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General Hospital Subotica, Department of Orthopedic Surgery and Traumatology
Clinical Center of Vojvodina, Novi Sad
Department of Orthopedic Surgery and Traumatology
Institute for Child and Youth Health Care, Novi Sad
Department of Pediatric Surgery
University of Novi Sad, Faculty of Medicine Novi Sad

CYCLOPS SYNDROME - A COMPLICATION AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

KIKLOP SINDROM KAO KOMPLIKACIJA POSLE REKONSTRUKCIJE PREDNJEG UKRŠTENOG LIGAMENTA

Vladimir RISTIĆ1, Milica ILIĆ2, Mile BJELOBRK2, Vladimir HARHAJI2,4 and Vukadin MILANKOV3,4

Summary
Introduction. Cyclops syndrome is one of the causes of failure of anterior cruciate ligament reconstruction. The aim of the study was to examine the quality of life of patients who had this complication and its consequences till the return to unrestricted (sports) activities.

Material and Methods. During an eighteen-year follow-up of 4330 patients, cyclops syndrome was found in 71 patients (1.64%). This study included 60 of them, who agreed to fill out a questionnaire and functional scoring scales.

Results and Discussion. The mean Tegner score was 5.95 and Lysholm score was 86.13 points. After the arthroscopic removal of cyclops lesion, excellent results were found in 22 patients (36.7%), good in 19 (31.7%), poor in 16 (26.7%) and very poor in three cases (5%). On average, athletes lose 10 months from injury to anterior cruciate ligament reconstruction. It takes at least 6 months to return to competitive sports. If cyclops lesion occurs, it takes approximately 10 months to arthroscopy, and on average 3 months of postoperative recovery.

Conclusion. Cyclops lesion is a complication that significantly compromises the outcome of anterior cruciate ligament reconstruction, in terms of functional scores, subjective symptoms, the intensity of sports activities, and quality of life. Arthroscopic removal of the cyclops lesion leads to satisfactory postoperative results, but athletes lose 2.5 years on the whole, from injury to return to unrestricted sports activities.

Key words: Anterior Cruciate Ligament Reconstruction; Range of Motion, Articular; Reconstructive Surgical Procedures; Postoperative Complications; Quality of Life; Recovery of Function; Arthroscopy; Surveys and Questionnaires

Sažetak
Uvod. Kiklop sindrom predstavlja jedan od uzroka neuspeha rekonstrukcije prednjeg ukrštenog ligamenta. Cilj istraživanja je da utvrdi kakav je kvalitet života pacijenata koji su imali ovu komplikaciju i koliko gube od povratka nerestriktivnim (sportskim) aktivnostima.


Ključne reči: rekonstrukcija prednjeg ukrštenog ligamenta; opseg pokreta zglobova; rekonstruktivne hirurške procedure; postoperativne komplikacije; kvalitet života; oporavak funkcije; artrosko-pija; istraživanja i upitnici

Introduction
Anterior cruciate ligament (ACL) reconstruction is an effective surgical procedure with 75% to 90% of patients reporting good or excellent outcomes [1, 2]. Complications after ACL reconstruction are rare, but with the increase in the number of reconstructions, their number is also increasing. Arthrofibro...
sis is one of the potential complications. The scar tissue in the knee joint may cause pain and limitation of movement. It may occur in primary arthrofibrosis without a known pattern. Secondary arthrofibrosis is caused by immobilization and infection [3, 4] or poor surgical technique, causing graft friction due to positioning of the tibial fixation tunnel too anteriorly [5], inadequate notchplasty or too large size of the graft [6, 7].

Cyclops lesion is also called localized anterior arthrofibrosis, because of its location in front of the graft tibial attachment. It is often detected by magnetic resonance imaging (MRI) as asymptomatic, almost in 25% of all reconstructions [8]. This syndrome causes a progressive knee extension deficit, with or without pain and instability. Even a 5-degree loss of knee extension may significantly limit the patient’s sports activities, presenting a difficulty returning to their previous level. Considering the fact that ACL injuries and cyclops syndrome are most common among young physically active athletes, it is very important to examine all aspects of the injury: causes, mechanisms, risk factors, treatment and rehabilitation [9, 10]. Successful arthroscopic reconstruction, postoperative follow-up and aggressive rehabilitation significantly reduce the duration of treatment, rehabilitation, costs of treatment, and provide faster return of patients to daily and work activities [6, 7, 11, 12].

