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Surgical treatment of symptomatic patellofemoral malalignment: Do we need an ideal patellofemoral congruency to solve the symptoms?

Hirurško lečenje simptomatske patelofemoralne inkongruencije: Da li je uspostavljanje idealnih odnosa u zglobu neophodno za rešavanje simptoma?

Milan Apostolović*†, Miodrag Vukčević†‡, Vladimir Vučković*, Boris Vukomanović*†, Nemanja Slavković*†, Goran Djuričić§, Nebojša Antonijević†‖, Oskar Čučilović*

***Institute for Orthopaedic Surgery „Banjica“, Belgrade, Serbia; University of Belgrade, †Faculty of Medicine, Belgrade, Serbia; ‡Clinical Center „Zemun“, Zemun, Serbia; §University Children`s Hospital, Belgrade, Serbia; Clinical Center of Serbia, ‖Clinic of Cardiology, Belgrade, Serbia**

Abstract

Background/Aim. The aim of this prospective nonrandomized study was to test functional results of different surgical strategies in the operative treatment of symptomatic patellofemoral malalignment. Our hypothesis was that immediate extensive surgery does not have serious advantage comparing to "step by step" procedure, regarding the main symptoms and functional end result. We wanted to check whether obtaining ideal surgical patellofemoral congruency is an essential prerequisite for subsidence of the major symptoms of patellofemoral malalignment. **Methods.** The study included 35 patients with patellofemoral malalignment who had persistant major symptoms: patellar pain and slipping, 3 months after nonoperative treatment. Divided into three groups, they all underwent the realignment surgery, but in different extent and sequence: immediate extensive surgery, step by step surgery, and only proximal realignment. Their overall functional scores as well as major symptoms were assessed at the beginning, after the surgery, and during the 3-years follow-up period and then, compared at the end. **Results.** There was no significant difference in the functional results among the groups, neither at the beginning ($p = 0.1318$) nor at the end of the study ($p = 0.3996$), but the results at the beginning compared to those at the end of the study showed a statistically significant difference in all three groups ($p1 = 0.005062$; $p2 = 0.011719$; $p3 = 0.000352$). The same result was in regard to the major symptoms. **Conclusion.** The study confirmed that insisting on immediate extensive surgery in order to achieve precise and complete congruency of the patellofemoral joint, did not prove its advantage over the less invasive, individual surgical approach concerning functional scores and major symptoms.

Key words:
patellofemoral pain syndrome; surgical procedures, operative; recovery of function.

Apstrakt

Uvod/cilj. Ova prospektivna nerandomizovana studija rađena je sa ciljem da se u lečenju simptomatske patelofemoralne inkongruencije nepodudarnosti uporede funkcionalni rezultati postignuti različitim hirurškim strategijama. Radna hipoteza bila je da se neposredom ekstenzivnom hirurgijom ne postižu značajno bolji rezultati u odnosu na dva glavna simptoma i krajnji funkcionalni skor u poređenju sa umerenijom hirurškom strategijom. Nameravali smo da proverimo da li je postizanje idealnih geometrijskih odnosa u patelofemoralnom zglobu opsežnom hirurgijom neophodno za rešavanje glavnih simptoma patelofemoralne inokngruencije. **Metode.** Studija je obuhvatila ukupno 35 bolesnika sa patelofemoralnom inkongruencijom, kod kojih su i posle tri meseca neoperativnog lečenja i dalje postojali glavni simptomi: bol u prednjem delu kolena i osećaj isklizavanja patele. Svi bolesnici su podvrgnuti hirurškim centražnim procedurama, ali su u zavisnosti od obima i redosleda tih intervencija podeljeni u tri grupe: prva sa jednokratnom ekstenzivnom hirurgijom, druga, gde su proksimalne i distalne centražne procedure vremenski razdvojene i treća kod koje su rađene samo proksimalne procedure. Funkcionlni rezultati, kao i dva glavna simptoma, ocenjivani su na početku lečenja, posle poslednje hirurške intervencije i tokom trogodišnjeg praćenja, i na kraju međusobno upoređeni. **Rezultati.** U pogledu funkcionalnih rezultata, između grupa nije bilo statistički značajne razlike ni na početku

