The aim of study was to analyze the influence of bilateral anterior cruciate ligament reconstructions on life quality of patients and their return to sports activities. The study included 32 operated patients, whose average age was 30.46 years (19–55). The participants answered a modified Knee Injury and Osteoarthritis Outcome Score questionnaire set and gave data about preoperative and postoperative periods. The participants’ age and parameters of Lysholm scale did not correlate significantly with the subjective level of physical activity after the second knee surgery. After the first anterior cruciate ligament reconstruction, 4 participants (12.5%) did not return to trainings, while 28 did (87.5%); 8 patients (25%) did not return to competitions and 24 of them (75%) achieved the competition level of sports activities. After the anterior cruciate ligament reconstruction of contralateral knee, 6 (18.8%) did not return to trainings, while 26 (81.2%) did; 15 patients (46.9%) did not return to competitions, while 17 (53.1%) continued to compete without restrictions. The average values of questionnaire scores were between 95.1–98.2 points. The results showed that the participants who achieved the competition level of sports activities after the first reconstruction had significantly higher questionnaires scores between 95.1–98.2 points. Discussion and Conclusion. Resuming the same or higher level of sports activities an athlete with bilateral injury has returned to sports activities without restrictions after the bilateral anterior cruciate reconstructions.

Keywords: Quality of Life; Anterior Cruciate Ligament Reconstruction; Knee Injury and Osteoarthritis Outcome Score; Knee Injuries; Osteoarthritis; Knee Lysholm Knee Score

Conclusion

The results of the study showed that the participants who achieved the competition level of sports activities after the first reconstruction had significantly higher questionnaires scores between 95.1–98.2 points. Discussion and Conclusion. Resuming the same or higher level of sports activities an athlete with bilateral injury has returned to sports activities without restrictions after the bilateral anterior cruciate reconstructions.

Keywords: Quality of Life; Anterior Cruciate Ligament Reconstruction; Knee Injury and Osteoarthritis Outcome Score; Knee Injuries; Osteoarthritis; Knee Lysholm Knee Score

Introduction

According to various studies, the annual incidence of anterior cruciate ligament (ACL) injuries in general population ranges from 0.01 to 0.08% [1-3] and the incidence is significantly higher among sports active population (1.5-1.7%) [1-4]. The annual ACL incidence in amateur sporting groups is...
osteoarthritis of knee joint is experiencing greater reconstruction [5, 23]. The younger generation with associated meniscal injury as soon as 10 years after ACL rupture and 48% of people with associated ACL rupture and 48% of people with associated meniscal injury and injuries of surrounding structures. Knee osteoarthritis develops in 13% of people with isolated meniscal injury and injuries of surrounding structures. Knee osteoarthritis develops in 13% of people with isolated meniscal injury and injuries of surrounding structures. Knee osteoarthritis develops in 13% of people with isolated ACL rupture and 48% of people with associated meniscal injury as soon as 10 years after ACL reconstruction [5, 23]. The younger generation with osteoarthritis of knee joint is experiencing greater psychological stress than older people [24]. In addition, the chances of having the same injury are three times higher in teenagers with injured ACL, but surgery is associated with poorer treatment outcome and a lower quality of life [25]. The quality of life related to health essentially refers to physical, social, emotional and psychological components, values and priorities in life [26–28]. The effect of rehabilitation on the quality of life can be in the form of restrictions on high-functional activities such as competitive sports and difficulties in meeting their professional obligations [29].

Bilateral ACL injuries can significantly compromise the excellent results in the sport in the span of a few years due to the long absence from training and competition, which may be perceived by the patients as a reduction in the quality of life. Since there are few data on the quality of life after injury and operative treatment of athletes, this study has been aimed at determining how the bilateral reconstructions affect the return to sports activities, and whether there is a difference in the quality of life between the patients who have undergone only anterior cruciate ligament surgery and those who had associated injuries of meniscus.

### Material and Methods

Having been approved by Ethics Committee of Clinical Center of Vojvodina, this retrospective study was performed at the Department of Orthopedic Surgery and Traumatology in Novi Sad. The study sample included 32 of 50 patients operated for bilateral ACL ruptures in the period from January 01, 2003 until December 31, 2012, who had given their consent to participate in this study. The respondents were 5 women and 27 men, whose average age was 30.46 years (ranging from 19 to 55 years).

