken to his room.

PATELLAR FRACTURE

The patellar fracture occurred in 10 patients (0.45%) (Table 1). There were 7 men and 3 women, their mean age being 23.5 years (19-30). In 8 patients a fracture of the patella was on the same leg where there was the reco-nstruction of the anterior cruciate ligament in a knee, and on the two from which the graft was taken from the opposite knee. The fracture developed in 4 cases intraoperatively; in one case seven days after surgery; in 3 cases after two months; and in two cases 7 months after anterior cruciate ligament reconstruction. The fracture was immediately recognized in the patients with vertical non-displa-ced patellar fracture, and the broken

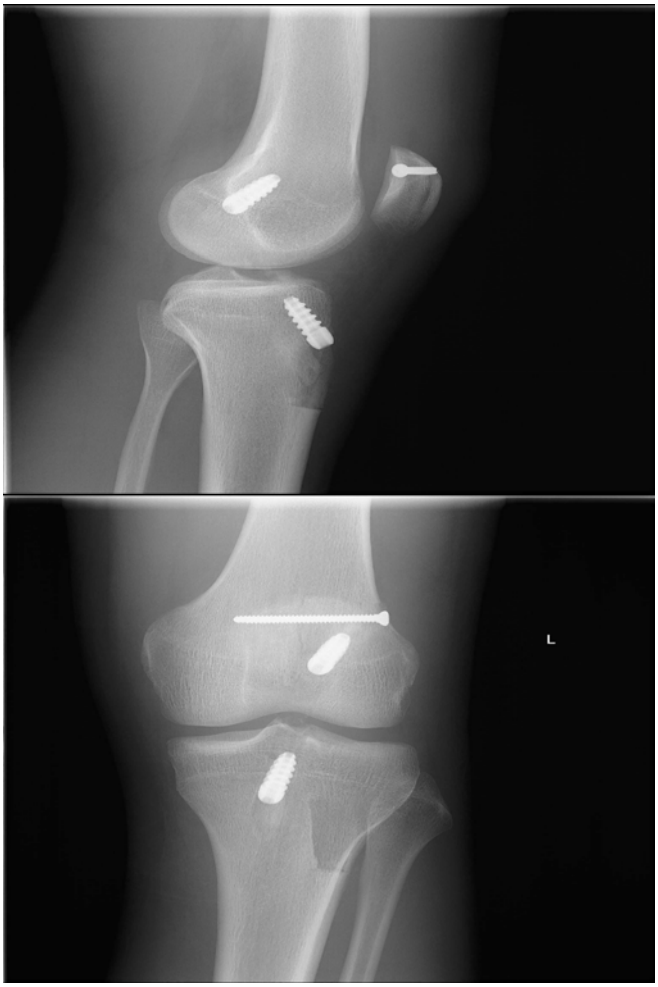

FIGURE 1A and B

PROFILE AND AP RADIOGRAPH OF THE LEFT KNEE WITH PATELLAR FRACTURE OCCURRED INTRAOPERATIVELY AND IMMEDIATELY EXECUTED OSTEOSYNTHESIS WITH SCREW.

screw osteosynthesis was carried out (Fig. 1AB), without changes in the rehabi-litation period. One patient was treated non-operatively with plaster of Paris for 6 weeks which was followed by physical therapy. In four patients patellar fracture was tre-ated with operative reduction and osteosynthesis with needles and wire (Fig. 4AB).

PATELLAR TENDON RUPTURE

In four patients suffered a rupture of patellar tendon (0.18%). (Table 2) Three patients had a rupture of patellar ligament occur after an average of 8 months (6-10) during the jump, and one patient suffered in a car accident 6 months after ACL reconstruction. One patient received corticosteroids due to the pain in the top of the knee cap. Reconstruction of the patellar ligament was performed by a technique previously published with BTB allograft taken from the local bone bank[7]. A 15cm long anterior skin incision was made. After debridement of the scar tissue in the patellar tendon area, a 25mm long and 11mm wide bo-ne through was created in the patella and the tibial tubercle. A 25mm long and 11mm wide BTB frozen allograft taken from the local bone bank was used for the recons-truction. The tibial bone plug of the allograft was pressfi-tted into the tibial through and secured with two screws. The patellar bone plug was press-fitted into the central part of the patella (into the spot where the previous graft was harvested) and fixed with

FIGURE 2 A and B

PROFILE AND AP RADIOGRAPH OF THE KNEE AFTER A BLOODY REPOSITION AND OSTEOSYNTHESIS PATELLAR FRACTURE.

