Case report

An arthroscopic check valve release improves knee intrameniscal cyst symptoms in adolescent: A case report

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\textbf{ABSTRACT}

Intrameniscal cysts begin with the flow of synovial fluid from a meniscal tear in one direction, enlarging probably as a result of an on-and-off valve mechanism of the tear flap. The current available literature focuses primarily on the necessity for surgery, however a large meniscus resection to remove cysts may place an additional burden on menisci, leading ultimately to knee joint degenerative changes. In this article, we present a rare case of intrameniscal cysts with an isolated horizontal meniscal tear in an adolescent, and describe a new arthroscopic procedure for treating this type of intrameniscal cyst. We performed arthroscopic partial release of the meniscal tear check-valve mechanism, preventing further intrameniscal cyst expansion. The patient’s clinical symptoms improved, and this procedure may also be useful in treating intrameniscal cysts with an isolated horizontal meniscal tear and can be considered as an option to preserve meniscal function and minimize degenerative arthritis in young athletes.

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1. Introduction

The check-valve mechanism, which results from fibrocartilage mucoid degeneration or influx of synovial fluid from a meniscal tear, is the most common theory proposed as a cause of meniscal cysts [1]. Meniscal cysts have been reported in approximately 1 to 7\% of patients who underwent meniscectomy [2,3] and 8\% of patients who underwent knee MRI after meniscal repair [4]. Meniscal cysts are also known to develop after meniscal repair [5,6]. These reports indicate that these cysts are not rare, and meniscal cysts in the medial meniscus occur one to two times more frequently than those in the lateral meniscus [4,7,8]. However, no reports describing the characteristics and incidence of intrameniscal cysts in adolescent patients have been published to date. We report a case, which suggests that the intrameniscal cyst was caused by a traumatic horizontal tear in the medial meniscus of a young patient.

2. Case report

A 15-year-old boy experienced pain in the left knee upon landing from a jump while playing volleyball. He gradually developed pain while ascending and descending the stairs, and then referred to our outpatient unit approximately 3 months after injury.

On initial examination, there was no indication of swelling, warmth, erythema or limitation of the range of motion (ROM). The patient experienced a strong pressure type of pain immediately anterior to the left medial collateral ligament at the level of the joint line, however we could not palpate any soft tissue mass. The McMurray test was positive and the Lysholm score was 73 points.

Preoperative plain radiographs revealed a femorotibial angle (FTA) of 178° and a preoperative T2-weighted MRI revealed a horizontal tear in the medial segment of the medial meniscus, opening toward the superior surface. The T2 MRI also found a uniform high-intensity band extending from the medial segments to the posterior horn of the meniscus, with the tear crossing through the high-intensity region (Fig. 1A and B).

We diagnosed the patient with an intrameniscal cyst associated with medial meniscus injury. Conservative treatments was ineffective, we performed arthroscopy to observe the meniscal tear site, which revealed local synovial membrane hyperplasia around the tear in the medial segment of the medial meniscus. The tear, from which a mucoid substance flowed, was palpated as a recess using a probe (Fig. 2A). The probe was inserted into the tear to release the check valve of the meniscal tear, some tissue was resected and we scratched tissue within the cyst while maintaining the stability of the meniscus. The exfoliated tissue within the cyst was submitted for histopathological analysis. We confirmed the meniscus stability and complete check valve release. Repair of the meniscus was not necessary. The opening of the cyst into the joint cavity measured

4 × 5 mm (Fig. 2B). Pathology of the exfoliated tissue revealed the synovial tissue having papillary architecture with a single cell layer (Fig. 3).

Tenderness of the medial joint line disappeared, the McMurray test was negative and the patient could play volleyball 3 weeks postoperatively. The postoperative Lysholm score was 100 points at 4 weeks following surgery. MRI was performed 4 months after surgery with the patient’s consent. The T2-weighted MRI showed a region of high intensity where the meniscal cyst was located, extending into the superior surface at the medial segment of the medial meniscus. The high-signal intensity region had not expanded, and no subchondral changes were observed (Fig. 4).

No recurrence of symptoms has been observed up to 2 years postoperatively. He continues his regular follow-ups, but has not given consent for further MRI. Plain radiographic images taken at the 2-year follow-up compared with those at the first visit have shown no changes in FTA; moreover, no pathological changes have been observed in the 2 years since surgery.

