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RESULTS OF ARTHROSCOPIC TREATMENT OF CHRONIC PATELLAR TENDINOPATHY

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ABSTRACT

Background: The surgical treatment of chronic patellar tendinopathy could be open or arthroscopic. A general agreement on the best surgical treatment option is still lacking.

Purpose: The aim of our study was to evaluate the clinical results after a minimally invasive arthroscopic treatment of chronic patellar tendinopathy including a resection of the lower patellar pole**.**

Methods: The study included 14 patients with a mean age of 26 years and chronic patellar tendinopathy refractory to non-operative treatment of more than 6 months. All patients underwent arthroscopic debridement of the adipose tissue of the Hoffa's body posterior to the patellar tendon, debridement of abnormal patellar tendon and resection of the lower patellar pole. Preoperative and postoperative evaluation was undertaken using clinical examination, magnetic resonance imaging (MRI) and the Lysholm and Victorian Institute of Sport Assessment-Patella (VISA-P) scores. Return to sports and postoperative complications were also assessed. The mean follow-up was 12.2 ± 0.9 months.

Results: All 14 patients continued with sport activities, but only 12 of them (85.7%) achieved their presymptom sporting level. The median time to return to preinjury level of activity was 3.9 ± 0.8 months. Patients showed a major improvement in the mean Lysholm score from 51.1 ± 3.8 to 93.4 ± 4.2 (p=0.001) and in the mean VISA-P score from 42.1 ± 3.5 to 86.7 ± 8.4 (p=0.001) There were no postoperative complications.

Conclusion: We found that this arthroscopic technique gives reduced morbidity and satisfactory outcome resulting in significantly faster recovery and return to sports in patients with chronic patellar tendinopathy**.**

Keywords: chronic patellar tendinopathy, arthroscopic treatment, clinical results

INTRODUCTION

Patellar tendinopathy is a painful condition of the knee that is mostly localized on the proximal posterior part of patellar tendon. In 1973, Blazina et al. used the term jumper's knee for this condition [1]. As the name implies, the condition is common in athletes performing jumping sports such as basketball, volleyball and track (long and high jump). The prevalence of jumper's knee is higher in elite athletes than in non-elite athletes (14.2% vs. 8.5%) with almost twice higher predominance in males [2, 3]. Although historically it was first believed that jumper's knee was an inflammatory condition

(tendinitis), studies dating back 40 years described jumper's knee as a degenerative condition (tendinosis) [4]. Repetitive mechanical stress from athletic activities which tend to stretch the tendon for more than 5% leads to tendon micro-tearing with occurrence of clefts in collagen structure [5]. As the collagen production by tenocytes has a turnover time of 50 to 100 days, insufficient rest between sporting session shortening the adequate time to repair leads to tenocytes dead, reduced and impaired collagen synthesis, necrosis, degeneration, fibroblast infiltration and neovascularization. Tendon fibroblasts increase the level of prostaglandin E2, leukotriene B4, vascular endothelial growth factor (VEGF) and matrix metalloproteinase (MMP), which contribute to tendon breakdown and tendinopathy (4). Tendinosis is a result of an imbalance between the demands that are placed on a tendon and its ability to remodel.

Although overuse injury and chronic overload of the knee joint extensor mechanism are probably the main causes for chronic patellar tendinopathy, other influencing factors should be considered because there are many athletes who are exposed to the same excessive volume and frequency of training, but they do not develop jumper's knee. Some intrinsic factors of the knee like ligamentous laxity, excessive Q-angle of the knee, abnormal patellar height, impaired flexibility of the extensor muscles and previous ongoing inflammation of the knee can predispose to this pathology [4, 6]. According to the study by Johnson et al. the mechanical impingement and compression of the inferior patellar pole onto the posterior aspect of the patellar tendon in flexion is an important factor in the pathogenesis of jumper's knee [7]. Determining increased tendon thickness of the posterior part of the proximal patellar tendon in the place of impingement with the elongated lower patellar pole, the authors concluded that this was a more compatible mechanism in pathogenesis than in tendon stress overload alone. Analyzing the patellar tendon thickness, the length of the non-articular patellar surface and the ratio between the articular and the non-articular patellar surface Lorbach et al. concluded that chronic patellar tendinopathy in athletes was associated with a longer lower patellar pole [8}. After 6 months of unsuccessful conservative treatment for chronic patellar tendinopathy a surgical treatment is indicated. Open and arthroscopic surgical techniques have been described but the best surgical treatment is still unknown. According to some studies although both surgeries give satisfactory results with success rate over 77%, arthroscopic surgery gives fewer complications and faster return to sport activities [9]. Considering the knowledge about the pathogenesis of patellar tendinopathy until today, most authors [10–15] recommend resection of the prominent lower patellar pole in addition to the obligatory debridement of soft tissue at the lower patellar pole. However, there are also authors who present satisfactory results only with arthroscopic debridement of the adipose tissue and abnormal patellar tendon targeting the area with neovessels and nerves on the dorsal side of the patellar tendon [6, 16–19].