It was designed as a retrospective-prospective study. The knee injury and osteoarthritis outcome score (KOOS) questionnaire [30], entirely translated from English into Serbian and adapted for this purpose by adding questions relevant to this study was used to collect data. This questionnaire is an extension of osteoarthritis index “Western Ontario” and “McMaster” University (WOMAC) [31] and most commonly used instrument for the assessment of the relevant effects of therapy in patients with osteoarthritis. The questionnaire has been designed to assess the short-term and long-term results after a knee injury, and is divided into five parts: the first involves the quality of life following ACL surgery; the second one relates to pain in different activities; the third is related to daily activities performed by the patient; the fourth part is related to the level of physical activity, Lysholm score [32], while the finishing fifth part focuses on the very consciousness of the patient’s quality of life and how he perceives his injury. Before surgery, all patients completed the questionnaire about the details of injuries and subjective scores. The questionnaire also represents the register of ACL injuries at the Department of Orthopedic Surgery and Traumatology in Novi Sad. The study sample included 32 of 50 patients operated for bilateral ACL ruptures in the period from January 01, 2003 until December 31, 2012, who had given their consent to participate in this study. The respondents were 5 women and 27 men, whose average age was 30.46 years (ranging from 19 to 55 years).

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of Orthopedic Surgery and Traumatology in Novi Sad and is available publicly.

The patients answered the questionnaire set and provided information about their sports activities and activities in their daily life. The following parameters were included for each patient: age, gender, height, body mass, length of training before injury, length of time from the first injury to operation, length of time from the first injury to the comeback to training, length of time from the first operation to the comeback to competition, length of time between the two injuries, length of time from the first operation and the injury of the other knee, length of time from the second knee injury to operation, length of time from the other knee injury to the comeback to training, length of time from the other knee injury to the comeback to competition, dominant leg, quantity of pain in typical activities (pivoting, extension, flexion, walking on flat surface, walking on stairs, long standing and sitting), and the achieved level of physical activities after both operations.

The quality of life questionnaire was sent to the respondents via electronic mail (e-mail). Its purpose was explained to the respondents, who then gave their consent for their answers to be used for the purposes of this study. Criteria for exclusion from the study were the patient’s unwillingness to participate in the study, or failure to respond to e-mail or phone call. Standardized options were provided for answering (5 Likert’s “boxes”) [33], and a number of points from 0 to 4 was assigned for each question. The score of 100 indicated no symptoms, while 0 indicated extreme symptoms, and it was calculated for each dimension separately. Instructions for scoring are given in a separate “KOOS” document on scoring [33]. According to the importance of research and additional questions, our scoring is different compared to the standardized scoring method that is given in KOOS questionnaire [30], but the results are identical to the original. According to the “KOOS” scoring scale, the higher score means the better quality of life and better health condition of respondents.

Within descriptive statistics, the following parametric values were analyzed: mean value, standard deviation, minimum and maximum, as well as the frequency of the presence of each category as a non-parametric value. Student’s T-test was used to calculate the differences between groups. Pirson’s $\chi^2$-test was used to compare the differences between the tested groups for nonparametric values. Data were analyzed and shown by tables and graphs for each group.

**Results**

Out of 32 patients, 14 patients injured the right knee first and 16 patients injured the left one, while both knees were simultaneously injured in two cases. The left leg was dominant in 19 patients (for jumping), and the right one was dominant in 13 patients. No statistically significant correlation was observed between the age of patients and their level of activity, nor the effect of the dominant leg on bilateral ACL injuries. The correlation of age and the activity level was $F(2.29)=1.59$, $p=.221$ ($p>.05$).

The periods between injuries and operations are shown in Table 1.

The injuries happened during sports activities in all patients: 16 (50%) got the injury in competition, 8 during the training (25%) and 8 in recreational sporting activities (25%). The associations between the type of sport and bilateral ACL rupture is shown in Graph 1 and competition level of sports activities is given in Graph 2.

**Graph 1.** Sport that caused bilateral ACL rupture

| Graph 1. Vrsta sporta koja je dovela do obostrane povrede prednjeg ukrštenog ligamenta |

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soccer/VOB</td>
<td>37%</td>
</tr>
<tr>
<td>Basketball</td>
<td>26%</td>
</tr>
<tr>
<td>Handball</td>
<td>13%</td>
</tr>
<tr>
<td>Others</td>
<td>19%</td>
</tr>
</tbody>
</table>

ACL and meniscus injuries during the first and contralateral knee injuries are shown in Table 2.

