Arthroscopic treatment of cyclops nodule after rupture of the anterior cruciate ligament

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Background
Cyclops nodule can develop after anterior cruciate ligament (ACL) injury. It can lead to loss of full knee extension with development of an audible and palpable 'clunk' with terminal extension.

Patients and methods
Sixteen patients presented with persistent lack of full knee extension after torn ACL. All patients were subjected to rehabilitation with emphasis on knee extension for 6 weeks after presentation. Persistent lack of full extension despite aggressive rehabilitation was an indication for arthroscopic resection of the cyclops nodule. At arthroscopy, a cyclops nodule was found impinged in the intercondylar notch and acted as a mechanical block to full knee extension. After arthroscopic resection of the nodule under spinal anesthesia, the knee was manually manipulated to regain full knee extension. Physical therapy exercises were then prescribed to obtain and maintain full extension.

Results
Full knee extension was achieved for 12 (75%) patients at the time of the surgical procedure. After 2 years of follow-up, all patients achieved full range of knee motion with no complications.

Conclusion
It is important to recognize a cyclops nodule as a possible cause of extension loss in any patient with ACL injury. It is readily amenable to arthroscopic resection and good patient outcome.

Keywords:
anterior cruciate ligament rupture, cyclops nodule, knee

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Introduction

Cyclops syndrome was first described by Jackson and Schaefer [1] in 1990 in patients who had undergone anterior cruciate ligament (ACL) reconstruction with a patellar autograft. They termed it cyclops syndrome to emphasize that arthroscopy revealed a soft-tissue nodule with surface vessels reminiscent of the eye of the cyclops of Greek mythology. At arthroscopy, the loss of extension was seen to be caused by that soft-tissue nodule abutting the intercondylar notch.

While injury to the ACL is very common, stump entrapment following an ACL tear is an uncommon finding and is considered a variant of the typical cyclops lesion that occurs after ACL reconstruction. In comparison with the traditional cyclops lesion, there is no history of previous ACL reconstruction in stump entrapment [2]. However, other reports have documented its occurrence after ACL injury without any history of ACL reconstruction, and can be considered as a cause of lack of knee extension. In addition, cyclops nodules have also been described in post-trauma patients with a clinically or radiologically intact ACL, probably a reaction to microtrauma leading to subclinically torn ACL fibers [3,4].

Marzo *et al.* [5] suggested that when cyclops syndrome occurs after ACL reconstruction, the microtrauma related to the position of the graft in the anterior third of the tibia caused graft impingement on the notch at full extension, leading to the formation of scar tissue. The microtrauma pathophysiology proposed by Marzo *et al.* [5] likely also plays an important role in the occurrence of cyclops lesions after ACL injury without reconstruction.

The cyclops lesion after ACL rupture also impinges in the intercondylar notch with passive knee extension and results in diminished knee extension similar to that found after the ACL reconstruction [1]. These lesions are important to recognize as they impair normal function, can be easily treated with arthroscopic resection, and are not amenable to conservative therapy [4]. There have been few reported series of cyclops lesions after the ACL rupture causing diminished knee extension [3,4]. The purpose of this study was to identify and treat cyclops lesions that caused lack of knee extension in which the lesions

occurred due to rupture of the ACL in the absence of ACL reconstruction.

