

# The results of arthroscopic resection of Cyclops lesion after anterior cruciate ligament reconstruction

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## Background

This study evaluates the results of arthroscopic resection of Cyclops lesions that develop after anterior cruciate ligament (ACL) reconstruction.

## Patients and methods

Between October 2016 and June 2021, 12 patients presented with lack of full knee extension due to Cyclops lesion after ACL reconstruction. All patients were subjected to local examination. The knee's MRI and arthroscopy revealed the classic signs of a Cyclops lesion. The patients were treated by arthroscopic resection of these lesions. 9 patients (75%) underwent a notchplasty. After arthroscopy the patients underwent a short course of physiotherapy to regain full ROM. All patients (11 men and one women) with a mean age of 30 (25 to 40) years, were followed-up for a minimum of 12 months. Range of motion of all patients was documented.

## Result

12 patients were treated with arthroscopic resection of Cyclops lesions. The average angle of knee extension improved from 15° (range 10 to 25°) to 2° (range 0 to 5°). After a minimum duration of follow-up of 12 months, full knee extension was achieved for all patients.

## Conclusions

It is important to recognize a Cyclops lesion as a possible cause of extension loss in any patient with ACL reconstruction. They are usually symptomatic, and their removal can restore range of motion to levels that are very close to normal.

## Keywords:

anterior cruciate ligament, cyclops lesion, knee, reconstruction

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## Introduction

Jackson and Schaefer first identified the Cyclops syndrome in 1990 in patients who had had patellar autograft reconstruction of the anterior cruciate ligament (ACL) [1]. The lesion is so named because at arthroscopy it has a head-like morphology with a focal region of discoloration, resembling an eye Runyan and colleagues, Jones and Allum [2,3].

When Cyclops syndrome occurs after ACL reconstruction, the micro-trauma that can be related to the narrowing of the intercondylar notch or the improper position of the graft in the anterior third of the tibia caused graft impingement on the notch at full knee extension, leading to the formation of neoproliferative fibrous nodule, impinging on the intercondylar notch when the knee is extended and acting as a mechanical extension block Marzo and colleagues, Fujii and colleagues [4,5].

Patients with small intercondylar notches are more likely to develop Cyclops lesions in their ACL-reconstructed knees, according to research by Fujii and colleagues [5]. This finding could be helpful in determining the best ACL reconstruction method

for each patient. Cyclops lesion formation may be influenced by notch impingement brought on by the graft's size mismatch with the intercondylar notch.

These lesions are important to recognize as they impair normal function, are easily treated with arthroscopic resection and are not amenable to conservative therapy Runyan and colleagues, Saddik and colleagues [2,6].

In most cases, the Cyclops lesions require arthroscopic excision in order to restore the extension deficit and relieve the patient's symptoms. If a vigorous rehabilitation programmed fails, this operation is advised [7–11]. The results of excision are excellent, and lesions hardly ever return after excision Kambhampati and colleagues [12].

In the present study, the significance of notchplasty as a simultaneous procedure with Cyclops lesion removal

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was discussed, and notchplasty was advised in all cases of ACL reconstruction.

The purpose of this study was to evaluate the results of arthroscopic resection of Cyclops lesion after ACL reconstruction.

### Patient and methods

Between October 2016 and June 2021, 12 patients presented with persistent loss of full knee extension due to Cyclops lesion with an average 12 months after ACL reconstruction using semitendinosus and gracilis (hamstrings) autograft.

11 patients were males and one was female, ranged in age from 25 to 40 years (mean 30). We prepared for this study after the approval of the local ethical committee. Each participant provided a written informed consent.

Patients who experienced persistent loss of complete knee extension following ACL reconstruction were included in the current study. Patients with prior bone procedures around the knee, knee arthritis, past open knee surgery, a history of knee fractures, infections, or systemic diseases were excluded from the study.

Age at Cyclops surgery, the degree of active knee extension, the interval between the ACL reconstruction and Cyclops surgery, and all technical surgical information, such as the type of graft, notchplasty, and any concomitant meniscal tears, were all recorded. The data from the preoperative magnetic resonance images were also analyzed. Demographics of all patients are shown in (Table 1).

The patients reported multiple episodes of lack of full knee extension. All patients were subjected to local

examination. Examination did not reveal swelling or effusion of the knee. The Lachman test, anterior drawer test, as well as the pivot shift test were negative and no signs of meniscal tear or cartilage pathology were found.