In the correlation between total Lysholm score and age of patients, lower score values were found in older patients (Table 3).

The average values of KOOS questionnaire ranged between 95.1 and 98.2 points.

A statistically significant difference in the correlation of age and each component of KOOS questionnaire (Table 4) was found in the components

<table>
<thead>
<tr>
<th>Table 1. Time of ACL injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tabela 1. Vreme povredivanja prednjeg ukrštenog ligamenta</strong></td>
</tr>
<tr>
<td>Time/Vreme</td>
</tr>
<tr>
<td>1st injury-1st operation/l.povreda-l.operacija</td>
</tr>
<tr>
<td>1st injury-2nd injury/l.povreda-2.povreda</td>
</tr>
<tr>
<td>2nd injury-2nd operation/2.povreda-2.operacija</td>
</tr>
</tbody>
</table>
Table 2. ACL and meniscus injuries during the first and contralateral knee injuries

<table>
<thead>
<tr>
<th>Injury</th>
<th>Isolated ACL</th>
<th>Both menisci</th>
<th>Medial meniscus</th>
<th>Lateral meniscus</th>
</tr>
</thead>
<tbody>
<tr>
<td>The first/Prva</td>
<td>15</td>
<td>3</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>The second/Druga</td>
<td>17</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

*Ligamentum cruciatum anterius

Table 3. Correlation between Lysholm score and patient’s age

<table>
<thead>
<tr>
<th>Age/Starost</th>
<th>Lysholm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson correlation</td>
<td>1</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.029</td>
</tr>
<tr>
<td>N</td>
<td>32</td>
</tr>
</tbody>
</table>

Table 4. Correlation between KOOS questionnaire components and patient’s age

<table>
<thead>
<tr>
<th>KOOS component/KOOS komponenta</th>
<th>Age/Dob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain/Bol</td>
<td>.354</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.039</td>
</tr>
<tr>
<td>N</td>
<td>32</td>
</tr>
<tr>
<td>Symptoms/Simptomi</td>
<td>.052</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.778</td>
</tr>
<tr>
<td>N</td>
<td>32</td>
</tr>
<tr>
<td>Activities of daily life/Aktivnosti dnevnog života</td>
<td>-.067</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.715</td>
</tr>
<tr>
<td>N</td>
<td>32</td>
</tr>
<tr>
<td>Sports activities/Sportske aktivnosti</td>
<td>-.326</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.050</td>
</tr>
<tr>
<td>N</td>
<td>32</td>
</tr>
<tr>
<td>Quality of life/Kvalitet života</td>
<td>-.020</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.915</td>
</tr>
<tr>
<td>N</td>
<td>31</td>
</tr>
</tbody>
</table>
“Pain” and “Sports activities and recreation”. High scores of both tests mean that there was no significant decrease in of the patients’ life quality. Thus, the thesis of our research that the quality of life after bilateral ACL injuries is lower than before them is not justified.

After the first ACL reconstruction, 4 participants (12.5%) have not returned to trainings, while 28 have (87.5%); 8 patients (25%) have not returned to competitions and 24 of them (75%) achieved competition level of sports activities. After the ACL reconstruction of contralateral knee 6 patients (18.8%) have not returned to trainings, while 26 (81.3%) have; 15 patients (46.9%) have not returned to competitions, while 17 (53.1%) of them still compete without restrictions (Graph 3).

Discussion

ACL reconstruction surgery is among those operations that improve the quality of life. They are not vitaly indicated, but are usually performed on sports active population because the unstable knee can hardly achieve top sports results [6–8, 15, 19, 34, 35].