two screws. Multiple wire loops, connecting the upper patellar edge and a screw fix-ed to the tibial tubercle, were put as reinforcement. The remnants of the patellar ligament were sutured. After tightening the wire loops, the knee range of motion was checked. Before closing the wound, the patellar height was checked via a lateral radiograph and compared to the opposite knee (Fig. 5). Postoperatively, a CPM machine was used, with the range of motion set from 0 to 45 degrees immediately after the operation, and up to 90 degrees of flexion in the following two weeks. At the same time, quadriceps strengthening and active knee extension exercises were included in the patient's postoperative physical therapy programme. He was allowed partial we-ight bearing for the first 6 weeks after the procedure and started full weight bearing afterwards, when he achieved 100 degrees of flexion and full extension in the operated knee. Wires and screws were removed 6 months after the operation due to the breakage

The results were made based on the mean Lysholm score[26], arthrometric and X-ray images.

RESULTS

All patients were invited for the check-up 5 years after surgery on average (2-8 years) and all had full extension and flexion in the operated knee. The mean Lysholm sco-re was 92 (85-100). All of them have continued to engage in sporting activities at the same level after 9 months on average (6-12 months). In all patients the Lachman test was with the firm stop, arthrometric 2 (1-3) mm compared to the other leg[27]. X-ray changes in the patella were found in 2 patients, who had multifragmentary fractures. Insall Salvati index on the operated side was identical to the contralateral side (Fig. 6).

DISCUSSION

The use of patellar tendon autografts for anterior cruciate ligament (ACL) reconstruction is widespread and is deemed to provide good, reproducible clinical results[2,4]. Fracture of the patella, after harvesting the central third of the patellar tendon for a bone-tendon-bone (BTB) autograft is a rare complication whose incidence ranges from 0.23% to 2.3%[12,28,29,30,31]. In the first report after 407 ACL reconstruction we noticed 1 case[32] but now after 2215 reconstructions of the anterior cruciate ligament of the knee using BTB technique, we had fracture of the patella in 10 (0.45%) patients. There is not sufficient data concerning the incidence of patellar tendon rupture after ACL reconstruction. Benner et al[33] have noticed 13 cases of patellar tendon rupture after 5364 ACL reconstructions. Lee et al.[31] reported one case of postoperative patellar tendon rupture after 1725 BTB ACL reconstructions.

In the first report after 1300 ACL reconstructions we have noticed 1 case of patellar tendon rupture[7]. Now after 2215 ACL reconstructions we have noticed 4(0.18%) ca-ses of patellar tendon rupture. Almost all of the reported cases of the knee extensor mechanism complications were on the same side as the ACL injury, except the cases of contralateral patellar tendon rupture after harvesting BTB for ACL reconstruction of the other knee[17,23]. Patellar tendon rupture occurred in one patient with, after contra-lateral BTB graft harvest for multiligamenar reconstructi-on.

The causes of patella fractures after anterior cruciate ligament reconstruction are manifold. First of all, taking a bone graft from the patella leads to a significant weakening of the bones (Fig. 1B). The recommendations for mi-nimizing the risk of patella fracture include avoiding the use of osteotomes to make the initial bone cuts and to remove no more than 25 to 30 mm of the length of the pate-lla, and no more than 9 to 10 mm of its width. The front part of the patella is the strongest and most resistant to the load, and its resistance after taking the graft is reduced by 30%-40% without a significant increase in pressure bet-ween the patella and the femur[34,35]. Friis and al.[36], who investigated the biomechanical strength of the patella after taking the graft, found that the patella from which the gra-ft was taken was more sensitive to stress than normal, and that the striped graft taken caused less stress on the bones than the oval or trapezoidal graft. The main conclusion of this study is that the lower part of the bone taken less stre-ss on the patella, and the graft length should not exceed the equator of patella. Malek et al.[37] consider that the de-pth of the graft taken not to maximum 1/3 the patella thi-ck. Additionally, the technique of taking graft is critical. Osteotom should be used carefully after the initial cuts saw. Making a 45-degree angle to the upper pole of the graft during the intake may reduce postoperative stress. Jackson and al.[38] propose the application of semi-circular oscillating saw with a smaller graft taken, and to form a smooth rounded bottom, which probably causes less stress than traditional methods in the angles.