The aims of this study were to examine the quality of life of patients with cyclops lesion, the time necessary to return to unrestricted (sports) activities, and whether there were statistically significant differences between sex and age of the respondents.

**Material and Methods**

A descriptive-retrospective study was conducted at the Department of Orthopedic Surgery and Traumatology with the approval of the Ethical Committee of the Clinical Center of Vojvodina. The study included 60 patients with cyclops syndrome after ACL reconstruction performed at the Clinic in the period from January 2000 to May 2018.

Of the 4330 patients who underwent bone-patellar tendon-bone (BTB) ACL reconstruction technique during an 18-year period, this complication was found in 71 patients (1.64%). A survey questionnaire was sent by e-mail to all volunteer respondents [13].

A modified Knee injury Osteoarthritis Outcome Score (KOOS) was used in the data collection [14] as well as Tegner [15] and Lysholm scores [16]. Questions related to problems specific to this type of injury have been added. The questionnaire was designed to assess the short-term and long-term effects of knee joint injuries and it was divided into four parts. The first included general information about the level of sports activities before and after injury, type of sport, mechanism of injury, time from injury to diagnosis of ACL rupture, time from injury to reconstruction, concomitant injuries, time from ACL reconstruction to arthroscopy and symptoms that were the reason to seek help again. The second segment covered issues related to pain and constraints during various activities. The third part was related to the post-operative level of sports activities, while the fourth referred to the quality of life after surgery and the way they experienced their injuries.

The respondents had the opportunity to give their suggestions at the end of the questionnaire. The segment on the quality of life contained 6 questions related to: perceptions on their current quality of life, difficulties after surgery, awareness of limitations and lifestyle changes in order to avoid activities that could potentially be harmful.

All patients were contacted by telephone to explain the purpose of the research, and answers to the questionnaire were forwarded via e-mail. We performed a selection and separation of medical data (medical history, computer database) of all patients with cyclops syndrome after ACL reconstruction.

Out of the total number of respondents, 52 were males (86.7%) and 8 females (13.3%). The youngest respondent, at the time of the research, was 18 and the oldest 50 years old. The average age was 26.7 years (± 6.472). At the time of injury, the average age of the respondents was 22.6 years (± 5.726), ranging from 14 to 42 years. The average height was 184.93 cm (ranging from 158 to 206 cm), while the average weight was 85.85 kg (ranging from 59 to 130 kg).

In 58 patients, the injuries occurred during sports. One patient was injured in the workplace, and in one case the injury was a result of a traffic accident. There was no statistically significant difference in the cause of injuries between male and female respondents (Sig = 0.005 < 0.05).

It was found that 42 examinees (70%) injured their right knee, while left-sided injuries were found in 18 patients (30%). The dominant jumping leg was left in 40 subjects, and the right leg in 20 patients.

Only four respondents had a positive family history of ACL rupture. In all cases, the patient’s father was injured. In the remaining 56 patients, no one in the family had a similar injury.

A contralateral ACL injury was found in 11 patients, i. e. 18.3% of the total number of participants. There were 24 patients with concomitant injuries. Out of that number, 11 had a rupture of the medial meniscus, 9 of the lateral meniscus, and 4 patients of both menisci.

Before ACL injury, 30 respondents (50%) were professionally engaged in sports, 27 (45%) were recreational players, while 3 patients did not engage in sports (5%). By analyzing data on the level of
sports activity before injury, the obtained results showed that 12 of them were international athletes, 14 were national and 13 were regional athletes.

Within the descriptive statistics, the variables were determined for parametric features: mean value, standard deviation, minimum and maximum. For nonparametric features, the incidence of certain categories was investigated. In the data analysis and hypothesis testing, a paired sample T-test was used as well as regression analysis.

Results

Data on the current level of sports activity showed that at present 5 athletes compete at international level, 7 at republic, 9 at regional, 24 at recreational level, while 12 patients stopped their sports activities.