In our sample, the average absence from competition was 31 months for an athlete with bilateral ACL rupture because ten months had passed in waiting for the first operation (due to untimely reporting for examination, diagnosis and losing time on the waiting list for surgery), plus another 6 months at least after that period before returning to competition after the rehabilitation. In case of contralateral ACL injuries, the patient waited for the new operation for 9 months on average and resumed competitive sports in 6 months at best. When it is known that in Serbia the first ACL injury occurs in the 26th year of life, and the second in the 30th year on average [15, 19, 34, 35], it is clear that an athlete has a dilemma about continuing or discontinuing the active sports career. In majority of foreign studies [4, 8, 36] athletes also lose between 1.5 and 2.5 years of competitions after bilateral ACL reconstructions. The difference is in fact that the time frame from the injury to operation is shorter (within two months), but those athletes have longer average period to return to competitions. Thus, as many as 89% of professional American basketball players return to active sports 11.6 months after unilateral injury (11.6 ± 4.1), which also happens in the 26th year of life (25.7 ± 3.5) on average [36].

ACL injury of contralateral knee usually happens 3–4 years after the first injury [4, 8, 19].

The most prominent risk factor for the contralateral ACL injury is the attempt to return to a high (competitive) level of physical activity [6–8, 19], which is in agreement with our results because 75% of our operated patients returned to competition level of activities after the first operation, and then had another knee injury within the first 4 years after the first operation. Most authors [4, 7, 8, 19] confirm the above mentioned time frame, while Orchard et al. [38] have found that the greatest risk factor for the contralateral ACL injury is the history of an ACL reconstruction in the previous 12 months.

Intensive sports that involve movements of pivoting, forced valgus and anterior translation of tibia, during one-leg landing and sudden change of direction represent risky activities for ACL rupture [34, 37]. The fact that in our former studies [16, 34, 35] almost half of all of the patients were injured in football (soccer in the United States) only reflects sports preference of young population in Serbia due to the popularity of that sport among young professionals as well as playing football by the middle-aged population as a recreational activity. Football was the most prominent sport also in this study; the second and third place was taken by basketball and handball, respectively. Soury et al. [9] put American football (rugby) in the first place with 25.6%, then basketball and soccer with 20.7% and 11%, respectively. This is in accordance with the findings of our studies. The difference is only in fact that rugby is more popular sport than soccer in North America. Swedish authors [5] believe that handball is a high risk sport due to the rapid change of direction movement of players and pivoting, which says more about the popularity of that sport in Scandinavian countries. Authors from Japan think that basketball and gymnastics are sports with the highest risks among women [39].

Except our four participants (13%) who have not returned to trainings after the initial injury, all others have continued to be involved in sports at the level of trainings or returned to regular competitions. According to our earlier results the most commonly injured athletes are those who take active part in sports activities for the period from 11 and 20 years, most often in competitive matches, and considerably less in friendly matches and in the sessions. The parts of competition that have the highest risk are its middle part and end of match [34]. Our results showed that the patients who were in competitive level of sports activities accounted for 50% in the structure of our participants.

Returning to trainings and competitions shows a decreasing trend in function of time (Graph 3). After the first ACL reconstruction, 12.5% of participants have not returned to trainings and 25% have not returned to competitions, whereas only 18.8% have not returned to trainings after the second ACL reconstruction, that being a slightly decreasing trend. However, as many as 46.9% of athletes have not returned to competitions without restrictions, which can be explained by the assumption that the average time from operation to training and competition is longer after the second reconstruction than after the first one. Longer period of rehabilitation in addition to the time factor between the first operation and the second injury (average 3.6 years; 6 months–13 years) results in a lower percentage of athletes who have returned to unlimited sports activities. Not competing for some time is irreparable for an active athlete.
According to Swedish researchers [6], the patients with contralateral ACL injuries had lower knee function, activity level and quality of life scores compared with patients who had undergone a single ACL reconstruction. The median Lysholm score was 9 points before the first injury, 7 points before the second injury and 4 points during the follow-up after bilateral operations [6]. The mean Lysholm score for patients with bilateral ACL injuries was only 82 points [6]. This is a significantly lower score in comparison to primary operations that are generally above 94 points [15, 16, 35]. Even re-operated patients with complications had better results [15, 17, 18].

Motohashi et al. [39] compared the groups with bilateral and unilateral injury and concluded that the results were better in the one with unilateral injury because only 10% of the patients with bilateral injuries returned to sports activities without restriction, whereas that percentage was 35% in the group with unilateral injury. Falstrom and Ardern et al. [6, 40] and Salmon et al. [4] reported that 40-43% and 56% of those patients returned to sports, respectively. Our results are similar to the majority of others [5, 15-17, 36], showing that 75% of athletes (65-89%) returned to the competition level after the first operation. That percentage was significantly lower (53%) among our patients after the second reconstruction, but it was still higher than in the majority of other studies where it ranged between 10-40% [6, 39, 40].