3. Discussion

Isolated horizontal meniscal tears are rare in young patients and are more typically associated with older age and osteoarthritic disease [9,10]. Terzidis et al. [11] observed that an evaluation of 378 isolated meniscal tears in young athletes showed 22.5% of tears to be horizontal. Schuldt et al. [12] reported that a history of trauma is usually recorded in around 50% of meniscal cyst cases. We have found no published previous report that described the characteristics and proportion of intrameniscal cysts in adolescents. Our patient experienced pain soon after trauma and had no pathological changes in arthroscopic presentation, therefore we give rise to the view that his intrameniscal cyst was caused by a traumatic horizontal tear.

Ryu et al. [13] reported that meniscal cysts can result from injuries, chronic infection or bleeding, and mucoid degeneration. The liquid component of the meniscal cyst is similar to synovial fluid; thus, some studies currently report that a check-valve mechanism causes the flow of synovial fluid from a meniscal tear in one...

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Fig. 1. A. Preoperative coronal MRI image showing an intrameniscal cyst associated with a horizontal tear in the medial segment of the medial meniscus, opening toward the superior surface. B. Preoperative sagittal MRI showing a horizontal tear with a uniform high-signal intensity band extending from the medial to the posterior segment of the medial meniscus.

Fig. 2. A. Intraoperative arthroscopic findings: the tear, from which a mucoid substance flowed (white arrow), palpated as a recess using a probe. B. Opening of the cyst into the joint measuring 4 × 5 mm (arrow).

Fig. 3. Pathology of the exfoliated tissue within the intrameniscal cyst showing the papillary architecture of synovial tissue covered by a single cell layer (hematoxylin and eosin, scale bar = 200 µm).
direction [1]. This causes pooling of the fluid into the cyst without a reflux into the joint forming a meniscal cyst.

Tyson et al. [14] reported that pain or discomfort accompanying a meniscal cyst may be caused by the meniscal tear itself or by stretched soft tissues in the knee close to the joint capsule or meniscus. Before surgery, our patient experienced pain after landing from a jump and while using the stairs, indicating the possibility that a small meniscal tear may have caused the pain. However, depending on the position of the leg, a cyst closed off by a valve may become hard, and the rise in internal pressure may stimulate the joint capsule or surrounding soft tissue, contributing to the clinical symptoms. This mechanism can also be considered as a cause of pain, no matter how small the cyst.

The pathology report of our patient revealed the presence of synovial tissue within the cyst. Hernandez et al. [15] stated that cystic contents may form from synovial tissues surrounding the wall of a meniscal cyst. The synovial tissue within the cyst was the likely source of the synovial fluid production, which subsequently increased the size of the cyst in our case. The check-valve mechanism of the meniscus flap prevented the synovial fluid escape leading to increased cyst pressure producing painful symptoms.

Preservation of the meniscus is considered important during surgery. Our surgical procedure included an excision of the meniscus flap and making a small hole on the surface of the meniscus, resulting in a favorable outcome in a short period. The check-valve mechanism was released and the synovial fluid that had flowed into the cyst was allowed to escape, thus preventing the rise of internal pressure in the cyst and cyst expansion, consequently preventing stimulation of the peripheral soft tissues (Fig. 5). In addition we performed scratching within the cyst, in an attempt to help the cyst in the red-red meniscal zone heal on its own.

The short-term outcome was favorable in this case report, however, further long-term follow-ups with imaging will be required to determine the influence of a 5-mm hole on meniscal function in the region where the intrameniscal cyst existed, and on the risk of recurrence. This arthroscopic procedure is minimally invasive and useful for such cases considering that extensive meniscectomy to remove the intrameniscal cyst alters knee function due to the lost meniscus and the fact that the check-valve mechanism causes a meniscal cyst.

4. Conclusion

We report an unusual case of intrameniscal cyst in an adolescent caused by a traumatic horizontal tear and the arthroscopic intrameniscal cyst check valve release procedure. However, the clinical outcome was encouraging and further case studies will be required to establish indications for this procedure, this procedure can be considered as an option to preserve meniscal function and minimize arthrosis.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References
