

Cyclops syndrome following ACL reconstruction: a complex issue that extends beyond mechanical obstruction

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Hypothesis: We hypothesized that cyclops syndrome represents a mechanical issue, suggesting that the problem (extension deficit) is definitively resolved and solved once the cyclops is removed.

Materials and Methods: During a two-year period (from January 1992 to December 1994), in which 835 bone-patella-bone autograft ACL reconstructions were performed, 36 patients (4.3%) required arthroscopic revision for Cyclops lesions. The mean age of patients was 26.2 years old (range, 16-43 years). Average time of treatment of the Cyclops lesion after primary surgery was 10 months (range, 2.5-26 months). Activity level was intensive for most of the patients. All patients were evaluated with the IKDC scoring system (subjective evaluation and clinical exam) and KT 1000 testing. Residual Cyclops symptoms were also analyzed. The mean follow-up was 9 years (range, 8-10 years).

Results: Seven patients were lost to follow-up and were excluded from the study. Twenty-nine patients were followed up: 6 by phone (16.7%) and 23 clinically (63.9%). Two recurrent ACL lesions were noticed (6.9%). The mean final IKDC subjective score was 81.6 points (range, 50-100). Half of the patients had good results (greater than 82 points), while the other half had reduced scores (between 50 to 80 points). The distribution of the final IKDC objective score was: A = 17.4%; B = 65.2%; C = 8.7%; D = 8.7%. Thirteen patients had persistent Cyclops symptoms (44.8%), 14 patients still had loss of motion (48.3%), and 15 patients had diminished levels of activity (51.7%).

Conclusions: Cyclops syndrome, while not affecting knee laxity, is associated with significant long-term symptoms. This suggests a complex etiology beyond mechanical factors. Early surgical intervention may mitigate chronic complications.

Type of Study: Retrospective clinical study

Keywords: cyclope/ ACL complication / Arthrogenic Muscle Inhibition (AMI) / extension deficit/ knee

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Introduction

In spite of advancements in arthroscopic ACL (anterior cruciate ligament) reconstruction, complications, such as arthrofibrosis and stiffness, still persist. Loss of extension after ACL reconstruction was historically considered beneficial. Graft healing and incorporation was thought to be facilitated with a lack of knee extension, in order not to load the graft. Progressively, as the expected results always increase, a new problem, well described by D. Jackson in 1990 and called the Cyclops syndrome, occurred. The lesion takes its name for its morphological resemblance to the one-eyed Greek mythological monster. The Cyclops lesion may present in 2 distinct morphologic forms (**Figure 1A and B**). It may have a pedunculated attachment to the ACL graft, with a variable height [1][2][3] or it may present as a fibroid mass at the base of the graft in which it morphologically resembles an elephant's foot [1][2][3][4].

These formations are responsible for a mechanical obstacle, between the tibia plateau and the femoral notch, while extended knee. With repeated trauma, the Cyclops lesion, which is normally pearly color, may appear inflamed and ecchymotic (**Figure 1C**).

Histologically, the Cyclops is an intra-articular nodule constituted with fibrocytes, more immature in the center. The central part is also well vascularized that explains the bruise when impingement occurs and thus becomes the iris of the Cyclops eye. Sometimes, bone tissue,

mature (as residue of tunnels drilling) or immature (due to neoformation), could be observed in its structure.

Patients typically complain of a lack of extension, that could be isolated (10° to 15°), or associated with pain and clunk occurring with extended knee, swelling of the knee after certain activities. The lack of extension could be variable, increasing with constrain activities. This phenomenon could be explained by an expanded nodule according to the bleeding of its central ecchymosis [5]. The syndrome appears with variable delays, depending on the volume of the nod, its ecchymotic character, from couple weeks to couple months. It could also be very late, explained as an inconvenience to recover optimum sports activities.

Clinical examination shows an anterior pain caused by sudden extension, painful fad pad on both sides of patellar tendon (subextended knee), barely associated with tumefaction.

The surgical arthroscopic procedure has two main periods: The first is compulsory, stepwise excision of the nodule, in order not to damage the graft (**Figure 2A**). Second is facultative, in cases when extension remains limited notchplasty is possibly performed using a burr or a Gouge, especially on the anteromedial side of the notch (**Figure 2B**). At the end of the procedure, full range of motion should be recovered. Obviously, the impingement should also disappear. After this procedure, previous studies reported short term results that were less favorable than expected [5], with a lower level of sports activities.

Our objective is to evaluate the long-term results and to demonstrate whether this is a strictly mechanical problem.