A group of Japanese authors [39] classified their patients according to how they returned to sporting activities into group A, the patients who had returned to the former level of sporting activities; group B, those who had returned to sporting activities with a reduced ability; group C, those who had returned to other sports less risky for knee injuries; and group D, those who discontinued sports completely. The results of comparison of the patients with the first and second ACL reconstruction were better in the group with unilateral injury because there were three times more athletes classified in group A (that achieved the same competition level). By questioning their patients with reconstructed bilateral ACL ruptures, Ardern et al. [40] found that 60% of their operated athletes did not return to pre-injury activities more because of their subjective perception than because of lower quality of operation. The main reasons for not returning were not trusting the knee (28%), fear of a new injury (24%) and poor knee function (22%).

By correlating the associated injuries during the second knee injury and the achieved level of physical activity, it was found that meniscus ruptures did not play a crucial role in restitution of activities in this study group. Statistical parameters show that there is no statistically significant difference. The reason for such a result is again significant disproportions in the representation and associated absence of ruptures within the group, as well as the higher percentage of those participants who were not able to provide the information on associated knee injuries. Only 9.4% of the respondents had the rupture of medial meniscus, another 9.4% had the rupture of the lateral one, and 3.1% of both menisci simultaneously. As many as 25% of participants did not know if they had an injury of menisci, while 53.1% of them had an isolated ACL rupture. Falstrom et al. [6] found ruptures of medial meniscus in 15.4% of cases during initial injuries and 31.1% during the contralateral injuries. Lateral meniscus was injured in 15.4% of initial ACL injuries and in 13.1% of contralateral. Both simultaneously injured menisci during the initial rupture happened in 4.6% of cases and in 3.3% during contralateral ACL rupture. Ardenord et al. [8] have also concluded that the previous meniscal and chondral injuries were not the predictors of future contralateral ACL reconstruction, although they noted significantly greater percentages than we did (40% menisci and 27.5% chondral lesions). Average scores for each of the components of KOOS questionnaire show that our results are quite close to the maximum score, ranging from 95.06 to 98.21 points, which leads us to the conclusion that bilateral ACL reconstructions provided good results.

Although the objective result of the operation satisfy the criteria of returning to the sports activities, we believe that athletes have their contralateral knee injured due to the unconscious sparing of initially operated knee, thus overloading the other knee. It usually takes longer than 6 months to regain the absolute neuromuscular control and proprioception of the originally operated knee, when athletes return to competitions. Sometimes it takes years, and another ACL gets injured in the meantime [5, 8, 15].

The shortcoming of this study is that the patients did not fill in the KOOS questionnaire exactly at the specified intervals starting from the initial injury, which would follow the dynamics and dependence of the questionnaire’s components and aspects of postoperative period. This should be done in a future study. Getting the statistical significance of the KOOS component “Pain” could be explained by the lower level of pain tolerance which decreases with the person’s age [41]. The statistical significance of an adverse effect of moderate intensity obtained in the analysis of component “Sport and recreation” means that the absence of difficulties in sporting activities decreases with age. This can be explained by the reduction of motor abilities with aging, decline in motivation and change of lifestyle [41]. The main disadvantages of the study are a small sample of patients (32) and fact that the patients had to recall specific information about activities and symptoms retrospectively, thus the subjectivity in filling in the questionnaire could not be excluded. Similar difficulties have been reported by other authors [5, 6, 41].

Conclusion

Returning to the same or higher level of sports activity after reconstruction of the anterior cruciate ligament is one of the preconditions for the rupture of contralateral ligament.
Although we recorded satisfactory results of bilateral reconstruction of the anterior cruciate ligament, 81% of the athletes returned to training, but only every second (53.1%) returned to the sport after previous operations without restrictions.

It took the athletes in our sample more than two and a half years on average to return to competitions. Operations of additional meniscus ruptures do not play a crucial role in restitution of sports activities.

Because of the methodologically small sample, the statistical correlations gave little or no statistical significance. Therefore, it is necessary to perform more detailed observation of the results obtained under different aspects of sports activities on a larger number of patients.

References