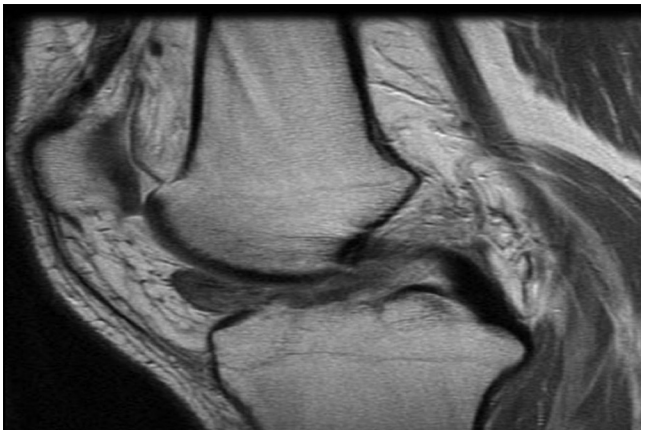
Patients and methods

This study was conducted from January 2007 to December 2010. Sixteen patients presented with persistent lack of full knee extension after torn ACL. Fourteen patients were males and two were females, ranging in age from 22 to 35 years. All patients were subjected to local examination and they had symptoms and signs of ACL ruptures, including instability with twisting activities, positive Lachman, anterior drawer, and pivot shift examinations and inability to return to their previous levels of activity. They developed anterior knee pain during and after exercise and gradual loss of knee extension. Only those patients were included in the current study who had persistent lack of full knee extension after torn ACL. All patients were able to achieve improvement with forced passive extension, but without the applied pressure their knees sprang back to the position of flexion contracture. The patients were excluded from the study if they had undergone prior ACL reconstruction, prior bony operations around the knee, arthritis of the knee joint, prior open knee surgery, past history of knee fractures, or systemic disease. Demographics of the subjects are shown in Table 1.

All patients had diminished active knee extension average of 17° (range 5–30°) and normal flexion compared with the opposite, uninjured knee. Four (25%) patients had a past history of arthroscopic knee surgery. Specifically, two patients had arthroscopic partial medial meniscectomy, one patient had arthroscopic partial lateral meniscectomy 3 months before examination, and one patient had a history of arthroscopic partial medial and lateral meniscectomies. This study approved by the Ethical committee of El-Minia University, El Minia, Egypt.

Plain radiography, as well as MRI examination, was performed for all patients to determine the diagnosis and to exclude other possible causes of diminished knee extension. MRI findings supported the diagnosis of the ACL tear with a nodular mass of intermediate signal in the intercondylar notch (Fig. 1). At MRI, the

Figure 1



A 28-year-old man with anterior cruciate ligament (ACL) tear. MRI shows a nodular mass of intermediate signal in the intercondylar notch.

Table 1 Data of the included patients

N	Age (years)	Sex	Prior ACL surgery	Time since injury (months)	Prior knee arthroscopy	Cause of prior knee arthroscopy	Associated pathologies found at arthroscopic resection	ACL tear MRI finding	Preoperative lack of active knee extension	Postoperative lack of active knee extension
1	35	Male	No	5	Yes	MM	—	Complete	25°	5°
2	24	Male	No	7	No	—	—	Partial	10°	0°
3	26	Male	No	8	No	—	—	Partial	15°	0°
4	25	Male	No	9	No	—	—	Partial	15°	0°
5	28	Male	No	5	Yes	MM and LM	—	Complete	15°	0°
6	22	Female	No	5	No	—	—	Complete	20°	0°
7	30	Male	No	6	No	—	Radial tear L. meniscus	Complete	10°	0°
8	30	Male	No	5	No	—	—	Complete	15°	0°
9	26	Male	No	9	No	—	—	Complete	5°	0°
10	27	Male	No	6	No	—	—	Complete	10°	0°
11	25	Male	No	7	No	—	—	Complete	25°	0°
12	23	Male	No	6	No	—	—	Complete	10°	0°
13	29	Male	No	6	No	—	Radial tear M. meniscus	Complete	30°	10°
14	28	Female	No	6	Yes	MM	—	Complete	30°	5°
15	30	Male	No	7	No	—	—	Complete	20°	0°
16	27	Male	No	8	Yes	LM	Flap tear M. meniscus	Complete	25°	5°

ACL, anterior cruciate ligament; LM, lateral meniscectomy; MM, medial meniscectomy.

ACL was partially torn in three of the 16 patients and completely torn in 13 patients.

All patients were subjected to rehabilitation with emphasis on knee extension for 6 weeks after presentation. Active flexion and extension were performed and all patients were allowed to bear weight as tolerated. Persistent lack of full extension despite aggressive rehabilitation for 6 weeks was an indication for surgical interference, as recommended by McMahon *et al.* [3]. When no further improvement in the range of motion was obtained, arthroscopic surgery to remove the cyclops nodule was recommended. Arthroscopy under spinal anesthesia was performed for all the patients. During arthroscopic evaluation, each knee had a cyclops nodule (Figs. 2 and 3) at the tibial insertion of the ACL. The nodule caused a mechanical block to the extension of the knee joint. All patients were treated by excising the cyclops nodule. Additional pathologies that were treated during arthroscopy were present in three patients; a radial tear of lateral meniscus in one patient, a radial tear of medial meniscus in another one, and a flap tear of medial meniscus in one patient.

