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RESULTS OF SURGICAL TREATMENT OF THE PATELLAR TENDON RUPTURE

REZULTATI OPERATIVNOG LEČENJA POVREDA ČAŠIČNE VEZE

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Summary

Introduction. The aim of the study was to report surgical treatment results of complete patellar tendon ruptures reconstructed by different surgical procedures. **Material and Methods.** This study included 35 patients, 26 males and 9 females, with an average age of 39 (range, 16 - 66) years. Seventeen patients had the risk factors (48.6%), including 11 with prior surgeries of the same knee: 7 reconstructions of the anterior cruciate ligament, 3 total knee replacement surgeries, and one intramedullary nailing. In 27 patients (77.1%), the surgery was performed during the first seven days after the injury. The following procedures were applied: patellar tendon repair with suture anchors in 5 cases; 13 transpatellar suturing through transpatellar tunnels; additional strengthening with wires and screws was performed in 7 patients; 7 reconstructions with bone-tendon-bone allograft taken from the bone bank, and in 3 patients contralateral bone-tendon-bone autografts were used. **Results and Discussion.** The average Lysholm score was 86.1 (range, 27 - 100). Excellent results were found in 19 cases (54.2%), satisfactory in 10 (28.6%), and unsatisfactory in 6 patients (17.1%) who had chronic diseases and total knee replacement. The patients with timely diagnosis had significantly better results (90.1) than patients with chronic tendon injuries (72.6 points). **Conclusion.** Good results of acute rupture reconstruction are achieved by transosseous techniques or suture anchors. The surgery is much more complicated in neglected and chronic ruptures, and the results are worse. Surgical procedures, such as the patellar tendon reconstruction by bone-tendon-bone graft, additionally strengthened with wiring and screws, contribute to stable fixation, enable early rehabilitation, and prevent stiffness and muscle weakness. **Key words:** Patellar Ligament; Tendon Injuries; Reconstructive Surgical Procedures; Treatment Outcome; Risk Factors; Lysholm Knee Score; Range of Motion, Articular; Bone-Patellar Tendon-Bone Grafts

Introduction

The patellar tendon is the final connection of the extensor mechanism of the knee. It is basically a ligament, connecting the sesamoid bone (patella)

Sažetak

Uvod. Cilj studije predstavlja prikaz rezultata lečenja kompletnih prekiđa čašične veze, rekonstruisanih različitim tehnikama. **Material i metode.** Studijom je obuhvaćeno 35 pacijenata: 26 muškaraca i devet žena, prosečne starosti 39 godina (16–66). Sedamnaestoro pacijenata je imalo faktore rizika (48,6%), uključujući 11 prethodnih operacija istog kolena, u vidu: sedam rekonstrukcija prednjeg ukrštenog ligamenta, tri ugradnje totalne proteze i jednog intramedularnog klina. Kod 27 pacijenata (77,1%) operacija je izvršena u toku prvih sedam dana posle povrede. Šivenje ligamenta i njegovo pripajanje za čašicu ankerima je primenjeno kod pet pacijenata; u 13 slučajeva postavljani su šavovi kroz tunele u čašici; dodatno ojačanje šavova žicom i zavrtanjima vršeno je kod sedam pacijenata; u sedam slučajeva rekonstrukcija je vršena kost–tetiva–kost alograftom uzetim iz koštane banke, a kod tri pacijenta kontralateralnim kost–tetiva–kost kalemom. **Rezultati i diskusija.** Prosečna vrednost Lišolmovog skora iznosila je 86,1 poen (27–100). Odlični rezultati postignuti su kod 19 (54,2%), zadovoljavajući kod 10 (28,6%), a nezadovoljavajući kod šest pacijenata (17,1%) jer su imali sistemska oboljenja ili raniju ugradnju totalne proteze kolena. Pacijenti čija je povreda pravovremeno dijagnostikovana imali su značajno bolje rezultate (90,1) od operacije hroničnih slučajeva (72,6 poena). **Zaključak.** Zadovoljavajući rezultati svežih ruptura postižu se rekonstrukcijama uz pomoć transosealnih šavova ili ankera. Kod previdenih i hroničnih slučajeva, operacija je znatno komplikovanija a rezultati lošiji. Operativne tehnike, poput supstitucije ligamenta kost–tetiva–kost kalemom, koji se dodatno ojačava žicama i zavrtanjima, doprinose stabilnoj fiksaciji, omogućavaju ranu rehabilitaciju i preveniraju kontrakturu i atrofiju mišića.