Correspondence to: Milan Apostolović, Institute for Orthopaedic Surgery "Banjica", M. Avramovića 28, 11 000 Belgrade, Serbia.
E-mail: apostolovic_milan@yahoo.com

($p = 0.1318$), ni na kraju ($p = 0.3996$) lečenja, ali su u sve tri grupe postojale statistički visoko značajne razlike pri poređenju rezultata na početku, sa onim na kraju lečenja ($p1 = 0.005062$; $p2 = 0.011719$; $p3 = 0.000352$). Isti odnos dobijen je i za dva glavna simptoma. **Zaključak.** Studija je pokazala da u hirurškom lečenju simptomatske patelofemoralne inkongruencije, u pogledu funkcionalnih rezultata i rešavanja dva osnovna simptoma, postizanje idealnih odnosa u patelofemoralnom zglobu jednokratnom ekstenzivnom hirurgijom ne donosi značajnu prednost u poređenju sa manje invazivnim, sekvencijalnim, individualnim hirurškim pristupom.

Ključne reči:
patelofemoralni bolni sindrom; hirurgija, operativne procedure; funkcija, povratak.

Introduction

Malalignment of the patellofemoral joint, besides morphological, involves also a dynamic incongruence of the joint surfaces of trochlea and patella. The dynamic aspect of the patellar malalignment, according to Grelsamer [1], is presented by translational (subluxation) and/or rotational (tilt) deviation of the patella related to one of patellar axis. There are two major symptoms of the patellofemoral malalignment: patellar slipping and anterior knee pain. Patellar slipping that occurs during flexion and extension of the knee, sometimes also presented as catching and pseudo locking, is regarded as a subjective interpretation of the clinical phenomena known as patellar subluxation. Both morphologic and dynamic disorders of the patellofemoral joint, in various reciprocal relations, represent the source of patellar slipping. Those disorders could be constitutional, acquired or the combination of those two [2,3]. The anterior knee pain that originates from the patellofemoral joint is controversial in many ways. Patellofemoral malalignment is one of the principal etiologic factors for that pain, but certainly not the only one. Histological and functional changes in small parapatellar nerves, especially of the lateral retinaculum, also contribute substantially to occurrence of the pain syndrome [4]. Degenerative changes in subchondral bone as well as fibrous synovial plicae of the knee are also responsible for the pain. Some authors hypothesize that a number of patients might have individual trigger for the onset of the pain [1].