Materials and Methods

This is a retrospective, single-center, single-operator (PC), cohort study. From January 1992 to December 1994, the senior author (PC) performed 835 ACL reconstructions using Bone-patellar tendon-bone autograft. Of these, 36 were reoperated for Cyclops syndrome (4.3%), including 26 males and 10 females. Mean age during the second surgery was 26.2 years old (range 16 to 43). All patients had active lifestyle. Twenty-five patients had intensive activities (86.2%) and 4 patients had moderate activities. Twelve athletes (41.4%) had very

strenuous activities with contact (soccer) and 17 athletes (58.6%) had strenuous activities (ski).

Of the reoperated patients, twenty-three (63.9%) have been clinically examined, and 6 patients (16.7%) have been followed up by telephone (JB). That represents a follow-up's percentage of 80.6%. Seven patients (19.4%) were lost to follow-up. The mean follow-up was 9 years (range, 8 to 10).

IKDC evaluation sheet (subjective and clinical exam) and KT 1000 device were used to assess the patients who were available to come in the office. Residual specific Cyclops symptoms were also analysed.

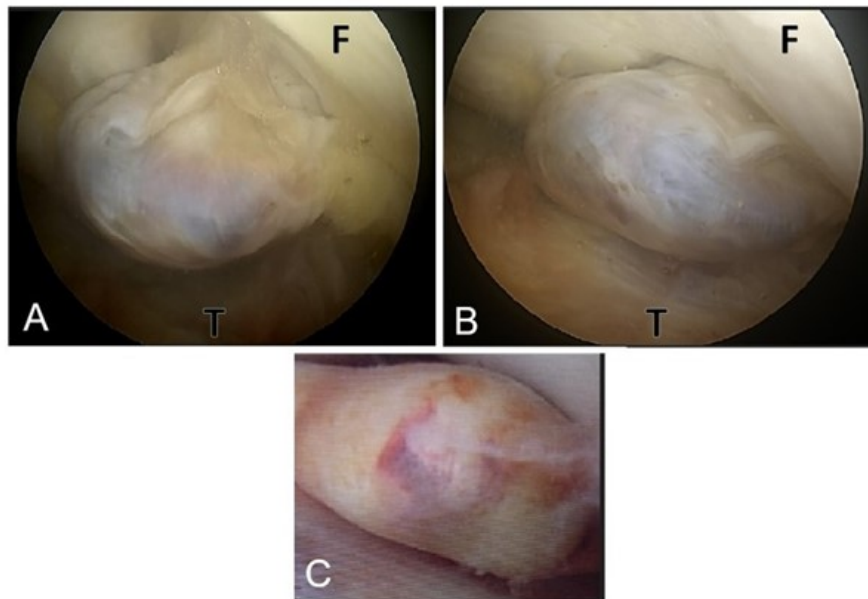


Figure 1. Notch arthroscopy showing a Cyclops lesion at 90° of flexion (A) and in full extension (B and C). C presenting a Cyclops lesion with inflammation and ecchymosis. F: Femur, T: Tibia

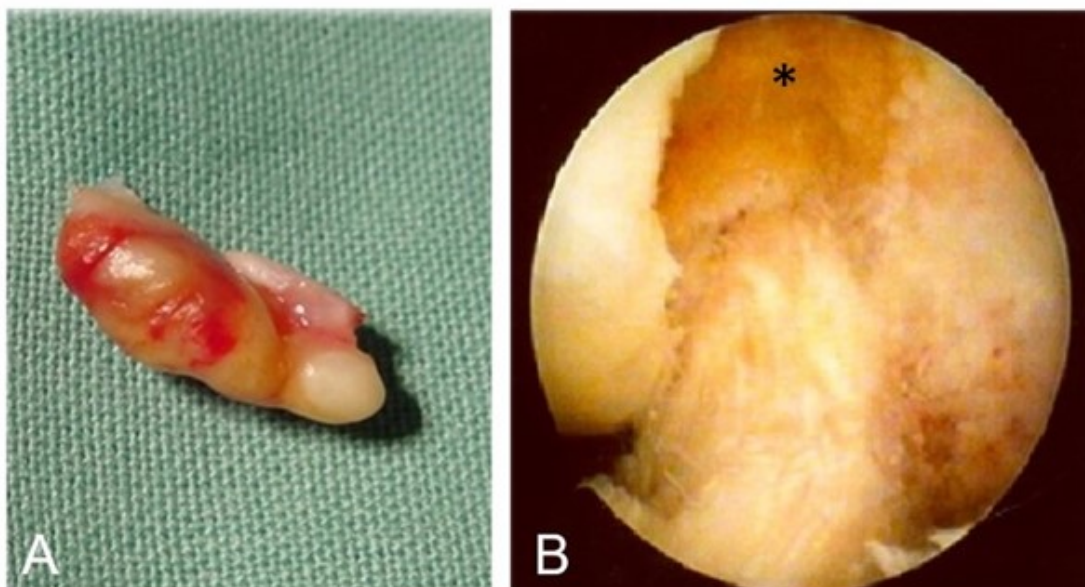


Figure 2. After resection of a Cyclops lesion the nodule is excised: A: macroscopic aspect, B: Notch arthroscopy after notchplasty (*).