The aim of our study was to evaluate the clinical results after minimally invasive arthroscopic treatment of chronic patellar tendinopathy including a resection of the lower patellar pole.

PATIENTS AND METHODS

Patient selection

The study was prospective and included 14 patients (12 men and 2 women) with a mean age of 26 years (range 16 to 34 years). Seven of the patients were volleyball players, six were basketball players and one was soccer player, all competing on national level. All included patients had refractory chronic patellar tendinopathy and a previous unsuccessful conservative treatment of patellar tendinopathy for more than 6 months. Six of the patients were treated with rest, non-steroidal anti-inflammatory drugs and eccentric quadriceps exercises, five of them were treated with shockwave therapy and tree patients were treated with platelet-rich plasma application. Patients with previous patellar tendon surgery, rheumatic, degenerative and metabolic knee diseases and additional knee injury (meniscal tears, osteochondral injuries, ligament insufficiency reconstruction) were excluded from the study. Patients with Q angle > 20°, a genu valgum > 7°, trochlear angle > 145° at the skyline view and patella alta (Insall–Salvati index > 1.2) were also excluded from the study because of the necessity of combined surgical treatment in these patients.

Prior to surgery, from all patients a detailed history was taken and a standardized clinical examination was performed in order to confirm patellar tendinopathy and exclude other conditions like patello-femoral pain syndrome and Hoffa impingement. Radiographic assessment included conventional radiographs and magnetic resonance imaging (MRI) in order to exclude other intra- and extraarticular copathologies and to make preoperative evaluation of the patellar tendon and infrapatellar fat pad tissue as well as patella bone position and morphology.

Preoperative MRI evaluation of the patellar tendon and surrounding tissues was conducted utilizing T1, T2, and proton density-weighted sequences. Standardized MRI evaluation included assessment of the length of the non-articular lower patellar pole surface, bone marrow edema of the lower patellar pole, thickness and edema of the proximal patellar tendon and proximal Hoffa fat pad edema (Figure 1). In some studies [8, 20] edema was identified by detecting an increased signal intensity compared to the signal of the same surrounding tissue; thickening of the proximal patellar tendon was noted if it showed a non-harmonic swelling compared to the distal part of the tendon exceeding a diameter of more than 7 mm and the length of the non-articular lower patellar pole surface was taken as abnormal if it was longer than 9 mm. Preoperatively all patients completed the questionnaire and the Lysholm and the Victorian Institute of Sport Assessment (VISA-P) knee scoring system were used for the assessment of the preoperative knee condition. VISA-P scale was studied specifically to assess symptoms and functionality in patellar tendinopathy, with good inter- and intra-observer reliability and stability [21]. All patients were operated in the period from January 2016 to March 2019 at the University Clinic for Orthopaedic Surgery in Skopje by the same orthopedic surgeon and the same postoperative rehabilitation protocol was implemented in all of them by the same physiotherapist. All patients preoperatively voluntarily signed a document for informed consent.

Figure 1. *Sagittal MRI view of the knee in T2 sequence showing longer non-articular lower patellar pole surface, increased thickness and increased signal intensity (edema) of the proximal patellar tendon and proximal Hoffa fat pad edema*