Treatment of the symptomatic patellofemoral malalignment should always start nonoperatively [5]. The cornerstone of this treatment is a physical therapy, based on knee extensor and hip abductor muscles strengthening, appropriate patella bracing and taping, foot orthotics, and modification of life activities associated with bending of the knee. Although it obviously does not address the knee extensor alignment significantly, forementioned therapy shows good results in terms of subsidence and sometimes complete elimination of the major complaints [2, 6, 7]. Unacceptable result of the nonoperative treatment, that was performed not less than three months continually, leads to preparation for the surgery [8]. Surgical treatment of the symptomatic patellofemoral malalignment is mainly based on the knee extensor realignment. Proximal alignment procedures are focused on passive and dynamic balance of the parapatellar soft tissues: medial and lateral retinaculum as well as muscles attached to the patella. Those procedures could be combined mutually as well as with distal ones, performed either immediately or step by step. Since rotational component of patellar malalignment tilts patella laterally with consecutive shortening of lateral retinaculum, proximal alignment presumes open or arthroscopic lateral release [9]. On the opposite side, reparation, reefing and reinforcing of the medial patellofemoral ligament (MPFL) is common in the acute and subacute disorders either arthroscopicaly [10, 11] , or as an open surgery [12,13], whilst in chronic cases, reconstruction of the MPFL is regarded as standard procedure, sometimes with advancing distal fibers of the *vastus medialis obliquus* muscle [14–16]. Attitude to immediate lateral release and reparation or reconstruction of the MPFL, according to literature, is noticeably different and obviously controversial [17–20]. Distal alignment procedures have represented basis of the surgical treatment of patellofemoral malalignment since 1938 when Hauser [21] introduced his technique of tibial tubercle transfer. They are mainly aimed to correct the Q angle, and, to a certain extent, patellar height and contact area between patella and trochlea. It presumes translocation of the tibial tubercle together with patellar ligament insertion, or partial translocation of the ligament, performed as a classic open surgical procedure [22, 23]. Besides the knee extensor, the surgical treatment of the patellar malalignment could be focused on deepening the trochlear sulcus [24], removal or refixation of the loose osteocartilaginous body, high tibial osteotomy to correct varus/valgus knee alignment, removal of synovial tissue, and peripatellar soft tissues denervation. The combination of proximal and distal procedures as well as arthroscopic and open surgery enables immediate and precise correction of marked patellofemoral malalignment and accomplishment of almost ideal congruency. Despite that fact, in the reviewed literature, postoperative outcomes, concerning patellar pain, slipping and overall functional results, apparently were not always ideal [18, 24–27]. On the other hand, nonoperative treatment, even without noticeable correction of the alignment, in a number of patients, establishes good functional control of the knee extensor, significant reduction and sometimes even complete subsidence of the major symptoms. In some cases, where surgical treatment of patellofemoral malalignment was planned as two steps procedure (first arthroscopic or arthroscopicaly assisted proximal alignment, and second distal procedure), even proximal alignment alone, significantly decreased or completely eliminated major symptoms, providing also acceptable and good functional results. Long-term follow-up of those patients showed that, in most of the cases, there was no need for further surgical treatment, besides the fact that, neither clinically nor using imaging methods, physiological patellofemoral alignment and congruency were not achieved.

The aim of this study was to test whether establishing ideal geometrical congruency and alignment of the patellofemoral joint by means of extensive one-stage surgery, provided a significant advantage in treatment of the symptomatic patellofemoral malalignment. We compared extensive one-stage surgery with two other, less invasive surgical strategies, evaluating their functional results and improvements of the major symptoms.

Methods

This prospective nonrandomized study included 35 patients with patellofemoral malalignment and complaint on anterior knee pain and patellar slipping, without improvement of the symptoms after a 3-month program of nonoperative treatment. After the program, their two major symptoms were both still present and evaluated according to the Tegner and Lysholm scale [28]: for the anterior knee pain each of them scored less than 15 (max. 25), and for the patellar slipping less than 10 points (max. 15). Other inclusion criteria were presence of at least two out of 3 quantitative factors of patellofemoral malalignment [29]: "Q angle", according to Brattstroem [30], higher than 15°, "Laurin angle" (measure of patelar tilt) less than 20°, and "Merchant's angle" (measure of patellar subluxation) more than +6°. The positive clinical test of provoked patellofemoral pain [31] was also obligatory. The exclusion criteria were: previous knee surgery, bilateral knee symptoms and x-ray signs of arthritis of the patellofemoral joint.