McCarroll[10] presented the theory that the transverse patella fractures are similar to stress fractures due to reduced vascularisation of the central parts of the patella. Benson and

FIGURE 3.

LATERAL VIEW SHOWS A DEFECT LOCATED BELOW THE LEFT PATELLA AND PROXIMAL PATELLAR POSITION.

FIGIRE 4A

LATERAL X-RAYS OF THE LEFT KNEE SHOW PROXIMAL PATELLAR MIGRATION, INSALL SALVATI INDEX LT: LP=1.5.

FIGURE 4B

LATERAL X-RAY OF THE LEFT KNEE AFTER TENDON REPAIR AND REINFORCEMENT WITH MULTIPLE WIRE LOOPS AND SCREWS.

Barnett[39] described the patella vascularisation and co-llateral blood flow after taking the graft. Extraossal blood supply surface of patella comes from geniculates artery that are stored while taking graft. The intraoosseous blood flow has three components: middle-patellar, polar and sy-stem from tendon and muscles quadriceps. The first two supply the middle third and lower pole of patella. If the damage occurs while taking graft, it can slow down the healing process on the graft, and affect the surrounding normal bone.

Bonami et al[8] studied the quality of tissue that filled the place where graft had been taken from during healing. A defect in the patellar ligament and patella filling fibrous tissue, which also reduces the strength and resistance of the anterior cortex of patella, predisposes fracture. Many authors[40,41] recommend filling the defect in the patella with spongious bone to preserve the anatomical integrity of the donor sites.

The majority of the described fractures happened during early postoperative period[8,42,43] an average of 57 days following BTB anterior cruciate ligament reconstruction, with an interval between 24 and 121 days. Christen et al.[44] described 6 intraoperative and 3 postoperative pate-lla fractures in a series of 490 patellar autograft ACL reconstructions. Fore of our patients sustained fractures of the patella intraoperatively, one after seven days, tree after two months and two after 7 months, the average being 61 days (0-210).

Intraoperative fracture of the patella occurred during bo-ne block removal and usually vertical splits without dislocation. Christen et al.[38] from 6 intraoperative fractures, only 3 of which were treated with internal fixation. In our first case we noted the existence of fracture without dislocation of the control X-ray that was made 6 weeks after surgery when the patient complained of constant pain in his patella. We slowed the rehabilitation program, and the fracture healed without affecting the final result. In another patient, a crack was heard and a non-displaced fracture of the longitudinal patella was noted after cutting the patella and lever strong chisels manipulation. We immediately made an osteosynthesis with one screw. The fracture healed without slowing down the rehabilitation program and it did not affect the final result.

Postoperative fractures occur with a direct blow results and impaction injury with the fracture being stellate or Y-shaped, while rapid eccentric quadriceps contraction, whi-ch may occur as the result of a fall, typically results in a transverse fracture pattern[45]. These fractures cause signi-ficant functional deficit that is manifested clinically as a loss of active knee extension. Rigid fixation to allow early mobilization is the recommended treatment for most isolated patella fractures[46] as well as for patella fractures in the postoperative period after ACL reconstruction. Non-operative treatment and treatments requiring extended immobilization should be reserved for those patients unwilling or unable to undergo surgery, or a fracture pattern that cannot be rigidly fixed. Once a patella fracture occurs, the short-term rehabilitation goals for the patient should be altered in order to enhance the likelihood of long-term success. Fracture healing without displacement is critical. A variety of fixation methods exist. Tension-band fixation has been reported with successful results[11]. However, as reported in the trauma literature, 22% of patients treated with tension-band wiring and early motion had displacement of more than 2 mm, and over 10% of patients will require hardware removal due to overlying irritation from the wire[47]. Other options include cannulated screw fixati-on, with or without a tension-band augment, or bicortical (superior to inferior) small or large fragment screw fixati-