Gljučne reči: tetiva čašice kolena; povrede tetive; rekonstruktivne hirurške procedure; ishod lečenja; faktori rizika; Lišolmov skor; obim pokreta zgloba; kost–tetiva–kost kalem

with another bone (tibial tubercle), but also a tendon, because the strong quadriceps muscle ends with it in the tibia. A patellar tendon rupture is the third most common injury of the extensor mechanism, right after patella fracture and quadriceps

Abbreviations

ACL	– anterior cruciate ligament
MRI	– magnetic resonance imaging
BTB	– bone-tendon-bone
N	– Newton
BPTB	– bone-patellar-tendon-bone

tendon rupture [1–4]. A current study [1] that followed 230 middle aged people (on average 44 years old), without symptoms associated with the knee joints, concluded that as much as 97% of them had asymptomatic magnetic resonance imaging (MRI) verified lesions of the following structures: 30% of menisci, 57% of cartilage, 21% of tendons and 3% of ligaments [1]. Moderate lesions of patellar tendon were found in 11% of knee joints, and serious asymptomatic lesions in 2% of all cases [1].

A patellar tendon rupture most often occurs at patellar insertion or its middle part [4–6]. In younger patients it occurs due to repeated microtrauma and as a result of taking out the medial part of the tendon during anterior cruciate ligament (ACL) reconstruction procedure, or after intramedullary nailing [5, 7, 8]. However, this injury is a result of degenerative changes in the tendon, corticosteroid infiltration, knee prosthesis and systemic diseases in older patients [6, 7, 9, 10].

The patellar tendon rupture is diagnosed by symptoms such as pain, palpable infrapatellar defect, inability to extend the knee against gravity, too high position of patella (confirmed by lateral radiography) as well as by ultrasonography and MRI in less obvious cases, such as partial ruptures and associated injuries [1].

Patellar tendon ruptures, especially chronic and neglected ones, are technically difficult to repair and the main goal of treatment is to reconstruct the extensor mechanism to allow painless full range motion of the knee joint, regain the muscle strength and non-restricted everyday activities. However, there is still a dilemma about an optimal surgical procedure, choice of implants, duration of wearing a cast, and rehabilitation procedures [5, 11]. Therefore, the aim of this study is to present our results of surgical treatment of the ruptured patellar tendon and to determine if there is a significant difference between the results among the patients with and without risk factors, as well between acute and chronic reconstructions.

Material and Methods

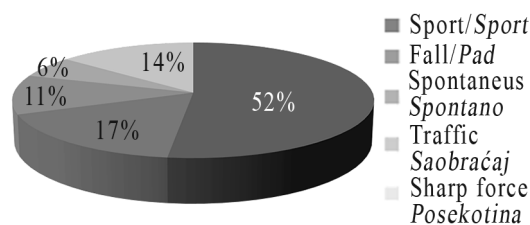
This retrospective multicentric study was performed at the Clinic of Orthopedic Surgery and Traumatology of the Clinical Center of Vojvodina, and at the General Hospital Subotica, with the prior approval of the Ethics Committee. In the period from 2008 to 2018, there were 52 patients with a complete patellar tendon rupture who underwent surgery. This study included 35 of them, who volunteered to complete a questionnaire available on the internet [12] and had X-rays of their knee and measurements of

the range of motion in the operated knee joint and girth of the thigh (10 cm above the patella). The average follow up was 4 years (range, 2 – 10).

The study included 26 males (74%) and 9 females (26%), with an average age of 39 (range, 16 – 66) years, among whom there was one case with a bilateral patellar tendon injury. The left knee was injured in 20 cases, the right in 16. The main cause of injury was a sport related activity (51.6%), because 15 athletes, mainly male, experienced a trauma during jumps (8 in basketball, 4 in soccer, 3 in handball), and three patients during weight lifting. Other causes were falls from a height in 6 patients, sharp objects causing bleeding wounds in 5 cases, old patients had four injuries with no serious trauma, and two ruptures happened in traffic accidents (**Graph 1**). A subgroup included 7 patients, 6 males and 1 female, aged between 18 and 25 years, with prior ACL reconstruction with complications of patellar tendon rupture.