There were 28 female, and 7 male patients, whose age ranged from 16 to 46 years (mean 28.9). Initially, the patients were divided into two groups. In the first group, there were 10 patients, all of them with both numerical predictors of patellar subluxation: Q angle more than 15°, and Merchant's angle more than +6°. For that reason, those 10 patients underwent immediate proximal and distal alignments. In the second group, with the rest of 25 patients, we planned to perform the same surgical scenario, but in two separate steps, at least 4 months apart: first step arthroscopic or arthroscopicaly assisted proximal alignment, and second – open distal realignment. But four months after the proximal alignment, 17 of those 25 patients were satisfied with the result. In all those cases, functional Tegner-Lysholm score exceeded 65 points and assessment of the patellar pain and slipping showed at least "good" results, so, further surgical treatment was stopped. Therefore, 4 months after the proximal alignment, the patients from the initial second group were subdivided into two more groups, those 17 whose surgical treatment was terminated and the rest of 8 who underwent delayed distal alignment. Finally, the study had three groups of patients: the first (10 patients) with immediate proximal and distal alignment, the second (8 patients) where proximal and distal alignment were performed in two steps four months apart from each other and the third (17 patients) where only proximal alignment was performed. For the assessment of functional status of their knees and major symptoms, we had to use one of the validated knee scoring systems. Most of the available functional knee scores are designed for specific pathology of the knee joint. Yet, some of them are modified, so that they could be used more extensively. The Kujala Anterior Knee Pain Scale [32] is designed for patellofemoral disorders, but since it includes some of the activities such as running and jumping, that most of our patients excluded from their everyday activities even before the onset of symptoms we decided to go for the Tegner-Lysholm Knee Scoring Scale, a modification of the classic Lysholm-Gillquist knee test [33], that was more appropriate for usual activities of our patients. The Tegner and Lysholm test utilizes eight major symptoms, findings and activities related to the knee, predominantly patellofemoral part, for evaluation of its functional status with maximal score of 100 points. The score is graded as follows: less than 65 is poor, 65–83 fair, 84–90 good and more than 90 is excellent. The first measurement was made after completion of physical therapy (before the surgery), the second – 4 months after the surgery, the third – a year later, and the fourth – 3 years later, with the total follow-up of 40 months after the surgical treatment.

By means of the Kolmogorov-Smirnov test, we confirmed that data obtained during the study did not belong to a normal distribution. Consequently, statistic analysis was accomplished using the nonparametric tests for rank analysis: Kruskal-Wallis *H* test and Wilcoxon signed rank *T* test. We used statistic program "Statistics 6.0 by StatSoft Inc". To assess whether our groups at the beginning as well as at the end of our study originated from the same distribution regarding either functional status or major symptoms, we used the Kruskal-Wallis test by ranks. For that test, the *p* values less than 0.05 indicated that differences among the groups were so large that they were unlikely to occurred by chance.

To compare functional results and major symptoms at the beginning to those findings at the end of the treatment, we used the Wilcoxon signed rank test for comparing two related, matched samples. We used the same Wilcoxon test for our repeated measurements, to compare every two subsequent phases of treatment, to estimate uniformity of improvement during the treatment. For both purposes, the Wilcoxon test was significant if the *p* values were less than 0.05.

Results

All 35 patients included in this study were divided into three groups in order to compare their functional results and major symptoms (patellar pain and slipping) during the follow-up period, using the Tegner and Lysholm scale. Basic statistic parameters of the obtained functional results are shown throughout the groups and all four measurements completed during follow-up (Table 1).

Mutual comparison of the groups, based on the results of the functional scores of the patients before any operative treatment, showed that there was no statistically significant difference between the groups at the beginning of the study according to the Kruskal-Wallis *H* test by ranks ($n = 35$; $df = 2$; $H = 4.05346$; $p = 0.1318$), providing hence a sound basis for evaluation of different modalities of treatment. At the end of our follow-up, functional status between the groups was also compared using the same Kruskal-Wallis *H* test again, without significant statistical difference between them ($N = 35$; $df = 2$; $H = 1.834619$; $p = 0.3996$).

Table 1

Functional status of all 3 groups throughout all 4 measurements

Group	FSM[1]	n	Median	Min.	Max.	25%	75%
1st	FSM 1	10	66.00	33.00	73.00	60.00	69.00
	FSM 2	10	77.50	63.00	86.00	73.00	82.00
	FSM 3	10	84.00	75.00	91.00	80.00	88.00
	FSM 4	10	83.50	81.00	91.00	83.00	88.00
2nd	FSM 1	8	65.00	55.00	76.00	61.50	71.50
	FSM 2	8	76.00	45.00	83.00	73.00	80.50
	FSM 3	8	82.50	63.00	92.00	76.50	86.50
	FSM 4	8	83.00	65.00	96.00	76.00	90.00
3rd	FSM 1	17	71.00	48.00	81.00	65.00	75.00
	FSM 2	17	78.00	55.00	85.00	72.00	80.00
	FSM 3	17	83.00	62.00	97.00	78.00	88.00
	FSM 4	17	89.00	62.00	97.00	80.00	93.00

FSM – functional score measurement; FSM 1 – preoperative; FSM 2 – 4 months after the surgery; FSM 3 – 1 year later; FSM 4 – 3 years later; n – sample size.