When compared with the opposite, uninjured knee, all patients' active knee extension was reduced by an average of 15° (with a range of 10 to 25°); knee flexion was normal compared with the opposite, uninjured knee. The knee with the nodule and extension loss (greater than 5° as opposed to a healthy contralateral knee) using a goniometer was identified as having Cyclops syndrome.

All patients underwent plain radiography, and MRI of the involved knee joint to determine the diagnosis and to exclude other possible causes of diminished knee extension. In all cases, sagittal (MRI) scans revealed an abnormal signal of a soft tissue mass that was attached to and immediately anterior to the ACL graft and was consistent with a Cyclops lesion that was impinging on the intercondylar notch (Fig. 1)). A diameter of 5 mm in each plane was used as the minimum required size to avoid false-positive cases as documented in previous a report [13]. No meniscal tears were detected.

Standard knee arthroscopy under general anesthesia was performed for all patients to remove the Cyclops lesions and improve the range of motion. Each knee had a fixed fibrous nodule (Fig. 2), with a head like appearance, adhered anteriorly to the ACL graft, and when the knee was extended, it impinged on the intercondylar notch. 9 patients (75%) underwent a notchplasty. The Cyclops nodule was successfully excised by shaving and, freeing the ACL graft which was intact. The nodule was histologically examined to confirm the diagnosis.

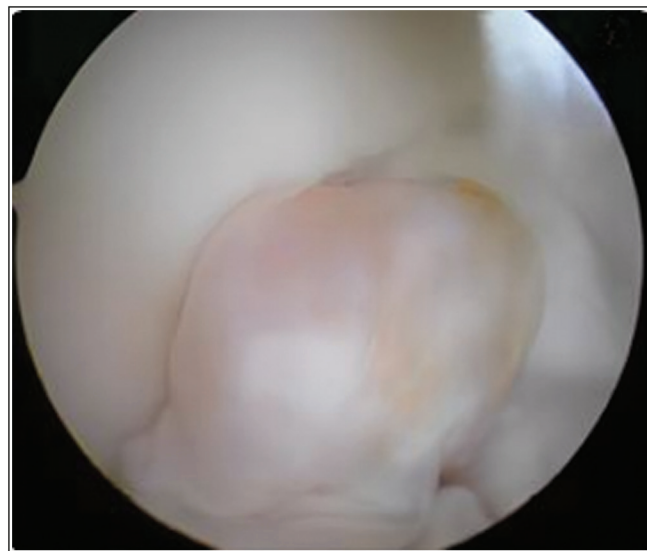
**Table 1** Data of the patients

N.	Age (Year)	Sex	Duration from ACL surgery and Cyclops resection (month)	Follow-up (month)	Type of ACL graft	Notchplasty	Associated meniscal tears	MRI finding of cyclops lesion	Preoperative lack of active knee extension	Postoperative lack of active knee extension
1	28	Male	8	24	*St, Gr	+	-	+	20°	5°
2	30	Male	10	12	St, Gr	-	-	+	10°	2°
3	25	Male	8	24	St, Gr	+	-	+	15°	3°
4	37	Male	8	12	St, Gr	-	-	+	15°	2°
5	29	Male	9	24	St, Gr	+	-	+	15°	0°
6	25	Male	12	12	St, Gr	+	-	+	25°	4°
7	40	Male	15	14	St, Gr	-	-	+	10°	0°
8	32	Male	18	20	St, Gr	+	-	+	15°	0°
9	26	Male	16	12	St, Gr	+	-	+	10°	3°
10	31	Female	10	14	St, Gr	+	-	+	10°	1°
11	29	Male	20	12	St, Gr	+	-	+	25°	4°
12	28	Male	10	24	St, Gr	-	-	+	10°	0°

\*St, Gr: Semitendinosus and gracilis.

**Figure 1**

Sagittal MRI shows a neoproliferative fibrous tissue mass located anterior to the ACL graft (arrow).

**Figure 2**

Arthroscopic view of the Cyclops nodule was located anterior to the graft.

After arthroscopy the patients underwent a short course of physiotherapy and regained full ROM after 3 weeks.

After a follow-up period of at least 12 months, patients were called for a check-up. The investigations included clinical examination, subjective symptom and activity level analysis, functional testing, and radiography. Range of motion was assessed goniometrically with the patient supine.