Surgical technique and rehabilitation

Surgery was performed in regional (spinal) anesthesia using tourniquet placed in the upper thigh and a thigh holder to obtain leg position. Each intervention started with an arthroscopic inspection of the knee joint through regular medial and lateral portals to rule-out any other joint pathology. Then, a low anteromedial accessory portal was made established beneath the patella directly next to the patellar tendon in order to obtain better approach to the distal patellar pole and to the proximal-posterior patellar tendon. For better orientation and adequate identification of the lower patellar pole and insertion of the patellar tendon, the lower patellar pole was marked with a needle (Figure 2). Debridement of the inflamed soft tissue from the proximal Hoffa fat pad and careful resection of the most degenerated posterior fibers of the patellar tendon next to the lower patellar pole was done using synovial resector (Figure 3). Electrocautery device was used to make cauterization of the persistent neovessels (Figure 4). In patients with a prominent lower patellar pole and changes in signal intensity within the lower patellar pole on MRI, resection of the lower patellar pole was performed in a step-by-step manner with arthroscopic burr (Figure 5). The resection was done carefully under arthroscopic control to avoid over- or under-resection of the lower patellar pole and electrocautery device was used to obtain smooth surface without bone peaks on the surface of the resected lower patellar pole. Surgery was finished with a lavage of the knee joint and wound closure using nonabsorbable suture.

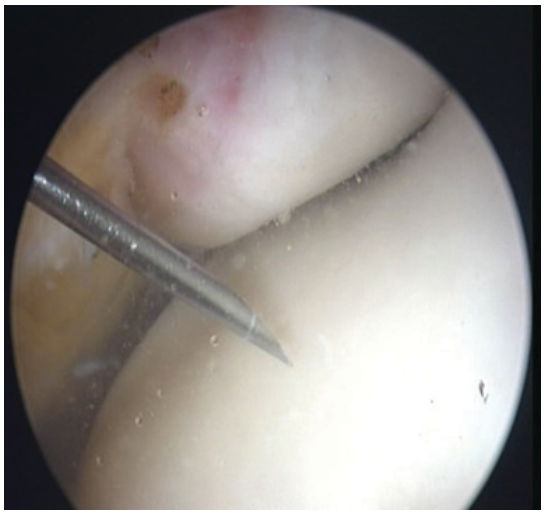

Figure 2. *Marking the lower patellar pole and superior insertion of the patellar tendon with needle (arthroscopic view)*

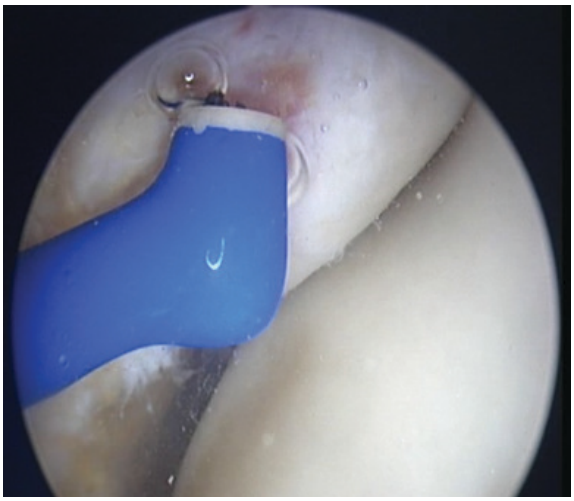

Figure 3. *Cauterization of the neovessel from the proximal Hoffa fat pad and degenerated patellar tendon fibers directly beneath the lower patellar pole with an electrocautery device (arthroscopic view).*

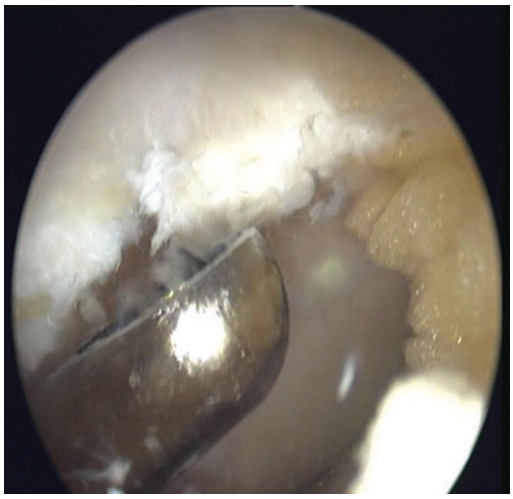

Figure 4. *Debridement of soft tissue from the proximal Hoffa fat pad and degenerated patellar tendon fibers next to the lower patellar pole using synovial resector (arthroscopic view).*

Figure 5. *Resection of the lower patellar pole with an arthroscopic burr (arthroscopic view).*

Rehabilitation protocol: The knee was immobilized with a knee brace in extension for 3-4 weeks depending on the degree of excision of patellar tendon fibers. The brace was taken only for passive range of motion exercises. Motion was gradually and partially restored until the fourth postoperative week, hence knee flexion more than 90 degrees and full weight bearing on the operated leg was allowed 4 weeks after the surgery. Gradual return to unrestricted competition was advised after the 8th postoperative week.