On the other hand, the functional results of all analysed patients in all three groups at the beginning, compared to those at the end of the treatment (40 months after the last operation), using the Wilcoxon matched pair test, showed a statistically significant difference (Table 2).

It is confirmed that all three surgical strategies applied in this study resulted in a significant functional improvement.

Using the same nonparametric analysis of the ranks (Wilcoxon test) where the matched pairs were successive measurements of the functional scores in each of the three groups of our patients, we have tested functional status between every two successive steps of the treatment, to estimate whether the improvement was smooth and consistent during the whole observed period, or irregular, limited to some of the phases (Table 3). To do so, we divided the whole follow-up period in three phases of the treatment as follows: first (I), from the preoperative measurement until 4 months after the last operation, second (II), beginning 4 months after the last operation and the year ahead and third (III) between 1 and 3 years after the second measurement.

In the 1st group, statistically significant changes of the functional scores occurred during first two phases of the treatment ($p < 0.05$), while, in the third, there was no significant change.

The median values in the first two groups (Table 1) altered to the same direction: showing an increase during the first two phases and stagnation during the third.

In the 3rd group, statistically significant changes in the functional scores were noticed during each phase of the treatment: improvement was consistent throughout the whole observed treatment. A continual increase of the median values in this group, shown in Table 1, were in accordance with the conclusion.

In the 2nd group, a statistically significant change in the functional score occurred only in the second phase ($p < 0.05$), while in the first, the p values were close to indicate a significant (0.068), and in the third phase there was no significant change.

Table 2

Comparison of functional results at the beginning to those at the end of the study

Group of patients	Period (months)	n	T	Z	*p*
1st	0–40	10	0.00	2.803060	0.005062
2nd	0–40	8	0.00	2.520504	0.011719
3rd	0–40	17	1.00	3.574027	0.000352

Wilcoxon matched pair test: statistically significant for $p < 0.05$; n – sample size; T – referent critical value; Z – standard score; *p* – probability.

Table 3

Comparison of functional results between every two successive steps of treatment

Group	Phase of treatment	n	T	Z	*p*
1st	I	10	0.00	2.80	0.005062
	II	10	0.00	2.80	0.005062
	III	10	15.00	0.89	0.374260
2nd	I	8	5.00	1.82	0.068704
	II	8	0.00	2.37	0.017961
	III	8	6.50	0.84	0.401679
3rd	I	17	12.00	2.54	0.011008
	II	17	0.00	3.62	0.000293
	III	17	4.00	3.18	0.001470

Wilcoxon matched pair test: statistically significant for $p < 0.05$; n – sample size; T – referent critical value; Z – standard score; *p* – probability.

Summing up the data, in the first two groups, we obtained similar results. A significant change of the functional score occurred after the extensive surgery and lasted until the end of first postoperative year, followed by flat, insignificant alteration during the third phase. In the third group we had even-handed, significant improvement during all three phases.

Two most important symptoms in patellofemoral malalignment, patellar pain and slipping, were observed separately. Basic satistic parameters of the major symptoms, in all three groups, preoperatively and during follow up, are shown in Tables 4 and 5.

Median values for patellar slipping, showed the most impressive and constant increase during the whole follow-up period and reached maximum only in the first group in which the patients underwent immediate extensive surgery (Table 4). On the contrary, the median values for the patellar pain were almost equal between all groups, with the even and slow increase, but non of them reached maximum (Table 5).