The average time interval since ACL reconstruction to the arthroscopic debridement of the cyclops lesion was 10.3 months, namely 1 month was the shortest interval, up to 6 years, that was the longest interval.

The most frequent subjective symptom before re-arthroscopy was the inability to fully extend the knee and it was found in 76.7% of cases. Of all the respondents, 29 had some difficulties during high energy activities, 28 had partial limitations, and 3 patients described their activities as very difficult.

The pain was graded according to the type of knee activity, with 23 patients experiencing pain when pivoting, 14 when extending, 32 when flexing, and 11 when walking on a flat surface, 24 during long standing, and 25 during long sitting.

During the first month after the second look arthroscopy, more than a third of the respondents, 22 (36.7%) started running, 11 (18.3%) continued training, and after six months 42 (70%) athletes returned to training, and 18 did not. Even a year after the repeated arthroscopic surgery, 23 respondents did not return to non-restricted sports activities (as much as 38.3%).

Table 1 shows the degree of severity of symptoms after arthroscopy in regard to the activities. It has been demonstrated that arthroscopic removal of the cyclops lesion significantly reduced patients’ symptoms (pain and limitations during: changing the direction, training, competition, landing, jumping, sprint, workout at gym), because half of patients had no symptoms, and pain always persisted only in 3.3% of cases.

The median Tegner score was 5.95; the minimum was 2, and the maximum 10 (standard deviation (SD) 2.274). It was found that there was no statistically significant difference between the sexes (Sig = 0.003 < 0.05).

The average Lysholm score was 86.13. The minimum was 50, and the maximum 100. The average score among the female respondents was 85.63, ranging from 72 to 95. Among the male respondents, the average score was 86.21, ranging from 50 to 100. Also, there was no statistically significant difference between the sexes (Sig = 0.026 < 0.05).

After the arthroscopic removal of the cyclops lesion, according to Lysholm score, excellent results were achieved in 22 patients (36.7%), good in 19 (31.7%), poor in 16 (26.7%) and very poor in three cases (5%).

Fifteen respondents (25%) continued training with the same intensity as before the injury, and 13 respondents (21.7%) were training with higher intensity. The number of patients who have reduced training intensity was 15 (25%), 17 of them (28.3%) stated that they did not practice sports actively, while activity decreased in seven patients (12.7%). Two years after surgery, three patients stopped practicing sports (5.4%).

The time span from arthroscopy to return to full competition was 3.3 months, on average. Only 23.3% returned to competition in the first 3 months. By the seventh month, 31 patients continued with competitive activity. Six respondents needed more than a year to achieve a competitive level. Out of the total number of respondents, 23 were no longer engaged in sports.

Knee surgery affected the quality of life to some degree in 80% of our respondents. The majority of patients were aware of their knee problems (63.4%), and 71.7% of respondents have changed their way of life to some extent in order to avoid activities that were potentially harmful to their health. Around 65% of participants in our study presented with some knee problems. The most frequent was the impact on the quality of life and daily functioning in a mild form. Considering sport activities, between 30% and 50% of the respondents did not have any difficulties. After competitions, 15 of 60 patients did not have any knee problems. During the usual training practice, 20 of them also had no difficulties. Between 40 and 60% of patients reported some limitations during changing the direction of movement, landing on injured leg, jumping, sprint, and exercises at gym.

Analyzing the questionnaire answers, there were no statistically significant differences in all age groups (Sig = 0.004 < 0.05).

Discussion

According to available literature, knee injuries account for about 30% of all sports injuries [17]. The incidence of ACL injuries is constantly increasing. Over the last three decades, all of the structures of the knee joint are more frequently injured, as well as ACL. The higher increase of injuries is the result of increased involvement of modern men in sports, both professional and amateur [1, 17, 18].