Follow-up

The mean follow-up was 12.2 ± 0.9 months. A detailed history was taken from all patients in order to assess the persistence of knee pain, the level of sports activities and the number of months until athletes were able to perform specific exercises without any or minimal pain. In all patients a standardized clinical examination (palpation of the lower patella pole and the area between the lower pole of the patella and the patellar tendon, one legged stance test and light squats) was performed to find out if there were still persisting symptoms of patellar tendinopathy. Postoperative MRI was done in 5 patients. All patients completed the questionnaire and scores from both, the Lysholm and the VISA-P knee scoring system were used for the assessment of the postoperative outcome.

Statistical analysis

For the statistical analysis, SPSS 12.0 software was used. All data were expressed as mean ± standard deviation. Comparison between preoperative and postoperative values was performed with paired-sample t-test and Wilcoxon paired difference test. Statistical significance was defined as p-values < 0.05.

RESULTS

All patients were classified as stage III tendinopathy according to the Blazina staging system. Magnetic resonance imaging evaluation prior to surgery showed that 11 of the 14 patients (78.6%) had longer (> 9 mm) non-articular lower patellar pole surface, 2 of the 14 patients (14.3%) had bone marrow edema of the inferior patellar pole, 13 of the 14 patients (92.9%) had thickness (> 7mm) and edema of the proximal patellar tendon and

9 of the 14 patients (64.3%) had proximal Hoffa fat pad edema. After the surgery, MRI was done only in 5 patients so because of the small number of examined patients we did not perform postoperative MRI evaluation in these patients. After the surgery mild to moderate pain and tenderness over the proximal attachment of the tendon was found in 2 of the 14 patients (14.3 %). No patient complained of pain and tenderness along the middle and distal part of the patellar tendon. All 14 patients continued with sport activities, but only 12 of them (85.7%) achieved their presymptom sporting level. The median time to return to preinjury level of activity was 3.9 ± 0.8 months. Two of the 14 patients (14.3%) were forced to change to low-impact sports because of the persistence of knee pain during the previous sporting level. At the final follow-up, patients showed a major improvement in the mean Lysholm score from 51.1 ± 3.8 to 93.4 ± 4.2 (p=0.001) and in the mean VISA-P score from 42.1 ± 3.5 to 86.7 ± 8.4 (p=0.001) (Tab. 2). There were no postoperative complications like knee infections or stiffness neither identified deep vein thrombosis in the operated patients.

Table 1. *Preoperative MRI findings in patients with patellar tendinopathy*

Patient number	Non-articular inferior patellar pole surface > 9 mm	Bone marrow edema of the inferior patellar pole	Proximal patellar tendon thickness >7 mm	Proximal patellar tendon edema	Hoffa fat pad edema
1	yes	no	yes	yes	yes
2	yes	no	yes	yes	yes
3	no	no	no	no	no
4	yes	no	yes	yes	yes
5	no	no	yes	yes	no
6	yes	yes	yes	yes	yes
7	yes	no	yes	yes	no
8	yes	yes	yes	yes	yes
9	no	no	yes	yes	no
10	yes	no	yes	yes	yes
11	yes	no	yes	yes	yes
12	yes	no	yes	yes	no
13	yes	no	yes	yes	yes
14	yes	no	yes	yes	yes
Total number with positive MRI	11	2	13	13	9

Table 2. *Follow-up time, period to return to sport after surgery and functional outcome scores*

Patient number	Follow-up (months)	Return to sport after surgery (months)	Preoperative Lysholm score	Postoperative Lysholm score	Preoperative VISA-P score	Postoperative VISA-P score
1	12	3	55	98	44	94
2	13	4	52	94	42	90
3	12	5	46	88	38	70
4	14	3	53	99	48	94
5	13	4	54	93	44	88
6	12	5	44	86	36	74
7	11	5	48	88	38	76
8	11	3	54	98	46	94
9	13	3	56	97	42	94
10	12	4	52	94	44	88
11	11	4	48	92	40	90
12	13	5	50	90	40	78
13	12	3	48	95	46	92
14	12	4	56	96	42	92
Mean (SD)	12.2 ±0.9	3.9 ± 0.8	51.1 ± 3.8	93.4 ± 4.2	42.1 ± 3.5	86.7 ± 8.4