All patients were examined 1–2 days after surgical resection. Physical therapy exercises were prescribed to obtain and maintain full knee extension. Because these patients usually achieved full extension easily, they were re-evaluated at 1-week intervals postoperatively. Once optimal results were obtained, outpatient follow-up examinations were performed at regular intervals for the first 3 months, and then at 6 months, 1 year, and 2 years.

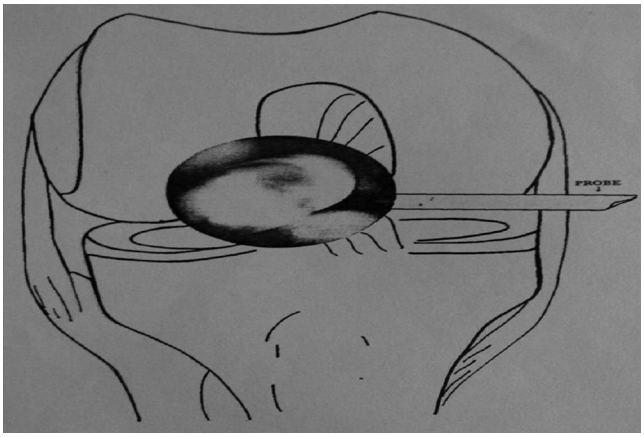
Results

All 16 patients (14 men and two women) were re-examined at a follow-up of 24 months after arthroscopic cyclops resection. The mean interval between the initial ACL injury and arthroscopic resection was 6.5 months (range 5–9 months).

Active extension of the knees was diminished preoperatively at an average of 17° (range 5–30°). However, after resection of the cyclops nodule, the angle of passive knee extension was diminished to be of average 3° (range 0–10°). The cyclops lesions had an average size of 15 × 12 × 10 mm (range 5 × 10 × 4 to 22 × 13 × 14 mm). During arthroscopy, all nodules were impinged on the roof of the intercondylar notch of the femur with passive knee extension. All meniscal tears in the current study did not interfere with range of knee motion during arthroscopy. None of these patients had a meniscal bucket handle tear. Full knee extension compared with the opposite knee was achieved after resection of the nodule and manipulation of the knee for 12 (75%) patients at the time of the surgical procedure. No complications occurred as a result of the arthroscopic resection procedure.

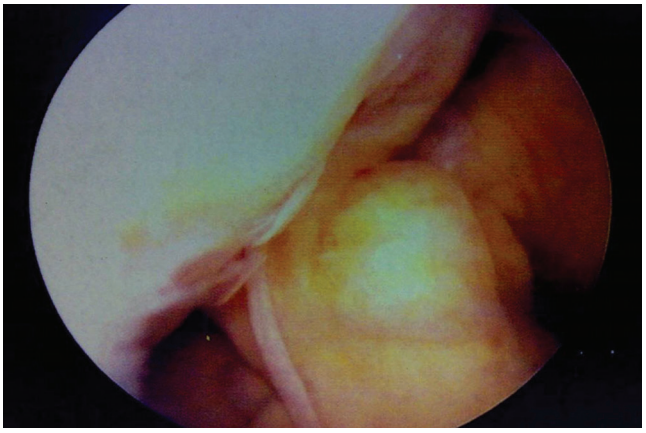
After arthroscopy all patients underwent a short course of physiotherapy and regained full range of motion after 3 weeks. At the last follow-up they had returned to their daily life activities. After 2 years of follow-up, full range of knee motion continued with no complications. Histological examination of the cyclops nodules revealed tight collagen bundles, with inflammatory reaction and necrosis (Fig. 4). The patients were advised from the beginning that an anterior cruciate tear is a significant injury and that an early concern is the prevention of arthrosis secondary to recurrent giving-way and reinjuries. The patients were told about the rule of thirds as reported by Noyes *et al.* [6]: that one-third of the patients with ACL injury will compensate adequately and be able to pursue recreational activities, one-third will be able