The most common activities that cause these injuries are skiing, football, handball, basketball, volleyball and traffic accidents (up to 20%) [19]. Regarding the situation in which the injury occurred, our results show a deviation from the literature data, as 96.6% of our patients sustained sports injuries, most often during playing soccer [20, 21].
The ACL reconstruction is today one of the most commonly performed surgical procedures. In the United States alone, more than 200,000 of these procedures are performed annually [18]. The main goals of the surgery are to remove the symptoms, gain full knee stability throughout the movement, and return to the previous level of sports activities. This is achieved in 75 – 90% of operated patients [1, 2, 22]. Immediately after surgery, instead of immobilization, it begins with early, controlled knee joint movements. The main tasks of rehabilitation protocols are to prevent swelling of the knee joint, establish good muscular control, and restore the full range of motion and prevent arthrofibrosis and patellar pain [9]. The early introduction of exercises prevents the development of complications such as arthrofibrosis and patellar pain. It is necessary to insist on achieving the full knee extension in the first three postoperative weeks, because it leads to optimal positioning of the graft and prevents excessive bleeding followed by an increase in the production of scar tissue [4, 10].

Complications following ACL reconstruction are relatively rare [4]. One of the potential complications is cyclops lesion. Cyclops syndrome was first described by Jackson and Schaefer in 1990 [7]. They defined it as loss of extension of the knee after ACL reconstruction, caused by intra-articular nodular proliferation of the fibrovascular tissue, originally from ACL graft. This syndrome was named after Cyclops, one-eyed giants from Greek mythology. The fibrous formation is arthroscopically resembling a head with reddish-blue areas that looks like eye of a Cyclop [23] (Figure 1). This lesion consists of interposition of fibrous tissue in front of the tibial insertion of the new ligament, which will work as an end point during extension, thus limiting the last degrees of motion. The clinical picture varies from painless strokes to the acoustic phenomenon (“click”) at the end of the movement, to the painful mechanical blocking the full extension [23]. Although pathophysiology and the cause of the occurrence are unknown, there are more theories about what leads to this lesion [23–25]. According to the first theory, the nodule is created from bone and cartilaginous residues, after drilling bone tunnels in the joint [23]. Another theory argues that cause happen to be a reparative process that occurs as a reaction to the residual living tissue of a ruptured ACL [24]. According to the third theory, repeated contact of the graft in the intercondylar notch ruptures its front fibers, causing fibrosis scattering [25]. The risk of cyclops syndrome is doubled when the tibial and/or femoral tunnel is placed too anteriorly [5, 23]. Patients with narrow intercondylar notch also have a higher tendency to develop this lesion [25], since the formation of the cyclops can be induced by contact, due to the incompatibility in the size of notch and graft, causing its impingement.

This syndrome is more common: in people who have undergone a ligament reconstruction with bone-patellar tendon-bone (BTB) graft than with hamstring tendons [26], in patients who had ACL reconstruction within the first four weeks after the injury, as well as those who had signs of inflammation at the time of surgery. It is most commonly developed around the distal remnant of the ruptured ACL due to an inflammatory reaction [27].

Cyclops syndrome most commonly occurs in the early postoperative period, in the first two months after the operation.
after the surgery [28], but there are also cases of delayed-onset lesions [29], even four years after reconstruction. Although this syndrome was primarily observed in people who had ACL reconstruction, cyclops can also occur after ACL rupture, but without surgery [27–29]. There is also a statistically significant correlation between the occurrence of cyclops lesion and knee extension deficiency in the 3rd and 6th weeks after ACL reconstruction. The stiffness of the back thigh muscles in the early postoperative stage may predict the occurrence of this complication [30].

Beside the cyclops lesions, there are also cyclopoid formations, with arthroscopic and MRI findings of cyclops, but without clinical manifestations and without deficiency in the knee extension [8, 29–32]. Histomorphological analysis shows a difference in the histological structure of the cyclops and cyclopoid nodules. Cyclops lesions are most commonly made of fibrous and cartilaginous tissue, coated with a synovial membrane, affected by ossification [31]. There are signs of bone formation with the activity of osteoblasts and osteoclasts. The tissue is well vascularized. There is no infiltration of inflammatory or granulocytic tissue [31]. Cyclopoid scarring formations are made of fibrous and granulocytic tissues, with areas of cartilaginous tissue, but without osseous tissue. A well-vascularized granulocyte tissue is surrounded by a mature, well-organized fibrous capsule. Cyclopoid formations do not contain grafted cells [31].