The participants were divided into two groups, a group with risk factors and a group without them (**Table 1**). Risk factors for patellar tendon rupture were found in 17 patients (48.6%). Chronic diseases were registered 8 times, 11 patients had former operations of the same knee joint, and three athletes had chronic tendinitis (one of them received a local corticosteroid therapy). Present comorbidities were as follows: two cases with diabetes, secondary hyperparathyroidism, rheumatoid arthritis, gout, and renal failure, each in one patient. Eleven patients with a predisposition for tendon rupture underwent the following surgeries: anterior ligament reconstruction (7), total knee prosthesis (3), and intramedullar nail that migrated proximally into the tendon after tibial fracture management (1).

The injury was diagnosed on time and the surgery was performed within the first seven days in 27 patients (77.1%). Different surgical procedures were used: surgical repair of 5 tendons with nonabsorbable Bunnell or Krackow-type sutures fixed with anchors; 13 repairs with sutures through patellar tunnels (**Figure 1**), and 17 cases with additional wires and screws placed through the tibial tubercle (**Table 2**). In eight cases (22.9%) the surgery was not performed in the acute phase (between 3 weeks and 2 months after the injury), so due to tendon proximal retraction, we used contralateral bone-tendon-bone (BTB) autograft, or BTB allograft



Graph 1. Causes of patellar tendon rupture
Grafikon 1. Uzroci povrede čašične veze

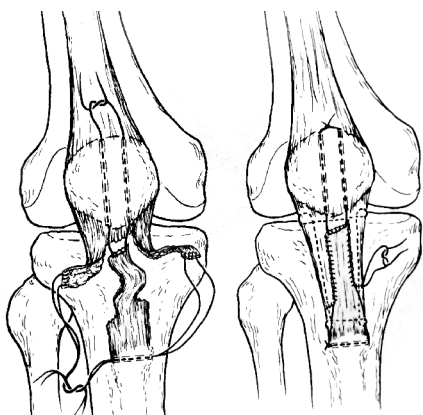


Figure 1. Surgical repair of acute patellar tendon rupture
Slika 1. Operativna tehnika akutne ruptуре ligamenta patele

from the bone bank, with augmentation using wires and screws [6] (**Figure 2**).



Figure 2. Lateral X-ray of a knee after chronic patellar tendon reconstruction with BTB graft, wires and screws [8]
Slika 2. Profilni rendgenski snimak kolena nakon rekonstrukcije hronične ruptуре ligamenta patele KTK (kost-tetiva-kost) kalemom, žicama i zavrtnjima [8]

All patients with acute ruptures wore their orthosis for three weeks, in order to reduce pain and swelling, because they underwent passive exercises from the second postoperative day, with partial weight-bearing. Postoperatively, the knee joint was immobilized for six weeks with delayed partial weight-bearing in patients with chronic rupture surgery. All of the patients underwent at least a three-month rehabilitation protocol.

The results were based on the average Lysholm score [13], which takes into account pain, swelling, instability, weight-bearing, climbing stairs, limping and squatting. Postoperative outcome was rated excellent in the range from 90 to 100 points, satisfactory from 80 to 89 points, and poor below 79 points. This scale was also used to compare the results between different patient groups and surgical procedures. The difference in volumes of the left and the right thigh exceeding 2 cm indicated hypotrophy of the quadriceps muscle.

Seventeen patients who did not respond to the invitation or did not want to fill the questionnaire were excluded from the study. The exclusion criteria were also partial rupture of this tendon and improper rehabilitation.

The results were statistically analyzed by Student's T-test and presented in tables and graphs. The values of $p < 0.05$ were considered statistically significant. Some of the surgical procedures were shown in figures.

Results

The highest Lysholm score was 100 points, the lowest 27, and the average score was 86.1 points. A statistically significant difference was found between the group of patients with chronic diseases and prior surgeries, with an average of 79.0 points, in comparison to the group without risk factors who scored 92.1 points ($p = 0.0197$; $p < 0.05$). The best results were found in patients with acute ruptures without risk factors, and the worst in two patients with chronic ruptures that had infection after total knee replacement with prosthesis, and a patient on dialysis (**Table 1**).