Previous radiographs were taken in 17 patients. Location of the tunnels, osteophytes, calcite deposit, patellar height (according to Caton and

Deschamps's index [6]) and arthritis stage (according to Albach's classification [7]) were analysed.

The average time between the initial surgery and the subsequent procedure was 10 months. The main results observed before the second surgery included a mean extension deficit of 6.5° (range 0 to 30°). Additionally, the mean flexion achieved was 120° (range 100 to 150°). Twenty-one patients reported anterior knee pain (58.3%), while 12 experienced a palpable "clunk" sensation (33.3%). Furthermore, fourteen patients (38.9%) noted knee swelling following specific activities.

All of the patients were reoperated under arthroscopic control. We found 23 pedicle nodules and 13 "elephant's foot". Thirteen times, an ecchymosis of the nodule was observed. All were excised and in 18 cases a notchplasty was necessary. None posterior arthrolysis was reported.

Results

Subjective evaluation of the knee

Twenty-nine patients fill in the IKDC subjective evaluation sheet, in the office or by phone. The IKDC subjective score shows that almost all the patients presented with a stable knee for strenuous activities (97%). Thirteen patients remained symptomatic after surgery, such as anterior pain (24.1%) and knee swelling (27.5%) during light or moderate activities (running, walking) (Table 1). As for the final subjective assessment (Figure 3), the mean was 82%, with approximately half of the patients scoring above 80%.

Range of motions

The mean absolute extension deficit in relation to the opposite side was 1.1° (range 0°- 15°), with 26 patients with no deficit, two with a slight deficit (3°) and 2 with a flexion contracture (10° and 15°).

The mean relative extension deficit was 4.1° (range 0°- 25°), with 15 patients with no deficit, 9 with a minor deficit (3 to 5°), 3 with a moderate deficit (10°), and 2 with a major deficit (20 to 25°). The mean absolute flexion deficit was 3.4° (min 0°, max 20°), with 18 patients with no deficit, 3 with a minor deficit (3 to 5°), 7 with a medium deficit (10 to 15°) and one with a major deficit (20°).

Stability

Using the KT1000 device, comparing to the other side, the manual maximal difference on average was 1.3 mm (range -3 to 4 mm). Two patients had a rerupture of the ACL (6.9%), after arthrolysis.

Sports activity

Fifteen patients (51.7%) diminished their activity level and 8 patients (27.6%) had to change the type of sport for a less strenuous activity.

Nineteen patients (82.6%) were stage A and B, 2 were stage C (8.7%) and 2 were stage D (8.7%).

Radiological outcomes

Radiographs were taken in 17 patients, 15 of them had normal tunnel locations (88.2%). Two patients had two anterior tibial tunnels (11.8%). Six patients had roof osteophytes and 8 had calcium deposits. A low patella was observed in 5 cases (29.4%) and normal in 12 patients (70.6%). No osteoarthritis was found, and all were classified as "stage 0" except 2 persons who were "stage I".

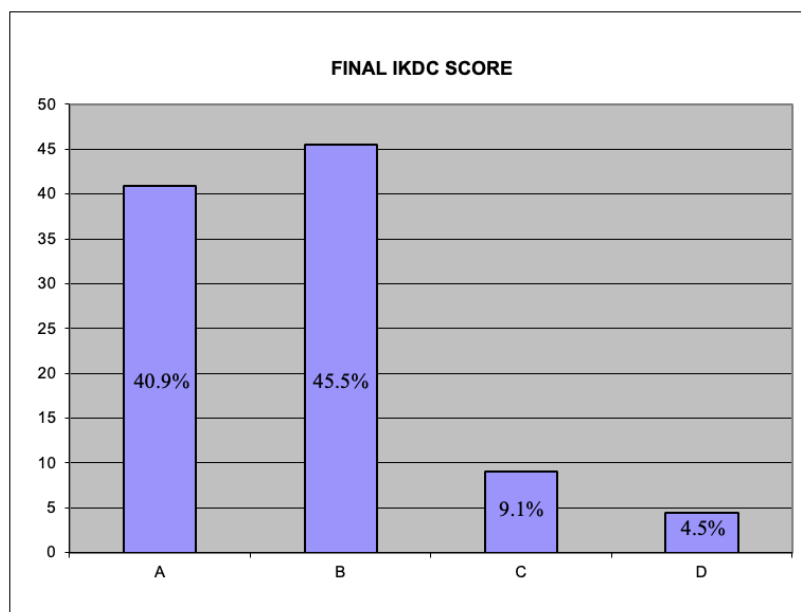


Figure 3. Final IKDC Score: A (normal) 40.9%, B (near normal) 45.5%, C (abnormal) 9.1%, D (severely abnormal) 4.5%.