The occurrence rate of cyclops syndrome in the literature varies from 1.2% to 25% [4, 7, 8, 31–34]. In our sample of over 4000 surgeries, the incidence was 1.64%. Although we used BTB graft, the reason for low incidence may lie in the fact that most of our patients underwent surgery at least three weeks after injury, when the full range of knee movements was achieved and the possibility of inflammatory processes and fibrosis was reduced.

Cyclops lesion can be prevented by adequate removal of all ruptured ligament fibers, positioning the bone tunnels in bones, avoiding fiber damage [11, 12] and early rehabilitation, which aims to achieve full extension and flexion of at least 90 degrees during the first postoperative month [9, 10]. If the lesion causes pain and movement restriction, predominantly in knee extension, arthroscopic knee debridement is necessary [6, 7, 11, 12].

In order to treat cyclops adequately, it needs to be recognized as soon as possible. The diagnosis is based on clinical symptoms and MRI findings (Figure 2). Patients complain of pain and progressive loss of extension with cracking or popping noises in the knee and painful terminal extension when walking or running. Among our respondents, the most common reasons for visiting the doctor and performing arthroscopy after ACL reconstruction were pain in 29 patients, loss of extension in 38, and loss of knee flexion in 15 patients. Swelling appeared in 18 subjects, and knee squint in 14 patients. The results of our research do not differ significantly from the results in the available literature [2, 6 – 8, 23], as others also reported that the most common symptoms that indicate second-look arthroscopy were: pain, swelling, and lack of terminal knee extension.

Of the 60 respondents who participated in our study, 52 were male (86.7%). In most other studies, this complication is more common in males [7, 17, 23, 31, 32]. The average age of our patients at the time of ACL injury was 22.6 years. The average age of male patients was 22.7 years, while it was 21.1 years in female patients. Our results are similar to those of a Japanese study of cyclops lesions [25], where the average age was 21.6 years, but in most others, the patients’ age ranged between 27 – 30 years [23, 31, 32]. The reason why patients of all ages are found in the literature is that athletes start their professional career earlier, the life expectancy has generally increased with the promotion of healthy life and healthy aging, and people remain physically active at older age as well.

Cyclops syndrome is treated arthroscopically, because methods of physical medicine and rehabilitation do not provide satisfactory results [7, 23, 31, 32]. The rehabilitation is long and hard, whereas the results are inadequate and short-termed, as confirmed in our study. Even when an increase in the range of motion is achieved, the deficit returns shortly after the end of rehabilitation. It is necessary to surgically remove the mechanical obstacle in the
joint. After arthroscopic removal of nodules, postoperative rehabilitation follows. In most cases, immediately after the surgery, the knee mobility increases, and after kinesiotherapy the full range of motion is achieved [32], which was also the case on our sample.

The gap between ACL reconstruction and arthroscopy in our patients was 10.3 months on average (from 1 month to 6 years). This period in other studies ranges from 9 - 21 months [23, 31, 32].

We evaluated the surgical status results using functional scales. The average Lysholm score in our patients was 86.13 points (50 – 100). Out of 60 patients, 68.4% were ranked as good or excellent. In the literature, the postoperative Lysholm score in the cyclops syndrome ranges between 91.5 and 94.1 points [11, 33], while in other surgical procedures used for the elimination of knee adhesions, only 82 points [12]. In our earlier papers [35–38], this value ranged between 93 and 97 points, which indicated that cyclops lesion is a complication that significantly compromises the average results of ACL reconstruction.

The mean value of Tegner score after arthroscopy in our patients was 5.95. We did not find the results of postoperative Tegner score in any study dealing with cyclops following ACL reconstructions. After the arthroscopic removal of all adhesions, the average postoperative Tegner score was 5 [12]. Otherwise, the average values of this scoring scale after ACL reconstruction range from 7.6 to 8.2 [36, 37]. These values are significantly better than in our study, which also indicates that the cyclops syndrome significantly affects the level of activity after ACL reconstruction.