## Results

All patients (11 men and one woman) were re-examined at a minimum follow-up of 12 months after arthroscopic Cyclops resection. After ACL reconstruction, the Cyclops procedures were carried out an average of 10 months (with a range of 8 to 20 months).

Preoperatively, the knees' active extension was reduced by an average of 15° (with a range of 10 to 25°). But when the Cyclops lesions were resected, the angle of knee extension was reduced to an average of 2° (with a range of 0 to 5°).

Hard nodulous formation with an average size of 14×12×12mm was detected in these 12 individuals adhering to the ACL graft and in front of the intercondylar notch. The ACL graft in all patients was intact. Tight collagen bundles, an inflammatory response and necrosis, vascularized dense fibrous connective tissue, and patches of chondroid metaplasia were all identified upon histological inspection of the Cyclops lesions.

All patients had full knee extension compared with the contralateral knee following excision of the lesions and manipulation of the knee at the time of the surgical treatment. No meniscal tears existed. The arthroscopic resection surgery was performed without any complications.

Since the Cyclops lesion was the only factor contributing to the loss of knee extension, all patients were satisfied with the Cyclops surgery at the final follow-up examination, which took place an average of 17 months (with a range of 12 to 24) following the surgery. The knee's full range of motion was maintained without any complications.

## Discussion

The most notable finding of the current study was that surgical excision and notchplasty as well as vigorous physical therapy can dramatically improve range of motion in patients with Cyclops nodules that formed following ACL reconstructions. This finding is in line with other studies Delcogliano and colleagues, Aglietti and colleagues Shelbourne and colleagues [9,14–16] that showed positive outcomes from surgically treating a localized form of arthrofibrosis. Many authors have shown that patients treated within 6 months of having ligament surgery had better results in terms of range of motion (ROM) and functional outcome Aglietti and colleagues, Cosgarea and colleagues, Noyes and colleagues [14,17,18]. However, we disagree with this

finding, as we noticed that the time from ACL surgery to Cyclops resection did not seem to affect the results.

However, other studies documented that Cyclops surgery must be performed within one year after ACL reconstruction and must be followed by an appropriate rehabilitation programmed to get the optimum functional results Delcogliano and colleagues, Eckerode [9,19]. This finding was documented to be true in our study.

A nodule in the intercondylar notch that causes loss of extension is, by definition, a Cyclops nodule. Jackson and Schaefer suggested in 1990 that the nodule results from residual debris left attached to soft tissue during drilling of the tibial tunnel [1]. Other researchers identified reparative ligament processes, ACL stump remnants from arthroscopic reconstruction, repeated micro-trauma to the graft, inadequate anterior notch clearance, improper placement of the tibial tunnel, or immobilization of the knee as triggers for graft hypertrophy or scar proliferation Marzo and colleagues, Dandy and colleagues, Hasan and colleagues, Fullerton and Andrews, Tonin and colleagues [4,8,11,20,21]. However, it could arise from a small, mostly torn, untreated ACL tear Tonin and colleagues, McMahon and colleagues [21,22].

Clinical findings vary from an extension deficit to painful cracking and knee stiffness. An audible clunk and pain at terminal extension is also a common finding Delince and colleagues [7]. However, a Cyclops lesion can also be found in asymptomatic patients during second look arthroscopy or may develop in patients without evident causes Delince and colleagues, Muellner and colleagues [7,23]. Therefore, other studies failed to identify a single predictive risk factor and a multifactorial aetiopathogenesis appears likely. Patients who had an ACL reconstruction within 48 h of the injury had a surgical revision rate for Cyclops syndrome of 6.3% versus 2.5% when the treatment was carried out after the inflammatory reaction had subsided Delince and colleagues, Hasan and colleagues [7,11].

A narrow intercondylar notch was an important intraoperative factor that was linked to an increased likelihood of Cyclops syndrome. According to Fujii and colleagues [5], there is a strong association between the size of the notch and the occurrence of Cyclops. They advised measuring the notch size on MRI prior to surgery. If the patient has a small notch, the graft size should be small to avoid the notch impingement and notchplasty is recommended. This was found to be true in the current study, as 9 of our 12 patients had a

narrow notch that were documented intraoperatively during passive extension of the knee at arthroscopy denoted impingement of the graft at the intercondylar notch. All of these 9 patients underwent notchplasty during Cyclops resection to improve the impingement and prevent further recurrence of the Cyclops lesions.