Comparison between the groups at the beginning of the treatment regarding both symptoms, using rank analysis (Kruskal-Wallis *H* test), showed no statistical difference (for pain: n = 35 df = 2; $H = 2.534385$, $p = 0.2816$, and n = 35 df = 2; $H = 2.461491$, $p = 0.2921$ for patellar slipping). The same results came at the end of the treatment: there was no statistically significant difference neither for pain nor patellar slipping (n = 35; df = 2; $H = 1.032605$, $p = 0.5967$ and n = 35; df = 2; $H = 1.642500$, $p = 0.4399$, respectively). So, concerning two major symptoms of patellofemoral malalignment, before our treatment, all three groups were equivalent, which was a good starting point for later comparison. At the end of the treatment, the results related to the patellar pain and slipping between all groups, also belonged to the same distribution pattern.

Comparison of the results, in the beginning and at the end of the treatment, for both symptoms, patellar pain and slipping, in all patients and groups, using the nonparametric rank analysis for successive measurements (the Wilcoxon matched pairs test), showed statistically significant differences: for pain $p = 0.000005$ (n = 35; $T = 11.00$; $Z = 4.555887$), and for slipping $p = 0.000015$ (n = 35; $T = 13.00$; $Z = 4.326570$). This confirmed equal results of the treatment, concerning both essential symptoms, regardless of surgery strategy.

Table 4

Patellar slipping in all three groups throughout the follow-up measurements

Group	PSSM	n	Median	Min.	Max.	25%	75%
1st	PSSM 1	10	6.00	2.00	10.00	6.00	6.00
	PSSM 2	10	10.00	10.00	10.00	10.00	10.00
	PSSM 3	10	12.50	10.00	15.00	10.00	15.00
	PSSM 4	10	15.00	10.00	15.00	10.00	15.00
2nd	PSSM 1	8	8.00	6.00	10.00	6.00	10.00
	PSSM 2	8	10.00	10.00	15.00	10.00	10.00
	PSSM 3	8	12.50	10.00	15.00	10.00	15.00
	PSSM 4	8	10.00	10.00	15.00	10.00	15.00
3rd	PSSM 1	17	6.00	2.00	15.00	6.00	10.00
	PSSM 2	17	10.00	6.00	15.00	10.00	10.00
	PSSM 3	17	10.00	10.00	15.00	10.00	15.00
	PSSM 4	17	10.00	10.00	15.00	10.00	15.00

Patellar slipping score measurement (PSSM): PSSM 1 – preoperative; PSSM 2 – 4 months after the surgery; PSSM 3 – 1 year later; PSSM 4 – 3 years later.

Table 5

Patellar pain in all three groups throughout the follow-up measurements

Group	PSM	n	Median	Min.	Max.	25%	75%
1st	PSM 1	10	10.00	5.00	20.00	10.00	10.00
	PSM 2	10	15.00	10.00	20.00	10.00	15.00
	PSM 3	10	15.00	15.00	20.00	15.00	20.00
	PSM 4	10	15.50	10.00	20.00	15.00	20.00
2nd	PSM 1	8	10.00	5.00	10.00	5.00	10.00
	PSM 2	8	12.50	5.00	15.00	10.00	15.00
	PSM 3	8	15.00	5.00	15.00	10.00	15.00
	PSM 4	8	15.00	5.00	20.00	12.50	15.00
3rd	PSM 1	17	10.00	0.00	15.00	5.00	10.00
	PSM 2	17	10.00	0.00	20.00	10.00	15.00
	PSM 3	17	15.00	0.00	25.00	10.00	15.00
	PSM 4	17	15.00	0.00	25.00	10.00	20.00

Pain score measurement (PSM): PSM 1 – preoperative; PSM 2 – 4 months after the surgery; PSM 3 – 1 year later; PSM 4 – 3 years later.