According to the Lysholm scale, 19 patients had excellent postoperative results (54.2%), 10 achieved satisfactory (28.6%), and all of the 6 patients with unsatisfactory (17.1%) results were in the group with chronic diseases and prior total knee replacement.

Twenty one patients (60.0%) returned to the activities of daily living without reduction, whereas in 14 (40.0%) the activities were reduced or modified.

Table 1. Average results among different types of injuries and patient groups
Tabela 1. Prosečni rezultati između različitih vrsta povreda i grupa pacijenata

	No/Br.	Average Lysholm score/Prosečni Lišolm skor
Acute ruptures/Sveže povrede	27	90.1
Chronic ruptures/Zastarele povrede	8	72.6
With risk factors/Prisustvo faktora rizika	16	79.0
Without risk factors/Odsustvo faktora rizika	19	92.1
Total/Ukupno	35	86.1

Table 2. Comparison between results of different surgical procedures
Tabela 2. Poređenje rezultata različitih operativnih tehnika

Surgical procedures <i>Operativna tehnika</i>	Number of patients <i>Broj pacijenata</i>	Average Lysholm score <i>Prosečni Lišolm skor</i>
Sutures with anchors/ <i>Ankerisani šavovi</i>	5	84.2
Sutures through patella/ <i>Šavovi kroz čašicu</i>	13	86.0
Sutures with wires and screws/ <i>Šavovi sa žicom i zavrtnjem</i>	7	92.4
BTB allograft + wires + screws/ <i>KTK alokalem + žice + zavrtnji</i>	7	88.7
BTB autograft + wires + screws/ <i>KTK autokalem+ žice + zavrtnji</i>	3	68.6

Legenda: KTK – kost-tetiva-kost

The patients with timely diagnosis, within 7 days after injury, had better results (90.1 points) than those with a chronic tendon tear (72.6 points) ($p = 0.008$; $p < 0.01$).

The surgical procedures used in the treatment of acute ruptures showed better average results than more complicated and technically demanding reconstructions with grafts and implants (87.0 versus 81.8 points) ($p < 0.05$) (Table 2). The transpatellar technique showed slightly better average results in acute repairs than anchor technique (86.0 vs. 84.2). The only group that achieved an excellent average result of 92.0 points included all the 7 patients with acute rupture. We used transpatellar sutures with wires and screws in these cases.

A subgroup including 7 patients with prior ACL reconstruction showed an average score of 88.7 points (80 - 100), and all of the athletes successfully returned to sports activities. Four athletes returned to sports activities after 6 months, one after 8, and two 12 months after the patellar tendon surgery.

One patient with a former tibial osteosynthesis showed a satisfactory result scoring 85.0 points, while the subgroup with prior arthroplasty scored significantly poorer with 51.7 points on average, and there were two cases with unsatisfactory results.

Thirteen patients (37.1%) had a thigh muscle hypotrophy, associated with limited range of motion in eight cases. Our participants had no serious complications such as rerupture, but two of them with total knee arthroplasty had infections.

Out of 17 cases where wires and screws for strengthening was performed, in 12 (71.0%) the fixation material was extracted three months after the surgery on average, especially in case of wire breakage, over tightening the implants, or they protruded under the skin.

Discussion

In contrast to quadriceps tendon injuries, which usually occur in population older than 40 years [2, 3, 14], patellar tendon is mainly injured in males under the age of 40 [14–17]. This was confirmed in our sample as well. When we analyzed patients with former ruptures of the quadriceps tendon, the average age was 54 years [2, 3], while the mean age in our sample was 39. Complete rupture of the patellar tendon is very rare [1, 4, 8]. We annually have 5 operatively treated cases

in the population of 800.000 citizens covered by two institutions. That is in line with an average incidence of 0.68 annual ruptures in 100.000 citizens [1]. The main cause of the patellar tendon injury is athletic trauma [14–18] during landing or stumbling, when the quadriceps muscle contracts eccentrically while the knee is flexed [18], thus more than a half our patients were injured during sports activities. The most common mechanism of injury was basketball landing (47% in a greater study) [14], followed by soccer injuries and weight lifting.