Watanabe and Howell [24] documented that anterior positioning of the tibial tunnel might increase the risk, but Muellner and colleagues [23] and Fujii and colleagues [5] studies did not support this idea. Pharr and colleagues [25] have indicated a higher incidence of Cyclops lesion in female patients—up to four times higher than in male patients.

The preventive measures during surgery include, evaluation for possible anterior dislocation of ACL stump, notch reconstruction if necessary, use of gradually increasing drill bit diameters to create the tunnels, and routine removal of bone and cartilage fragments, particularly at the tibial ACL insertion Delince and colleagues, Nagira and colleagues [7,26].

In the immediate postoperative period, Cyclops syndrome risk increased in correlation with loss of active knee extension and quadriceps stunning Sonnery-Cottet and colleagues [27].

MRI allows the assessment of the menisci for potential retear or extension of previous tears, and the joint can be examined for scar tissue and cartilaginous bodies that are either loose or fixed. Moreover, MRI allows the evaluation of tunnel position and alignment, graft integrity, and other concurrent causes of knee pain Olson and colleagues [28].

On MRI, the Cyclops lesion appears as a well-defined nodular mass anterior to the ACL graft. Runyan and colleagues, Saddik and colleagues [2,6]. In line with earlier studies, the Cyclops nodule in the current study was primarily located within the intercondylar notch, anterior to the ACL graft Muellner and colleagues, Wang and Ao, Stoller and colleagues [23,29,30].

The occurrence of a fibro-cartilaginous nodule or Cyclops lesion anterior to the distal third of the ACL graft, fractured bundles of the graft, guillotined fibres at the entrance into the notch, parallel fragmentation of graft fibres (lax bundles), and extrusion or moulding of the graft by the distal end of the notch are all examples of arthroscopic patterns of graft injury Watanabe and Howell, Cha and colleagues [24,31].

Microscopic analysis of Cyclops nodules after ACL reconstruction reveals they are composed of



dense fibro-connective tissue, rich in newly formed vessels, with variable content of cartilage, osseous tissue, and occasionally necrotic lamellar bone, a histologic composition consistent with micro-trauma pathophysiology Jackson and Schaefer, Delcogliano and colleagues [1,9].

Similar to the series of Bradley and colleagues [13], the Cyclops lesions in the present study had an average size of  $14 \times 12 \times 12$  mm.

However, a slowly but steadily increasing nodule might occur due to an inflammatory response after recurrent irritating stimuli to the graft Marzo and colleagues, Herbst and colleagues, Noailles and colleagues [4,32,33]. We would therefore support the theory that the nodule had formed during the early postoperative period and that only the symptoms of the Cyclops lesion were of late start based on these data and our own experience.

The incidence of symptomatic Cyclops syndrome ranged from 1.9 to 10.9%. The following risk factors were noticed: persistent hamstring tightness after surgery; narrow intercondylar notch and overly anterior tibial tunnel during surgery; and knee inflammation and motion range restriction prior to surgery. The creation of preventive measures is made possible by knowledge of these risk variables Noailles and colleagues [33].

This article emphasises the need to include a Cyclops syndrome in the differential diagnosis for patients who experience a delayed loss of knee extension following ACL surgery. In most cases, a thorough physical examination combined with an MRI investigation helps to connect patients' symptoms to a Cyclops syndrome. If conservative treatment does not fully restore range of motion, arthroscopic excision of the Cyclops lesion is advised and should be carried out.

A limitation to the current study is overall low number of patients. However, as Cyclops nodule is a rare complication, and the overall study patient number is considered acceptable.

However, the fact that postoperative intensive physiotherapy was provided while the patient was still in the hospital, ensuring a high compliance with exercise volume, strengthens the study.

## Conclusion

- (1) It is crucial to identify a Cyclops nodule as a potential source of extension loss in any patient

who has had an ACL reconstruction since knee extension restriction can be quite debilitating.

- (2) Cyclops lesions should be ruled out in the assessment of any patient with loss of knee extension following ACL reconstruction since they are generally symptomatic and can be easily amenable to surgical resection.
- (3) We highly recommend notchplasty during ACL reconstruction to prevent graft impingement as a risk factor for development of Cyclops lesions, especially in patients with a narrow intercondylar notch.
- (4) If a thorough physical examination and MRI are required to connect a patient's complaints to a Cyclops syndrome, arthroscopic excision is then advised and should be done if conservative treatment is unsuccessful in regaining full range of motion.

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## Conflicts of interest

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