Simultaneous Bicompartmental Bucket Handle Injury Associated With a Chronic Anterior Cruciate Ligament Rupture: Case Report and Literature Review

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Abstract
Simultaneously locked bucket handle injury of both medial and lateral menisci is a relatively uncommon phenomenon. Clinically, the knee is locked in flexion and the patient is unable to fully straighten the leg. Pain and effusion in both joint lines are also present. Frequently, these tears are associated with an anterior cruciate ligament (ACL) deficiency. There are few case reports regarding this association. A Pubmed, Embase, and Cochrane database search was performed in March 2021. We identified 8 case reports concerning this kind of injury. To report a patient with a simultaneous bicompartmental locked bucket handle and to analyze the currently available literature on the topic. We present a case of a 42-year-old male with a simultaneously locked bucket handle injury of both medial and lateral menisci associated with chronic ACL deficiency. He was treated in a single surgical time. Partial meniscectomy for both meniscus was performed before ACL reconstruction with a semitendinosus-gracilis graft. Simultaneous bucket handle injury of both meniscus is rare and uncommon. It may or may not be associated with an ACL deficiency. Treatment usually depends on the chronicity and concomitant injuries and should be individualized for each patient. Arthroscopic surgery with bilateral partial meniscectomy and ACL reconstruction in a single-stage procedure demonstrated good clinical and functional results.

Keywords Knee arthroscopy · Simultaneous bucket handle injury · One-stage surgical technique · Literature review · Meniscal tear · Meniscus injury · Both bucket handle tear

Introduction
Bucket handle injury is a vertical meniscal tear where the inner portion migrates to the intercondylar notch, while the peripheral fragment is still attached by coronary ligaments [1]. Its incidence varies from 10 to 26% of all meniscal lesions, and it is three times more frequent in the medial meniscus than lateral meniscus [2]. This is because the medial meniscus has less mobility due to a more rigid peripheral fixation than the lateral meniscus [2]. The incidence of meniscus tears during acute ACL injury is about 50%, but chronic ACL deficiency is as high as 80% [2]. Although bucket handle tears are usually unilateral, a few case reports of simultaneous involvement of the medial and lateral meniscus have been reported. Brammer et al. described in 1999, and for the first time ever, an image of a bilateral “bucket handle” injury of both medial and lateral meniscus associated with an anterior cruciate ligament (ACL) tear and named it the “Jack and Jill injury” [3]. The
aims of this study are to present a case report of a simultaneous bicompartamental locked bucket handle injury associated with a chronic ACL deficiency treated in a single surgical time and to analyze the currently available literature of this pathology. A Pubmed, Embase, and Cochrane database search was performed in March 2021. We identified 8 case reports concerning this kind of injury (Table 1).

Case

A 42-year-old male presented to our emergency department regarding left knee pain and effusion after falling from stairs. The patient reports a history of trauma to that knee 2 years ago while playing soccer. Since then, he refers to have symptoms of instability (giving way knee). The physical examination revealed a swollen knee locked in 20° of flexion and tenderness in both joint lines. Both active or passive full flexion and extension were impossible. The Lachman, anterior drawer, and pivot shift tests seemed to be positive. Varus and valgus stress tests presented no particularities. The pain in both joint lines increased with Mc Murray tests. The Rising Moon test was also positive [4]. Anterior–posterior and lateral x-rays were normal. Magnetic resonance imaging (MRI) was then performed and revealed findings consisting of bicompartamental bucket handle injury displaced into the intercondylar notch and a complete chronic rupture of the ACL (Figs. 1, 2, and 3). The posterior cruciate ligament (PCL), as well as the medial and lateral collateral ligaments, were intact.

Treatment was performed by arthroscopic surgery 5 weeks after the initial trauma. During the exploratory arthroscopy, the bilateral bucket handle injury was confirmed. Both tears were displaced into the intercondylar notch. They appeared to be in the white-white zone of the meniscus and were assumed to be within the non-vascularized portion. A mucoid, degenerated remnant of ACL was also observed in both femoral and tibial insertions, supporting the hypothesis that it was a chronic injury (Fig. 4). The inner portion of the medial and lateral meniscus were reduced with an arthroscopic hook. Partial meniscectomy for both meniscus was performed since the injuries were not plausible for meniscal sutures. At the same surgical time, the ACL was reconstructed using a transtibial tunnel with an inside-out technique. An autologous semitendinosus-gracilis graft in a quadruple configuration was used and fixed.