TABLE 1

FRACTURE PATELLAE AFTER ACL RECONSTRUCTION

Case	Gender	age	knee	sporting activity	fractures after surgery	type of fracture	treatment	return of the sport	lysch olm scor	artrometar measurements in mm	X ray findings
1	male	19	left	football	intraoperatively	vertical	-	6 months	100	1	repaired anatomically
2	female, ACL revisiof emalen	22	left, contralateral	handball	7 days	transverse	reposition and osteosynthesis	8 months	85	3	repaired anatomically
3	male	18	left	handball	7 months	transverse	reposition and osteosynthesis	12 months	96	2	repaired anatomically
4	male	23	right	basketball	7 months	transverse	reposition and osteosynthesis	11 months	90	2	repaired anatomically
5	male	29	right	recreational football	2 months	multifragment	reposition and osteosynthesis	10 months	84	3	reconstructed step 2mm
6	male	30	right	recreational fitness	2 months	multifragment		10 months	87	2	reconstructed step 2 mm
7	male	24	left	karate	intraoperativey	vertical	reposition and osteosynthesis	6 months	100	1	repaired anatomically
8	female	16	left	handball	intraoperatively	vertical	reposition and osteosynthesis	8 months	100	2	repaired anatomically
9	male, ACL revision	20	left,contralateral	recreational football	intraoperatively	vertical	reposition and osteosynthesis	8 months	90	4	repaired anatomically

on. Biomechanical testing of a modified tension-band compared to either 4.5-mm screws or an anterior tension ba-nd placed through 4.0-mm cannulated screws showed the cannulated screws and tension band to be the strongest construct[45]. Regardless of the method selected, the surge-on must achieve reduction of the articular surface with stability throughout a range of motion. Once the fracture is reduced and stabilized, the knee must be taken through a range of motion to ensure no displacement is observed prior to closure. Postoperatively, the patient is allowed a protected progressive range of motion in a brace, but weight-bearing is allowed only in full extension. Hardwa-re need not be routinely removed[48], but if symptomatic, it can be removed after the fracture has healed and ACL rehabilitation is complete.

Rupture patellar tendon after ACL reconstruction with BT graft is disabling injuries are technically difficult to repair, and the main goal of the treatment is to reconstruct the extensor mechanism in a way which would allow active knee extension. Patellar tendon rupture after ACL reconstruction may occur during the first month after the operation, usually as a result of trauma[23], or it may occur much later, 7 months to 10 years after the procedure, ei-ther as a result of a very strenuous physical activity (strong kick or high jump)[8,18], or without any trauma[19]. In our three patients a rupture of patellar ligament occurred after an average of 10 months (7-12) during the jump, and in one patient in a car accident 60 months after ACL reco-nstruction. One patient received corticosteroids due to the pain in the top of the knee cap.

Etiology of the patellar tendon rupture after ACL reconstruction is multifactorial. Because all of these ruptures occur in a very similar pattern, the reason may be mecha-nical[49]. Lairungruang at al.[50] compared the ultimate load bearing capabilities of the normal patellar tendon (4365.59N) to the patellar tendon after its central third was removed (2226.58N) and concluded that taking out the central third of the patellar tendon reduces both its cross-section area and ultimate load to one half. In cases where more than central

TABLE 2

PATELLAR TENDON RUPTURE AFTER ACL RECONSTRUCTION

Case No	1	2	3	4
Gender	male	male	male	male
Age	19	22	18	23
Knee	left	left	left contralateral	right
sporting activity	handball	football	football	handball
rupture after surgery	7 months	12 months	5 years	12 months
retrun of the sport	6 months	6 months	6 months	6 months
Lyscholm scor	100	85	96	90
Artrometar measurements in mm	2	3	1	2

third of the tendon is taken, the donor tendon might weaken even more than by one half. Abnormal tendon blood supply may be another cause of the rupture. Bonamo et al.[8] hypothesized that the remaining portions of the tendon may be devascularized during graft harvesting, and that the rupture happens as a result of avascular degeneration. Hardin and Bach[23] have further speculated that triangular rather than rectangular bone plugs may have a reduced potential to devascularize the remaining tendon and thus reduce the overall potential for patellar tendon rupture.

The aim of repairing tendon ruptures after ACL reconstruction is the restoration of muscle-tendon complex to its original position, restoration of the quadriceps function, preservation of the reconstructed tendon blood supply, splinting of the patellar tendon and preventing degenerati-ve changes of the patella. Several techniques have been developed in order to solve both the structural and functi-onal components of the problem. Repair of the ruptured patellar tendon after use of its central third for ACL reconstruction is usually performed with the use of suture anchors or sutures that are passed through intraosseous tu-nnels within the patella[8,18]. Hardin and Bach[23] augmented the repair with semitendinosis and gracilis tendon autograft, while Weber et al.[24] used fascia lata autograft for the same purpose. We use BTB allograft for the patellar tendon reconstruction bacuse our good clinical experience in using BTB graft for the reconstruction of the chronic patellar tendon rupture[52]. Burks and Edelson[53] were first to use bone-patellar tendon-bone allograft in repairing the chronic patellar tendon rupture. According to their techni-que, one bone plug was secured with screws to the tibial tubercle, while the other was secured to the patella using "zuggurtung" technique. We patellar bone plug was pre-ss-fitted into the central part of the patella (into the spot where the previous graft was harvested) and fixed with two screws. When Achilles tendon allograft[54,55], is used for patellar tendon replacement, the bony part is fixed to the tibial tubercle with screws, while the tendionuos part is pulled through the tunnel made in the patella. Advanta-ges of using allografts instead of autografts for patellar te-ndon reconstruction are the following: no donor site morbidity; earlier range of motion; and quadriceps strength restoration. The biggest disadvantage of allografts in general is the risk of disease transmission, as well as infection and delayed allograft incorporation.