The knee extensor mechanism injuries occur due to overuse, during direct trauma or in iatrogenic way [2, 3, 6–8]. An unchanged patellar tendon has a substantial strength and the average force needed for its rupture is 4366 Newtons (N) [18], but measured forces that affect it during sports activities, that include sudden deceleration after landings or weight lifting, range between 8 and 10 thousand N [19]. The tendon load is maximal at its insertions where collagen fibers are tougher, during active extension when the knee is at an angle of 60 degrees with a planted foot. Repetitive micro-injuries leading to tendon weakness usually precede the rupture. Ruptures of the patellar tendon can occur secondary to trauma, in association with systemic diseases [2, 8, 9], after total knee arthroplasty [20–22] or ACL reconstruction [5, 7, 8, 23], as a late complication of tibial nailing [24, 25], or after local corticosteroid or anabolic administration and redressement force under an anesthetic [4, 6]. In case of associated systemic diseases, which lead to collagen weakness, such as rheumatoid arthritis, diabetes, chronic renal insufficiency or secondary hyperparathyroidism, the patellar tendon rupture may occur even without a significant trauma [6, 9]. Described risk factors also include Osgood-Schlatter's osteochondrosis and systemic lupus erythematosus [10]. Nowadays, anabolic steroid and fluoroquinolone use is also associated with increased risk for tendons [26]. It is well documented that ciprofloxacin can cause rupture of Achilles tendon, rotator cuff, biceps, wrist extensors, quadriceps muscle, even bilateral rupture of patellar tendon in a young person without risk factors [26]. Almost half of our patients had some of the mentioned risk factors. One of them received local corticosteroids due to the pain in the top of the kneecap ("jumper's knee").

Fresh ruptures should be repaired immediately, if skin conditions are optimal. Preoperatively, the Insall-

Salvati ratio of the contralateral knee serves as a baseline to restore the patellar height of the operative knee. The length of patella and its tendon should be equal (4–5 cm) to avoid patella baja and patella alta [27]. In 12 cases we drilled four 3 mm tunnels vertically through the patella and placed mattress sutures through the proximal end of the tendon drawing it securely to the inferior pole of patella. Afterwards, the sutures were tightened over the superior part of patella. If secure fixation cannot be obtained with this method, some techniques use augmentation with semitendinosus or gracilis tendon autografts. It is also important to pay close attention intraoperatively to the tension of the suture to allow 90 to 100 degrees of passive flexion [28]. We agree with the authors, Shelbourne et al., who suggest that knee immobilization is necessary only for two weeks to achieve 90 degrees of flexion. After four weeks of rehabilitation, flexion is 110 degrees, after three months it is 130 degrees, and after 6 months 140 degrees is achieved [28]. They used augmentation of the repair with special cable placed through the patella and tibial tubercle and tensioned it at 60 degrees of flexion, to prevent rerupture, but provide immediate postoperative movements. With this aggressive rehabilitation protocol, all of their 12 patients had returned to their previous levels of activity [28]. We have also registered excellent results in acute ruptures (90 points on average). In contrast, earlier views that have been overlooked claimed that braces should be removed six weeks after the surgery of acute rupture of patellar tendon [29].

It was thought that chronic ruptures are more than 6 weeks old [4] and the majority of authors moved the timing for safe surgery forward into the first two weeks after the injury [5, 8, 23, 27]. When a rupture is more than 6 weeks old, the soft tissues undergo irreversible changes, the patella is retracted proximally 3–5 cm and may require extensive surgical release of scar tissue and quadricepsplasty [29–31]. There are many techniques described in literature used to repair chronic patellar ruptures. Some use hamstring tendon autografts [32], some Achilles tendon grafts [24, 26, 27], some, like we did, a BTB grafts [5, 8, 23]. Some techniques reconstruct the neglected rupture with Z-shaped shortening of patellar tendon and Z-lengthening of quadriceps tendon to achieve adequate length of extensor mechanism [33]. In comparison to patellar tendon, there are no significant differences in outcomes related to the timing of ACL reconstruction [34], but in case of patellar tendon surgery, the time of reconstruction is an important factor for the final outcome.