Figure 2



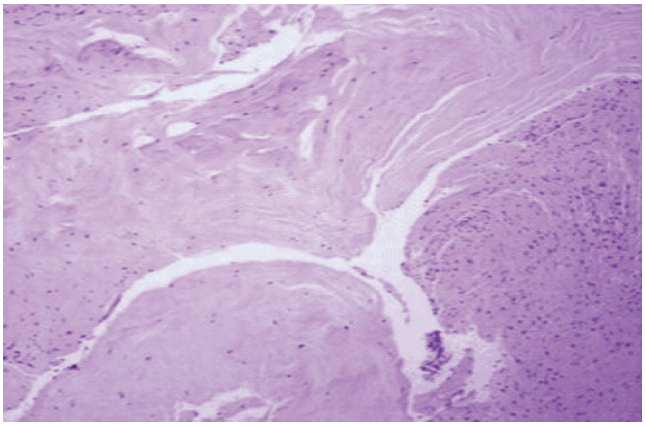
Arthroscopic view of the intercondylar notch of the femur showing the cyclops nodule (3).

Figure 3



Arthroscopic view of the cyclops nodule and the intercondylar notch.

Figure 4



Microscopic picture of cyclops nodule showing fibroblastic and fibrotendinous areas with neovascularity.

to compensate but will have to give up significant activities, and one-third will perform poorly and will probably require future reconstructive surgery. In the current study, no patient had ACL reconstructive surgery at the time of resection of the cyclops nodule. During the follow-up period, 13 patients did not require ACL reconstruction, they were not incorporated in athletic activities. Only three patients reported a history of ACL reconstruction, during the follow-up period performed by another surgeon and they did not report further complications regarding the range of movement of their affected knees.

Discussion

A nodule in the intercondylar notch that causes loss of extension is, by definition, a cyclops nodule. Not all cyclops nodules cause a loss of extension, but patients with lack of full knee extension after a torn ACL should be subjected to further evaluation for the etiology of loss of extension. Generally, a cyclops lesion (nodule) may develop from the residual ACL stump left at arthroscopic reconstruction or may develop from a minor, primarily torn, nonoperated ACL tear. The displaced and entrapped fibers elicit an inflammatory response, which causes thickening of the fibers and local accumulation of granulation tissue [3,7]. On arthroscopy, the lesion has a head-like appearance with a focal area of reddish-blue discoloration due to venous channels that resemble an eye. Hence, it is called the 'cyclops lesion' [4].

When loss of full extension persists for 6 weeks after ACL disruption despite aggressive rehabilitation, the presence of cyclops lesion should be considered [3]. Jones and Allum [8] reported six cases of an isolated rupture of the ACL being responsible for lack of full knee extension, but under anesthesia, most of the locked knees (84%) had full extension. Finsterbush *et al.* [9] described the etiology of diminished knee extension after partial tear of the ACL that disappeared after induction of anesthesia as being caused by fibrosis and adhesion of the fat pad and the synovium adjacent to the torn ACL. However, this can be caused by ACL stump, collateral ligament or a torn and displaced meniscus [8,10]. Although meniscus tears are common after torn ACL, Shelbourne [11] reported only nine of 900 acute ACL ruptures had a displaced bucket-handle meniscus tear that resulted in diminished knee extension. In the current study none of these patients had a meniscal bucket handle tear.

The location and histology of cyclops lesion indicate that it occurred at the time of ACL rupture, from its torn fibers. It is thought to occur from fibrosis of a residual tibial ACL stump. The displaced and entrapped fibers elicit an inflammatory response, which causes thickening of the fibers and local accumulation of granulation tissue [2]. Huang *et al.* [12] proposed two mechanisms for the entrapment of the torn ACL fibers. When the ACL is torn in its proximal one-third, the stump is displaced into the intercondylar notch and undergoes fibrosis and thickens. The knee is unstable and when it translates anteriorly, the thickened and fibrotic portion of the torn ACL shifts into the anterior recess, resulting in a type 1 lesion. Type 2 lesions occur when there is a tear at the distal end of the ACL, which leaves a long stump that folds back on itself.