In our cases, reinforce the tendon repair site with multiple wire loops, which are mechanically stronger than a single wire loop[18,23,24], in order to avoid postoperative casting or bracing[8,19,22] and most importantly allow immediate postoperative mobilization. We removed the wi-res when they broke, which was 6 months after the operation. This period proved to be sufficient for regaining a functional range of knee flexion and for the repaired tissue to regain sufficient strength before wire removal[18].

Postoperatively, it is important not to overload the pate-lla in the first 6 to 8 weeks.The prevention of complicati-ons after reconstruction of anterior cruciate ligament rehabilitation has an important role. When postoperative quadriceps and hamstring muscles are impaired, they allow abnormal patellar mobility, causes increased stress on the graft taken place. An early training of leg muscles with the return of neuromuscular proprioception is important for maintaining the knee stability and reducing the abnormal mobility of the patella.

CONCLUSION

Disruption of the knee extensor apparatus after anterior cruciate ligament reconstruction of the knee can be a serious problem in the total rehabilitation of the patient, and that possibility should be considered during ACL recons-truction. To prevent this complication, taking excessive BTB graft should be avoided; more precise cutting tools should be used, without damage to surrounding tissue, and careful closing of the peritendineuma; and rehabilitation must be carefully dosed. Local use of corticosteroids should be avoided.

Intraoperative fractures should be immediately treated with a firm osteosynthesis, and since they are usually wi-thout significant dislocations, they do not affect the rehabilitation process and the end result of ACL reconstructi-on. Patellar fractures, after ACL reconstruction, without dislocation are generally treated conservatively with imm-obilization; fractures with dislocation are treated by open reposition and internal fixation. Optimal treatment of patellar tendon rupture after ACL reconstruction is the compensation of patellar tendon with BTB allograft with firm fixation, allowing for the continuation of the rehabilitation program.

SUMMARY

KIDANJE EKSTENZORNOG APARATA KOLENA POSLE REKONSTRUKCIJE PREDNJEG UKRŠTENOG LIGAMENTA

Prekid kontinuiteta ekstenzornog aparata kolena posle uzimanja kost- ligamnet čašice- kost kalema je retka komplikacija. Uradili smo 2215 artroskopskih rekonstrukcija prednjeg ukrštenog ligamenta kost - ligamenet čašice - kost kalemom i kod deset pacijenata je došlo do preloma čašice (0.45%) a kod četiri do kidanja ligamnta čašice. Dva pacijenta sa prelomom čašice su lečena neoperativno a osam operativnom repozcijom i ostesintezom. Kod četiri pacijenta sa kidanjem ligamenta čašice (0.18%) rekons-trukcija je izvrešna tehnikom koja je prethodno objavljena sa kost- ligamnet čašice- kost kalemom uzetim iz koštane banke.

Prosecan Lysholm scor je bio 90 (85-100) i svi pacijenti su nastavili sa sportskom aktivnošću. Kod svih je Lachman test bio sa tvrdim zaustavljanjem u poredjenju sa drugom nogom. Radiografske promene su nadjenje kod dva pacijenta koji su imali višedelni prelom čašice.

U prevenciji ovih komplikacija treba izbegavati uzima-nje prevelikog koštanog kalema, koristiti što preciznije instrumente za sečenja, a rehabilitacija mora biti pažljivo dozirana. Optimalni tretman prekida kontinuiteta ekstenzornog aparata kolena posle uzimanja kost-ligamnet ča-šice- kost kalema hirurška rekonstrukcija, čime se omo-gućava nastavljanje rehabilitacionog programa.

Ključne reči: artroskopija, rekonstrukcija prednjeg ukrštenog ligamenta, komplikacija, prelom čašice, kidanje ligamenta čašice

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