DISCUSSION

In 90% of the patients with patellar tendinopathy the conservative treatment gives good results, but 10% of them remain unresponsive to conservative treatments and surgery is required. Higher recurrence rates that have been observed after conservative treatment especially in professional athletes (12%-27%) lead to interruption of exercise and a premature end of the career [22}. In general, surgery is indicated in patients with chronic patellar tendinopathy unresponsive to a minimum of 6 months of conservative treatment. Although surgical treatment of patellar tendinopathy in general gives satisfactory results, two dilemmas are still persistent: open or arthroscopic surgery should be preferred to achieve better clinical results and whether resection of the lower patellar pole during the surgery is required or not? Unfortunately, there is still no consensus on the best surgical treatment for chronic patellar tendinopathy. According to the published studies both surgeries give satisfactory results with success rate of more than 77% but arthroscopic surgery gives fewer complications, faster return to preinjury level of sport activities and a non-significant higher success rate [12, 14, 23–26]. Multiple tenotomies and excision of a portion of the tendon can theoretically decrease mechanical properties of the tendon prolonging the patient's return to full function and sports, especially when dealing with athletes, who expect to gain an excellent result to compete at a high level and to practice daily with infrequent rest increasing the risk of failure. The lack of prospective randomised controlled trials, poor methodology of study design and the large number of different techniques implies that no single technique is superior and limits the significance of the related studies. Another issue that is under question is the necessity of resection of the lower patellar pole during the arthroscopic surgery. Although according to some authors [7, 8] it is assumed that a longer non-articular inferior patellar pole might be a risk factor for the onset of patellar tendinopathy because of the impingement between these two structures in knee flexion, others consider that rather chronic overload than bony impingement is the main risk factor for the development of patellar tendinopathy [27]. Having in mind the previous knowledge about the pathogenesis of patellar tendinopathy, most surgeons except debridement of the inflamed soft tissue from the proximal Hoffa fat pad and degenerated posterior fibers and neovascularizations of the patellar tendon next to the lower patellar pole, they also prefer resection of the lower patellar pole during arthroscopic surgery [10–15]. There is another group of surgeons who prefer soft tissue procedures including resection of neovascularizations and denervation of the area around the patella's inferior pole but without resection of the lower patellar pole during arthroscopic surgery [6, 16–19]. According to the multifactorial model of the etiopathogenesis [15], which involves tendon's collagen tissue breakdown, increased neovascularity and neoinnervation in the painful degenerated proximal tendon tissue areas, development of sensitive nociceptors in the infrapatellar fat body and impingement of the proximal tendon and the Hoffa fat pad on the inferior pole of the patella, both procedures can be performed giving satisfactory results. That is why a good clinical and radiographic assessment including conventional radiographs, ultrasonography and MRI should be performed before the surgery. Although sometimes it is complicated to predict, good MRI evaluation and interpretation is crucial in these patients when decision about the type of arthroscopic treatment should be made. Typical MRI findings of increased length of the non-articular lower patellar pole surface with persistent bone marrow edema in it, thickening and edema of the proximal patellar tendon and proximal Hoffa fat pad edema show that resection of the lower patellar pole during arthroscopic surgery is probably required. Lorbach et al. [8 presented significant changes in tendon thickness (9.42 ± 2.87 vs. 4.88 ± 1.13; $P < 0.0001$) and a longer non-articular inferior surface of the patella (10.62 ± 2.86 vs. 7.098 ± 2.53; $P < 0.0001$) in a group of patients with patellar tendinopathy concluding that resection of the lower patellar pole is required [10]. According to some studies [8, 20], patients who have thickening of the proximal patellar tendon exceeding a diameter of more than 7 mm and the length of the non-articular lower patellar pole surface longer than 9 mm could be candidates for arthroscopic resection of the lower patellar pole. In our study 78.6% of the patients had longer non-articular lower patellar pole surface, 92.9% had thickness and edema of the proximal patellar tendon and 64.3% had proximal Hoffa fat pad edema. Thus, in addition to debridement of the inflamed soft tissue from the proximal Hoffa fat pad and careful resection of the degenerated posterior fibers of the patellar tendon and neovascularizations next to