Table 1  Resume of the literary review

| Author           | Year | Age of patient | Type of injury                      | Treatment                                                                 | Complications                  | Follow-up/month |
|------------------|------|----------------|-------------------------------------|---------------------------------------------------------------------------|-------------------------------|-----------------|
| Cetik et al      | 2006 | 30             | SBBH with chronic ACL injury         | PM of both menisci + ACLR with B-PT-BG in 1 stage                         | NR                            | NR              |
| Tecklenburg et al| 2007 | 19             | SBBH with acute ACL injury           | First surgical time: MI: 6 sutures outside-in + 1 all inside suture. EM: 4 all inside sutures + R-ACL ST-GHA | Arthrofibrosis: Needed surgical resolution at 3 months | Return to sports at 9 months |
| Wright et al     | 2010 | 38             | SBBH without ACL injury              | PM of both menisci                                                        | NR                            | 1.5             |
| Lykissas et al   | 2010 | 28             | SBBH without ACL injury              | PM of both menisci                                                        | NR                            | 12              |
| Koukoulias et al | 2011 | 38             | SBBH with acute ACL and MCL injury   | PM of the internal menisci + all inside sutures in external menisci + R-ACL ST-GHA | MCL was treated conservatively | 8               |
| Sheperd et al    | 2012 | 18             | SBBH with chronic ACL injury         | 2 stages: 1. Internal PM + EMS with 3 points all inside 2. R-ACL ST-GHA at 6 weeks | NR                            | NR              |
| Yang et al       | 2015 | 30             | SBBH with acute ACL injury           | PM of both menisci + R-ACL in one stage                                   | NR                            | 12              |
| Barret et al     | 2015 | 41             | SBBH without ACL injury              | PM of both menisci                                                        | NR                            | NR              |
| Our case         | 2020 | 42             | SBBH with chronic ACL injury         | PM of both menisci + R-ACL ST-GHA in one stage                            | NR                            | 18              |

SBBH, simultaneous bicompartamental bucket handle; PM, partial meniscectomy; IMS, internal meniscus suture; EMS, external meniscus suture; R-ACL, anterior cruciate ligament reconstruction; ST-GHA, semitendinosus-gracilis hamstrings autograft; MCL, medial collateral ligaments; B-PT-BG, bone-patellar tendon-bone graft; NR, not reported.
Fig. 1 PD FATSAT coronal MRI. Normal anatomy in an asymptomatic patient in A. In B and C, our patient with a bicompartamental bucket handle tears. Note the ACL (short arrow in A) and the PCL (long arrow in A and B), internal (star), and external (asterisk) meniscus. The PCL is normal (red area). The ACL is incomplete and torn (blue area). The displaced inner portion of the medial meniscus is represented in yellow and the displaced fragment of the lateral meniscus is in green. These findings are compatible with a bucket handle tear in both menisci.

Fig. 2 Sagittal T2 PD MRI. An internal parasagittal section in A, with double delta or inverted meniscus sign, represented by the anterior horn (thick black arrow) and a migrated and anteriorly rotated fragment (thin black arrow) of the medial meniscus. The posterior double cruciate sign is formed by the intercondylar meniscal fragment (thin white arrow), and the intact PCL (thick white arrow). In B, a contiguous section shows the bucket handle in the intercondylar notch (thick arrows).

Fig. 3 PD FATSAT axial MRI. In A, note a longitudinal bilateral meniscus tear, with meniscal fragments displaced towards the intercondylar notch. Medial meniscal fragment (thin arrows), and lateral fragment (thick arrows). In B, a schematic image representing the structures marked in the MRI of panel A.
into the femur using a cortical endo-button system. Tibial fixation of the graft was performed with a blunt titanium screw (Fig. 4). The patient had no immediate postoperative complications.