Discussion

Combinations of various surgical techniques applied on different levels of extensor apparatus of the knee as well as within the patellofemoral joint, using up to date diagnostic and surgical devices, enables complete correction of almost all diagnosed types of patellofemoral malalignment. However, postoperative functional scores, symptoms and objective findings were not equally satisfactory: some of widely accepted surgical techniques, after prolonged follow-up, showed disadvantages [25–27]. The other ones did not show major improvement over the nonoperatively treated patients [18], and some studies report significant differences between subjective records and objective findings [24]. Therefore, some authors advocate restricted and highly controlled surgery after precise definition of origin of the particular disorder [34].

In this study, the surgical treatment of the symptomatic patellofemoral malalignment included standard methods of proximal and distal alignment of the extensor apparatus of the knee. In all three groups, as the first surgical step, patients were submitted to arthroscopic, or arthroscopically assisted proximal alignment. The difference between the groups, besides geometric parameters of the patellofemoral joint and extensor apparatus of the knee, was also quantity of operations, and time frame of successive surgical procedures.

Comparison of the treatment results was based on assessment of the knee functional score of each patient as well as two major symptoms: patellar pain and slipping.

Since the functional score of the patients of all three groups was assessed preoperatively as equal, changes in the score at the end of the follow-up, could be regarded as outcome of the treatment. Statistically significant difference between functional scores at the end of the follow-up compared to the beginning of treatment, in all observed patients, pointed out equal end results of all 3 modalities of surgical treatment applied in this study. However, comparison of the functional scores within the groups, between succeeding phases of the treatment, showed a discontinuous increase in the first two groups where more extensive surgery was applied: during the first and second phase of treatment, which included period from the surgery until one year afterwards, the improvement was considerable unlike the third phase, which represented a period from 1 until 3 years postoperatively. So, in the first and second group, we achieved the successful functional results more rapidly than in the third group in which the amount of surgery was substantially smaller. But having in mind that at the end of the follow-up, the functional scores among all three groups did not show statistically significant difference and more rapid improvement of function after extensive surgery, it could be concluded that it did not provide better end functional result. Furthermore, the median values of the functional scores, at the end of the treatment, were the highest in the third group, where the least invasive surgical strategy was applied.

Launching definitive conclusions regarding results of surgical treatment of symptomatic patellofemoral malalignment and patellar instability, based only on evidence of the total functional score, might lead to inaccurate assessment of the treatment. Several articles confirm that, especially in cases with marked patellar instability, in spite of significant improvement of the functional score of the knee after the surgery, percentage of persistent instability was unacceptably high [18, 19, 35]. For that reason, in this study, besides the functional status, we tested separately two major symptoms of patellofemoral malalignment, patellar pain and slipping. There were no statistically significant differences concerning those two symptoms, among the observed groups, neither at the beginning nor at the end of the follow-up. Yet, patellar slipping, basically a biomechanical symptom, according to the median values, definitely showed more significant improvement after the extensive immediate surgery than in the second and third group. On the other hand, a pattern of the median values increase for the second major symptom, the pain, during the overall follow-up, was almost equal in all three groups. Nevertheless, all observed patients within all three groups, showed statistically significant difference and improvement, for both symptoms at the end of the follow-up, comparing to the beginning of the treatment. So, all three surgical strategies for the treatment of symptomatic patellofemoral malalignment, applied in this study, ended up with equal success concerning two major symptoms of the disorder.

Conclusion

The results obtained in this study proved that extensive surgery in the treatment of symptomatic patellofemoral malalignment did not confirm decisive role. On the other hand, the persistent and equally good functional results, after prolonged follow-up, were obtained in the patients who underwent only arthroscopic or arthroscopically assisted proximal realignment in the “step by step” surgery without insisting on immediate ideal congruency. Therefore, if a complex and extensive surgery, based on objective criteria, seems to be inevitable, two steps surgery should be considered by all means.

This study also implicates that achieving morphological and dynamic congruency of the patellofemoral joint in a surgical treatment of symptomatic patellofemoral malalignment, using combined proximal and distal procedures, gives substantial improvement of functional results promptly, but may not always result in complete solving of major symptoms. Nevertheless, equally good results in a surgical treatment of the same disorder could be obtained without insisting on ideal congruency.

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