The available literature is scarce regarding data about return to sport, considering the level and intensity of post-arthroscopic sports activities. Such information are found only in a Chinese study [33], where from 45 patients, only 6 athletes (13%), were unable to deal with their usual sports activities, due to loss of extension. Of the 60 respondents who participated in our study, 46 (80%) recovered full knee extension, and 37 knee flexion. Activities that require significant strength, such as lifting weight and participation in sports competitions, are partially complicated for 28 patients, very difficult for 3 patients, while 29 examinees reported no difficulty in these activities.

The average recovery time after arthroscopy and return to light sports activity or starting running in our respondents was two months. Fifty percent of them started running in the first two months after arthroscopy. In the first 6 months, 82% began running smoothly. The remaining 18% were non-athletes. On average, 2.15 months have passed since arthroscopy to return to training.

In the first three post-arthroscopic months, 45% of patients returned to training, and 70% after sixth months. The most comprehensive study examining the period needed to return to competition was our earlier study, when we examined the same parameters in patients with bilateral ACL reconstructions [35]. In that study, 87% of athletes returned to training after ACL reconstruction of one knee, and 75% continued competing. After surgery of the contralateral knee, 81% returned to training, but only 53% returned to full competition [35].

A comprehensive review on the return to sports activities after ACL reconstruction, which included 48 studies, with a total of 5770 participants and average follow-up period of 41.5 months [18], reported that 82% of participants had returned to sports activities at some level, 63% returned to the level of participation before the injury, and only 44% returned to competitive sport. Fear of recurrence is the most common reason for postoperative reduction or a cessation of participation in sports. Despite high chances for operative success, a relatively low rate of return to competitive sport supports the fact that psychological factors can influence the degree of return to sports activities after injury [18].

Reconstruction of ACL is considered to be a “quality of life” surgery, as it helps patients return the quality of life to the level before the injury. However, cyclops syndrome causes a progressive deficit of knee extension, with or without pain and instability. A loss of just 5 degrees can significantly limit the patient’s sporting performance and prevent the return to sports. Analyzing the data of the study, the results show that in 80% of our patients, knee surgery has to some extent affected the patients’ quality of life. The majority of patients are aware of their knee problems (63.4%), and 71.7% of respondents have changed their way of life to some extent in order to avoid activities that are potentially harmful to their health.

Our research has several limitations. One of the disadvantages is that patients were contacted by telephone or email, so we could not directly explain anything possibly unclear in the questionnaire. In addition to a small sample, we also had a great disproportion between the sexes. We only interviewed eight females, which affected the credibility of the examined correlations. In addition, there were some problems in designing the questionnaire itself. As the questions in the KOOS questionnaire are not specific to the cyclops syndrome, it was necessary to modify it, which affected the loss of statistical calculation of each individual segment of the questionnaire. One of the limitations is the time interval from the injury to surgical intervention and the moment of conducting the study and filling the questionnaire. The main problem is that for a large part of the questions patients were asked to retrospectively recall specific information about the activities and symptoms, so the presence of bias in the methodology cannot be excluded.

This research could provide guidelines for further studies to deal with the quality of life after cyclops syndrome, especially because a small number of papers deal with this topic, from the as-
pect of quality of life and the impact on sports activities of patients with this complication.

**Conclusion**

Cyclops lesion is a rare but a potential complication after anterior cruciate ligament reconstruction. This syndrome causes a progressive deficit of knee extension, significantly limiting the patient’s sporting performance and does not respond to rehabilitation treatment. Answers to questionnaire questions indicate that there are no statistically significant differences in age or sex distribution of examinees. Cyclops lesion significantly compromises the result of reconstruction, in terms of scale, subjective symptoms, the intensity of sports activities and the quality of life. After reoperation, the patients’ symptoms significantly reduced, but results of the activity scale and return to sport were worse than in patients who underwent reconstruction without this complication. The arthroscopic removal of the cyclops lesion leads to satisfactory postoperative results, but athletes lose altogether about 2.5 years from injury to return to unrestricted activities.

**References**


27. Irisawa H, Takahashi M, Hosokawa T, Nagano A. Cyclops syndrome occurring after chronic partial rupture of the anterior...


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Ristić V, et al. Cyclops Syndrome after ACL Reconstruction