The postoperative rehabilitation after chronic rupture surgery usually differs from more aggressive rehabilitation in acute injuries [23, 27]. That may be the reason why the results are not so good. In chronic ruptures, casts are removed usually after 6 weeks [4, 8, 29, 33] when active and passive exercises begin.

Cases of bilateral patellar tendon rupture are very rare, published mainly as case reports [4, 6, 8, 15–17, 26]. Since bilateral patellar tendon rupture is often unrecognized (up to 28% of cases) [29], it causes delays in diagnosis and treatment, because it is often nontraumatic and misdiagnosed with paraplegia. We

also had a patient with bilateral rupture who had been on long-term hemodialysis due to renal insufficiency. The final outcome was unsatisfactory, due to comorbidities and late diagnosis. In this case we used BTB allograft augmented with wires [8], while the length was determined on profile X-ray of the patient's uninjured knee (Insall-Salvati ratio). O'Dowd et al. followed 361 patients, 13 with bilateral repairs, with an incidence of 5.8% [14].

Anterior knee pain is the most common complication after tibial nailing. Its occurrence has been reported in 30 to 47% of cases, particularly in young and active patients [24, 25]. The choice of surgical approach, transpatellar or parapatellar, has been reported as a contributory factor for knee pain after nail insertion. The parapatellar approach is suggested, when patellar tendon and well vascularized retropatellar fat pad are retracted. Bad choice of proximal entry point in the tibial plateau and possible proximal migration of the nail, damaged the patellar ligament in one of our patients. Removal of the nail and suturing led to a satisfactory result.

Rupture of the patellar tendon may also occur after total knee arthroplasty. This serious postoperative complication happens in 0.17 to 0.55% of cases [20–22]. Intraoperative factors include over-resected patella, improper lateral release, too big components, and patellar maltracking [2, 20–22]. Postoperatively, a trauma may be the result of a revision procedure, with necessary appropriate extensile exposures. This increases the chances for infection and soft tissue adhesion [20–22]. Autografts and allografts (from the bone bank) are usually used in such cases, mostly Achilles tendon or BTB allograft [8, 23, 27]. In chronic ruptures, it is important to determine the length of allograft, because a too short leads to lack of flexion and too long results with lack of extension [35]. The results of direct repair of extensor mechanism failure are dismal (up to 90% unsatisfactory) because older population with knee replacement has a poor quality of tendon fibers [20, 21]. We had only one good outcome in three patients. Reconstructions with grafts can replace the retracted patella up to 3 cm distally [21, 22]. However, a large series of reported extensor allografts showed reasonable results after this complication of total knee arthroplasty in a group of 36 patients [36]. These patients were extremely challenging, because one third of them had previous infections. Eight patients had reruptures. After repeated revisions, two of them had recurrent ruptures [36]. It is important to perform graft tensioning in full knee extension to avoid failure [36].

A rupture of the patellar tendon after harvesting a BTB autograft occurs very rarely, in 0.1–0.24% of all reconstructions [5, 8, 23, 28]. In 6 of our 7 patients, rupture of patellar tendon occurred 10 months (7–12) after ACL reconstruction on average, during forced jumping. The etiology of patellar tendon rupture after ACL reconstruction lies in devascularization of the tendon during graft harvesting, its avascular degeneration, and because the donor tendon may be mechanically weak when the central third is removed [18]. Experimental measurements have proved

that the remaining two thirds of patellar fibers can absorb only a half of original tendon force, before the rupture (2227 N). We tried to prevent the disruption of the knee extensor apparatus during ACL reconstruction by avoiding harvesting too excessive BTB graft. Precise cutting tools should be used, without damaging the surrounding tissue, and careful closure of the peritendineum. The use of bone-patellar tendon-bone (BPTB) autograft is not recommended if patellar tendinopathy is obvious or there is a suspicion of partial tendon tear. It is known that patellar tendinopathy increases the risk of BPTB graft failure, when used for ACL reconstruction. In such cases, the surgeon should consider using a different graft [37, 38].