the lower patellar pole, we also performed a resection the lower patellar pole during arthroscopic surgery. Possible risks of this technique were the under- or over-resection of the lower patellar pole or a significant damage to the main fibers of the proximal patellar tendon resulting in rupture of the proximal patellar tendon or bony avulsion of the distal patellar pole. Residual overlooked small bone peaks in the anterior part of the lower patellar pole can also lead to treatment failure. Although bony resection of the lower patellar pole did not significantly extend the surgery time, we performed the surgery carefully to avoid previous complications.

Our study presents the middle-term results after surgical treatment of patellar tendinopathy with a 1- year follow-up. They showed that this arthroscopic technique, which includes resection of the lower patellar pole shows excellent clinical results, providing a fast return to sporting activities in patients with chronic patellar tendinopathy. Our results correspond with the results of some previous studies regarding the presented median time to return to preinjury level of sport activity [6, 10, 13–17, 19], the presented percentage of patients who continue with the preinjury level of sport activities without knee pain [13–19, 23, 26], the presented median scores of Lysholm [10, 13–15] and VISA-P [6, 14, 15, 17, 19, 26] scales and the presented incidence of postoperative complications [14, 15].

The lack of a control group included in the study, the small number of patients with a weak statistical significance, the short follow-up after the surgery and the absence of postoperative MRI are the weaknesses of our study. However, our study has some advantages such as the prospective study design with well-defined inclusion and exclusion criteria, homogenous group of patients (young age, athletes, same grade of tendinopathy) and standardized algorithms for surgery, rehabilitation and outcome assessment.

CONCLUSION

We found this arthroscopic technique, which includes resection of the lower patellar pole as a minimal invasive and safe technique that gives reduced morbidity and satisfactory outcome resulting in significantly faster recovery and return to sports. We especially recommend this surgical technique to be applied in highly active athletes with longer lower patellar pole where its resection can avoid a relapse of symptoms and treatment failure.

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Резиме

РЕЗУЛТАТИ ПО АРТРОСКОПСКИ ТРЕТМАН НА ХРОНИЧНА ПАТЕЛАРНА ТЕНДИНОПАТИЈА

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Вовед: Хируршкиот третман на хронична пателарна тендинопатија може да биде отворен или артроскопски. Сè уште не постои заедничка согласност во однос на изборот на најдобар хируршки третман.

Цел: Целта на нашата студија беше да се евалуираат клиничките резултати по минимално инвазивен артроскопски третман на хронична пателарна тендинопатија вклучувајќи и ресекција на долниот пол од пателата.

Методи: Во студијата беа вклучени 14 пациенти со средна возраст од 26 години и хронична пателарна тендинопатија рефрактерна на неоперативен третман подолг од 6 месеци. Кај сите пациенти беше извршен артроскопски дебридман на Хофиното масно перниче позади пателарната тетива, дебридман на оштетената пателарна тетива и ресекција на долниот пол од пателата. Предоперативната и постоперативната евалуација беше направена преку клинички преглед, снимање на магнетна резонанца и преку резултатите од Lysholm и Victorian Institute of Sport Assessment-Patella (VISA-P) прашалниците. Враќањето на спортските активности и постоперативните компликации беа исто така нотирани. Просечното следење на пациентите беше 12,2 ± 0,9 месеци.

Резултати: Сите 14 пациенти продолжија со спортски активности, но само 12 од нив (85,7%) постигнаа исто ниво на спортување како пред појава на симптомите. Средното време потребно да се вратат на исто ниво на спортување беше 3,9 ± 0,8 месеци. Пациентите покажаа значително подобрување во просечните резултати од Lysholm (51,1 ± 3,8 до 93,4 ± 4,2; p=0,001) и VISA-P прашалникот (42,1 ± 3,5 до 86,7 ± 8,4; p=0,001). Постоперативни компликации не се појавија.

Заклучок: Презентираната артроскопска техника дава намален морбидитет и задоволителни резултати со побрзо закрепнување и враќање на спортските активности кај пациентите со хронична пателарна тендинопатија..

Клучни зборови: хронична пателарна тендинопатија, артроскопски третман, клинички резултати