Table 1. Postoperative symptoms

Type of persistent postoperative symptoms		
Anterior Pain	7 (24.1%)	
"Clunk"	3 (10.3%)	
Swelling knee after activities	8 (27.7%)	
Algodystrophy	2 (6.9%)	
Comparison between before and after the arthrolysis		
	Persistan symptomes	New symptomes
Anterior Pain	5 (17.2%)	1 (3.4%)
"Clunk"	1 (3.4%)	2 (7%)
Swelling knee after activities	2 (7%)	6 (20.7%)

Discussion

The most important finding of this study is the persistence of symptoms in a significant number of patients, despite surgical intervention for Cyclops syndrome. While the majority of patients achieved a stable knee for strenuous activities, a substantial proportion continued to experience pain and functional limitations. This suggests that the underlying pathophysiology of Cyclops syndrome may be more complex than a purely mechanical issue.

The origin of the Cyclops syndrome remains controversial. Three theories can be discussed for the pathophysiology: Jackson and Chassaing developed the fibroproliferative theory in which the nodule comes from the residues left by the reamer [8]. Marzo explained a microtraumatic theory in which a conflict between the ligament and the notch is responsible [1][2][4]. McMahon and Trojany reported Cyclops syndrome before ACL reconstruction due to ACL rupture in which fragment are left behind [9][10]. We add that being too generous in shaving the prespinal surface is also a source of complication.

It is not entirely clear where in the literature the concerns regarding an association between remnant preservation and cyclops syndrome have arisen, because comparative studies have not demonstrated this [11][12]. In the current study, the overall rate of cyclops syndrome was 4.3%. Although the studies cannot be directly compared, this rate is similar with the rates of cyclops syndrome (1.93%- 8.4%) reported in studies using a non-remnant preserving technique [1][13].

The following risk factors were identified: before surgery, knee inflammation and knee motion range restriction at the time of surgery; during surgery, a narrow intercondylar notch and excessively anterior tibial tunnel; and after surgery, persistent hamstring spasm [14].

Delaloye et al identified that the most important risk factor for the development of cyclops syndrome was knee extension deficit in the early postoperative period. [15] In our series, twenty-five (69%) patients had an extension deficit, and regarding the position of the tunnels, two (11.8%) patients had tunnels that were too anterior. Patella tendon grafts may disrupt the extensor mechanism which is hypothesized to result in greater pain and quadriceps inhibition. Both of these factors are possible contributions to the increased incidence of knee extension loss in patients undergoing ACLR with bone-patellar tendon-bone autograft [16].

It is apparent that the early extension deficit observed in patients who go on to develop cyclops syndrome is very unlikely to be the result of a

mechanical problem. It is therefore logical to suggest that the observed extension deficit that leads to an increased risk of cyclops syndrome could be related to arthrogenic muscle inhibition (AMI) [17][18][19]. AMI is a frequent but underrecognized cause of extension deficit after ACLR. It is caused by changes in the discharge of articular sensory receptors (attributed to inflammation, pain, and swelling), which in turn alter neurological pathways resulting in a hamstring contracture and a quadriceps activation failure [20][21].

We can discuss the surgical delay of the arthrolysis, which is to long (almost 10 months). That was probably a reason to explain a laborious evolution of the knee. Earlier diagnosis and treatment could avoid this bad effect. A suitable time for the decision of surgical intervention for major motion loss after ligament reconstruction would be approximately 3–4 months [22].

Cyclops may not be a cause of recurrent lesion, but we have to be careful because the population in this study is small. There is no unfavourable effect on the IKDC score and on the laxity. But almost half of the patients remained symptomatic or still had loss of motion or diminished levels of activities. Individual factors, with excess fibrosis healing could be involved [1]. Klemmer et al in a case report presents risk factors such as female sex, increased BMI (body mass index), bone-patellar tendon-bone allograft and an extension deficit may be related to recurrence of cyclops syndrome [23].

Limitations of this study include the inherent weaknesses of a retrospective design and small sample size. Additional limitations were the fact that a fraction of the patients' follow-up data was retrieved via a telephone interview, and postoperative MRI (magnetic resonance imaging) was not performed. The most important weakness is the limited control group for comparison. The absence of a comparative group, such as patients who underwent successful ACL reconstruction without Cyclops syndrome.

Conclusion

In conclusion this study demonstrates that while Cyclops syndrome does not significantly impact knee laxity, it is associated with a substantial rate of persistent symptoms, including anterior knee pain, post-exercise effusion, and limited range of motion. These findings suggest that Cyclops syndrome may be more complex than a purely mechanical issue and that patient-specific factors may influence long-term outcomes. Early surgical intervention may be beneficial in

preventing the development of chronic symptoms. However, further research is needed to confirm these findings.

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