The most common surgical treatment of the acute patellar tendon rupture is simple suturing. This method provides lesser morbidity, so other studies also have reported excellent results in the treatment of patients with acute patellar tendon rupture [4, 39]. However, the gold standard for acute patellar tendon repair is transosseous technique, where sutures are passed through bone tunnels in the patella and tied over a bony bridge proximally [14, 28]. But there is a recent study that compared the results between 321 transosseous and 53 anchor repairs that showed that gold standard had 3.24 times the odds of reoperation versus anchor repair [14]. Other studies that followed the complications of anchor technique had reruptures more often (5 – 21%) [40, 41]. Our specimen is ten times smaller, but without reruptures in both groups.

The average operative results depend on the percentage of chronic ruptures in the whole sample, but the majority of them scored between 81 and 90 points according to Lysholm scale [4, 5, 8, 39]. We achieved the similar results with an average of 86 points. Our results of patellar tendon rupture surgery are also similar to quadriceps tendon reconstructions [2, 3], but not as good as the average results of ACL reconstruction, which range between 92 and 95 points [35, 38–41]. The average result of reconstruction of patellar tendon in our 7 patients with BTB graft (**Figure 2**) was almost excellent, with an average of 89 points (80 – 100), so all of them continued with sports activities [23]. Benner et al. [7] also treated 13 ruptures of patellar tendon after prior ACL reconstruction, but with anchors and wires. They achieved full range of motion in 11 of 13 cases (85%) after aggressive rehabilitation. Our results are similar, because 80% of our patients have no knee motion limitations. In our subgroup with prior ACL reconstructions, the results are even better.

An important issue to consider when reconstructing patellar tendon rupture after ACL reconstruction is whether to reinforce the tendon repair site with single or multiple wire loops [8, 23, 28, 42] or use postoperative immobilization instead. We reinforced the tendon repair site with multiple wire loops in 17 cases and secured immediate postoperative mobilization [23, 39]. In 71% of cases, removal of a multiple wire loop was required. Additional operation for removing the tension cerclage wiring is not always necessary, and it is recommended three months after the reconstruction [4, 23].

The most common early complications of patellar tendon surgery are deep venous thrombosis and local infection (both happen on average in 2.5%). The most common late complications are reruptures, that occurred in 6.5% of cases [14], as well as reduced mobility of the patella, low lying patella, limited flexion of the knee, persistent pain, and muscle weakness [4, 30, 31, 40]. The most frequent complication in our study was hypotrophy of the quadriceps muscle, which can be explained by insufficiently aggressive physical therapy in old patients with chronic ruptures. On the other hand, aggressive physical therapy may lead to patellar tendon rerupture, which was not the case in our study.

One of the disadvantages of our study is inclusion of non-uniformed groups. In some cases we compared the results between the young patients with risk factors and results of older patients without risk factors. This study compared the results of reconstructions among, for example, persons older than 40 years with risk factors and the same age group without them. A small sample does not allow proper comparison between transpatellar suturing and anchor technique. A histopathology analysis of the ruptured tendon could provide answers how to improve the strength of patellar tendon, especially in athletes in the fourth decade of life. This could prevent chronic tendinitis and injury. The future studies should follow the development of new surgical procedures, especially those that treat neglected and chronic cases. Some of them could provide more stable fixation, safer and earlier rehabilitation in order to prevent limited range of motion and muscle weakness.

Conclusion

Proper history taking and clinical examination with lateral radiography of a knee joint are sufficient for the diagnosis of complete rupture of the patellar tendon. These factors have a significant effect on the final treatment outcome. Mistakes and negligence in prior surgeries and during the examination can hardly be fixed with a late surgery.

The best surgical results of complete rupture of patellar tendon are achieved if the surgery is performed soon after the injury, in patients without prior surgeries of the same knee and without chronic diseases, no matter which technique is used. Good results of acute rupture repair can be achieved with transpatellar sutures or anchors.

All young athletes with prior surgeries of anterior cruciate ligament successfully achieved the level of former non-restricted activities after the reconstruction of patellar tendon.

Surgery is more complicated in neglected and chronic ruptures and the results are not so good. In these cases, surgical procedures using bone-tendon-bone grafts, taken from contralateral knee or from a bone bank, and augmented with wires and screws, may be successful. Similar surgical procedures provide stable fixation and early rehabilitation, preventing knee stiffness and muscle weakness.

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