The size of the cyclops lesion was determined by the amount of the torn ACL fibers and the resulting fibroproliferation. Small cyclops do not result in diminished knee extension, this indicates that there is a critical size that can lead to observable disability due to its impingement in the intercondylar notch with passive knee extension. Cyclops lesions are typically small, with Bradley *et al.* [13] reporting a mean size of 13 × 12 × 12 mm in a review of 20 lesions. These lesions can be either pedunculated or sessile, and are typically adjacent to the ACL. Similar to the series of Bradley *et al.* [13], the cyclops lesions in the current study had an average size of 15 × 12 × 10 mm. In accord with previous studies, the location of the cyclops nodule in the present study was predominantly anterior to the ACL stump [2,3,7].

Microscopic analysis of cyclops nodules after ACL reconstruction reveals they are composed of dense fibroconnective tissue, rich in newly formed vessels, with variable content of cartilage, osseous tissue, and occasionally necrotic lamellar bone, a histologic composition consistent with microtrauma pathophysiology [1,14]. Similarly, cyclops lesions that

occur after ACL rupture have a similar spectrum of pathologic and imaging findings, supporting a similar pathophysiology [7,15].

Recht *et al.* [16] originally described the MRI appearance of these lesions in a series of five patients, noting the characteristic morphology and location of a nodule that occurs in the anterior intercondylar notch. A partial tear of the ACL was suggested when the ACL demonstrated abnormal intrasubstance signal intensity, abnormal bowing, or inconsistent visualization of intact fibers with all pulse sequences. Previous reports found additional data [17,18] including history of trauma, presenting complaint and correlation with arthroscopic findings.

A differential diagnostic consideration for a focal low signal intensity nodule adjacent to the knee joint would be nodular synovitis (focal pigmented villonodular synovitis) [4]. The most useful imaging feature differentiating cyclops lesion is the intimate association of the lesion with the ACL or ACL remnant and its location at the tibial insertion site of the ACL; this was similar to the findings of the current study. A clinical history of extension loss is also helpful. In certain cases, however, the imaging distinction may be difficult. In addition, there is an overlap between the histology of nodular synovitis and cyclops nodules, and both entities have a stroma of collagen fibers with varying hemosiderin deposition [4]. However, absence of fat tissue excludes the incorporation of fat pad as a part of the origin of cyclops lesion. But there were tightly packed collagen bundles similar to those of ACL, associated with local necrosis and inflammatory process [3].

In the current study, 12 (75%) patients regained full knee extension immediately after resection of the cyclops nodule. However, lack of full knee extension continued in four (25%) patients after arthroscopic resection of cyclops nodule, but with more improvement than the preoperative values. The delayed improvement of these four patients despite the resection of the cyclops nodule was mostly due to the fibrosis and adhesion of the fat pad and the synovium adjacent to the torn ACL as described by Finsterbush *et al.* [9]. Furthermore, three of these four patients had a past history of previous arthroscopic surgeries for medial and lateral meniscectomies, that could play a role in their lack of full knee extension due to fat bad adhesions. However, after arthroscopy all patients underwent a short course of physiotherapy and regained full range of motion after 3 weeks.

True cyclops nodules are hard, may contain bone or cartilaginous debris, and are typically associated with clinical cyclops syndrome. Cyclopoid scars, in contradistinction, contain only fibroproliferative tissue and typically do not cause cyclops syndrome, since the nodule is soft and is compressed by the bone and does not prevent full extension. These findings have several important implications. Patients presenting with lack of extension should be evaluated for cyclops nodules. Similarly, patients with cyclops nodules should be evaluated for loss of extension. The distinction between cyclopoid scars and true cyclops nodules likely explains this difference [19,20]. Not all patients with cyclops nodules will demonstrate loss of extension because, as mentioned before, small cyclops do not result in diminished knee extension.

Because they are typically symptomatic and can be readily amenable to arthroscopic resection, cyclops lesions should be excluded in examination of any patient with loss of knee extension after a torn ACL [14,21,22].

Some torn ACLs form new attachments with appropriate qualities and quantities, in more appropriate locations within the knee joint, and some may actually reattach to the posterior cruciate ligament without the need to reconstruction. This can add some knee stability. This could explain why some documented ACL injury patients are able to cope without surgery [23]. This theory can explain why 13 patients out of 16 patients in the current study did not report the need to ACL reconstruction during the follow-up period.

Conclusion

Because limitation of knee extension can be disabling, it is important to recognize a cyclops nodule as a possible cause of extension loss in any patient with ACL injury. It is readily amenable to arthroscopic resection and good patient outcome.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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