Table 2 Rehab protocol

| 0–4 weeks | WB as tolerated in a brace in extension with crutches
|           | Brace in extension for sleeping
|           | Active/passive ROM 0–90°
|           | Quad sets, straight leg raise, heel slides
|           | Patellar mobilization
| 4–8 weeks | TWB without brace or crutches
|           | Quad strength adequate
|           | Wall sits to 90°
|           | Stationary bike
| 8–12 weeks| Full ROM
|           | Progress with closed chain exercises
|           | Lungs
|           | Leg press
|           | Proprioception exercises
| 12–16 weeks| Progress strengthening exercises
|           | Single leg strengthening
|           | Begin jogging and progress to running
|           | Sports-specific exercise

WB, weight-bearing; ROM, range of motion; TWB, total weight bearing.

Table 2 Rehab protocol

The patient had no immediate postoperative complications.

Standard rehabilitation protocols were initiated (Table 2). At 18 months of follow-up, the patient was re-evaluated. He was painless, with a visual analogue scale (VAS) of 1/10 and had a stable knee with negative Lachman and pivot shift tests. A full range of motion (ROM) was achieved. The subjective functional evaluation with the Lysholm score was 96 while the objective evaluation according to the International Knee Documentation Committee (IKDC) was grade A. The objective tibial anterior translation related to the femur was tested with the KT-1000 knee arthrometer (MEDMetric, San Diego, CA, USA). The difference between the injured knee and to that of the uninjured knee was < 3 mm, which is considered as an optimal result. The patient also returned to the pre-injury level of activity, with a Tegner score of 5.

Discussion

Meniscal bucket handle tears typically occur acutely in young patients after a traumatic event during sports. Shear- or rotational forces split the meniscus longitudinally, displacing the inner portion to the intercondylar notch. The incidence of this kind of injury varies from 10 to 26% of all meniscal tears. Most of them are unilateral and often associated with an acute ACL injury. Bicompartmental bucket handle tears usually occur non-simultaneously and are related to a chronic deficiency of the ACL. Meniscal bucket handle tears may present with effusion, pain in both joint lines, and mechanical symptoms. Although locking of the knee is a common finding, the lateral meniscal bucket handle tears may be present without locking [5]. Joint line tenderness is the most sensitive physical examination finding [2].

Little is known about the true mechanism of injury in cases of simultaneous tears of both meniscus. It has been described that complex knee traumas associated with concomitant ligamentous injuries may increase the risk of bucket handle tears. In addition, as for non-traumatic bucket handle tears, a close relationship with meniscal tissue abnormalities has been reported [6]. Notably, Sebaaly et al. published in 2015 a case report of bilateral Wrisberg discoid meniscus misdiagnosed as bucket handle injury [7]. Tecklenburg et al. reported a 19-year-old professional skier with bilateral bucket handle injury associated with an acute ACL tear after a high-energy trauma with a hyper flexed and externally rotated knee [8]. In our patient, we suspect an acute bicompartamental meniscal injury caused by a rotational mechanism in the presence of chronic ACL deficiency. Bicompartamental bucket handle tears are usually associated

Fig. 4 Arthroscopic view. Migrated medial and lateral bucket handle injury in the intercondylar notch, seen from an anterolateral portal view (black arrows) (A). Insertion of the ACL at the femoral level, with disruption of its fibers (B). Bilateral partial meniscectomy (C). Arthroscopic ACL reconstruction with quadruple ST-R1 (D)
with an ACL injury [1, 2, 8–10], but they may also occur in the presence of a competent ACL (Table 1) [11–13].

The blood supply to the meniscus comes from branches of the medial and lateral inferior and middle geniculate arteries (13). The outer 3 mm of the meniscus has sufficient blood supply to heal either spontaneously with conservative treatment or following meniscal repair. This 3 mm represents about 25–30% of the meniscus and it is called the “Red-Red” zone. Those with central margins extending into the inner 2/3 avascular zone are called “Red-White” tears. The “White-White” zone is in the inner 1/3 of the meniscus and it is avascular, with poor healing potential [14]. The actual location of the menisci injury is essential when considering a possible arthroscopic repair. It has also been reported that isolated meniscal tears, without acute ACL disruption, have higher failure rates [15]. This is probably due to the intrinsic factors released with the ligament tear.

While the history of a traumatic event and physical examination is helpful to diagnose meniscal tears, MRI is almost mandatory to confirm a bucket handle tear. Koukoulia et al. reported locked bucket handle tears of both medial and lateral menisci with simultaneous anterior cruciate and medial collateral ligaments injury in a 38-year-old male. They did not use MRI for evaluation or preoperative planning because MRI was not available at their hospital and they did not want to delay treatment. So they assumed that a bucket handle tear was the most likely diagnosis and performed a knee arthroscopy [10].

Classically, different MRI signs have been described for unicompartmental bucket handle meniscal injuries [16–19]. Bugnone et al. described the “Quadruple cruciate sign” in a coronal STIR T2-weighted image, as the only MRI specific sign for bicompartamental bucket handle lesion [20]. These four structures seen in the coronal images are the ACL, the PCL and the medial and lateral bucket handle meniscal fragments (Fig. 1). Kakel et al. reported the triple PCL sign in which, in the sagittal view, the PCL and the two meniscal fragments lying in the notch are observed [21].

An arthroscopic meniscal repair is usually performed whenever a nondegenerative tear in the vascularized area of the meniscus is encountered. Cha and West repaired the bucket handle tears of both menisci in ACL-deficient knee which is an exceptional case in the available literature [22]. Regarding the management of meniscal injuries, we decided to perform a partial meniscectomy of both bucket handles, since during the arthroscopic examination we evidenced complex degenerative tears in both meniscus in the avascular zone. Treatment of the currently available literature is resumed in Table 1. No complications were reported in the short or medium term by most of the authors. The only complication reported after meniscal sutures in both meniscus and ACL repair in a single surgical time was arthrofibrosis [6]. A second intervention within the first 3 postoperative months was required to improve the ROM [1, 2, 8, 9, 11–13]. They assumed that the arthrofibrosis in their patient might have resulted from the extensive initial surgery (Table 1).

We believe that case reports of low incidence pathology, like simultaneous unilateral bucket handle tears of both meniscus, should always be published. This may help the orthopedic surgeon to make decisions about diagnosis and treatment. Although there are several publications regarding this matter, one of the strengths of this work is the 18-month follow-up. To our knowledge, no follow-up has been this long so far. Furthermore, we reported the clinical-functional results obtained during this period. Only Koukoulia et al. reported clinical-functional results within 8 months of follow-up [10]. Another strength of this paper is the literature review we have carried out. Eighth case reports of bilateral bucket handle tears have been included and analyzed.

A few limitations of this case report should be addressed. The main limitation is the lack of imaging studies prior to this traumatic event. Therefore, we cannot truly determine if the bucket handle injuries were simultaneous or not. As commented before, lateral meniscus handle bucket tears may be present without locking. So we can only suspect and assume the synchronous tears.

To our knowledge, this is the first case report with bilateral bucket handle tears associated with chronic ACL injury treated with partial meniscectomy and ACL reconstruction with a semitendinosus-gracilis graft in a one-stage surgery. We have also reported the postoperative complications and clinical-functional outcomes with a follow-up of 18 months.

We believe that the results of this investigation could be used in the development of future publications of more levels of evidence. This would help to mitigate the limitations of our study.

**Conclusion**

Simultaneous bucket handle injury of both meniscus is rare and uncommon. It may or may not be associated with an ACL deficiency. Treatment usually depends on the chronicity and concomitant injuries and should be individualized for each patient. Arthroscopic surgery with bilateral partial meniscectomy and ACL reconstruction in a single-stage procedure demonstrated good clinical and functional results in our experience.

**Author contribution** Martin Buljubasich: idea, redaction. Agustin García-Mansilla: redaction, review, translation. Mariano García Bis-tolli: redaction. Juan Astoul: review. Matias Costa Paz: review. Renato Vestri: idea, review.
Declarations

Conflict of interest The authors declare no competing interests.

Ethics approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent to participate Written consent was obtained from the patient included in the study.

Consent for publication The patient has given written permission for publication.

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