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## RESEARCH ARTICLE

## Large Meniscocapsular Separation: Diagnosis and Treatment. A Case Series.

Sherif A. El Ghazaly,

M.D., F.R.C.S., Orthopedic Surgery Department, Ain Shams University, Cairo, Egypt.

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#### \*Corresponding Author

Sherif A. El Ghazaly  
[sherifghazaly@hotmail.com](mailto:sherifghazaly@hotmail.com)  
[sherif\\_ghazaly@med.asu.edu.eg](mailto:sherif_ghazaly@med.asu.edu.eg)

### Abstract

**Purpose:** To highlight a special entity of meniscal injuries – “*large meniscocapsular separation*”, involving more than 20 mm of the meniscus-capsule junction, stressing that they present as bucket-handle tear. This study reports diagnosis of large meniscocapsular tears and functional outcomes after suture repair. **Methods:** This retrospective study included five males with large meniscocapsular separation treated between January 2012 and December 2013. All were involved in sporting trauma. Average age was 28.4 years. All cases had a minimum 2-years follow-up, average (28.2 months). All cases had an M.R.I. There were 3 medial and two lateral meniscal tears. During arthroscopy, complete separation of the meniscus at the capsular junction was reported, with displacement into the notch in all cases. Reduction was done followed by using the shaver for edge abrasion. An outside-in suture technique had been used to repair the meniscus, using 4 horizontal sutures. The Lysholm knee score was recorded to assess functional outcome, and had been recorded before surgery, 6 months after surgery and at final follow-up. **Results:** Full range of motion was gradually restored. Minimal tenderness was noticed at site of sutures. Four patients had returned to pre-injury activity level. Lysholm knee score improved from a mean of 37.6 (range 20-61) preoperatively to 82.8 (range 78-89) at 6 months, then to 86.6 (range 79-94) at final follow-up. **Conclusion:** Large meniscocapsular separation presents as a bucket-handle tear. Vigorous twisting and locking should raise suspicion. M.R.I. may be misleading. Reduction and multiple suture placement from posterior to anterior allows healing and prevents further displacement.

**Level of Evidence:** Level IV, therapeutic case series.

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## INTRODUCTION

The meniscus may separate along its periphery via a vertical tear, causing a meniscocapsular separation. Among sports-related knee injuries, meniscocapsular separation is not common. [1-2] The separation may run a short distance of the meniscal rim or may be more extensive. The injured tissue can extend beyond 1cm,[3] or may be smaller than 5mm in length.[2] The purpose of this study is to highlight “*large meniscocapsular separation*”, involving more than 20 mm of the meniscus-capsule junction, that present as bucket-handle tears radiologically and intra-operatively, and report on functional outcome after suture repair of this extensive lesion.

### Patients and Methods:

The medical records of all knee arthroscopies performed during the period from January 2012 until December 2013 were reviewed. Out of 185 cases, five cases of traumatic large meniscocapsular separation were identified. All cases

had been pre-operatively diagnosed as having a bucket-handle tear. All were males and had given history of one or more locking episodes. Average age was 28.4 years (range 15-49) while average follow-up was 28.2 months (range 24-32). All but one patient had been involved in sports, reporting vigorous twisting trauma. The remaining patient had reported sitting with hyperflexed knee then sudden knee extension. All cases had had an M.R.I., which had shown double posterior cruciate ligament (PCL) sign and effusion. There were 3 medial and two lateral meniscal tears. One case had an old neglected complete anterior cruciate ligament (ACL) tear, while another case had a partial injury. In the remaining cases, no associated cruciate or collateral ligament injury had been detected. All of the cases in this report had been treated within 2 weeks of the injury. During arthroscopy, each had been diagnosed as large meniscocapsular separation. The injury had involved the meniscus-capsule junction, involving more than 20 mm of the meniscal perimeter, without a tear in the substance of the meniscus. The anterior and posterior roots had remained attached and free of tears. Reported as totally displaced into the intercondylar notch, the meniscal injury had seemed similar to a bucket-handle tear (Fig. 1, 2). In all cases, separation of the meniscus at the capsular junction and displacement into the notch had been recorded (Fig. 3), and no remaining meniscal tissue had been detected beyond the torn meniscus (Fig. 4). The Lysholm knee score had been recorded before surgery, 6 months after surgery and at final follow-up to assess functional outcome.

### Results:

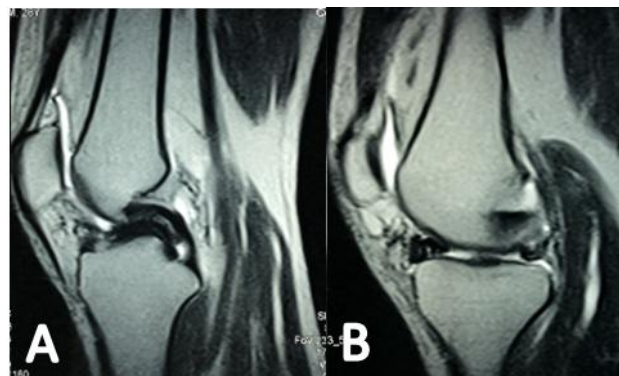
There were five males with average age 28.4 years (range 15-49). Follow-up period averaged 28.2 months (range 24-32). Pain and swelling improved gradually then subsided. No cases of infection were observed. Minimal tenderness was noticed at site of the sutures, but was tolerated by all patients (Fig. 5). Range of motion increased gradually from a mean of 48 ° preoperatively to 120 ° by 6 months (Table 1). Full range of motion was safely reached by 1 year in all cases. There was no instability and McMurray test was negative. Four of the patients returned to their pre-injury activity. The fifth case (49 years) regained full ROM and was active but abstained from sports. Although case (1) had an old neglected ACL tear which was not reconstructed upon patient request, examination revealed a stable meniscus at the latest follow-up. Knee examination showed no tenderness on the joint lines and there was no locking, signifying a stable meniscus after the repair. Lysholm knee score improved from a mean of 37.6 preoperatively to 82.8 at 6 months and to 86.6 at final follow-up (Table 1). Post-operative M.R.I. at 1 year showed no meniscal re-displacement.

**Table (1): Demographic and follow-up data of the patient cohort.**

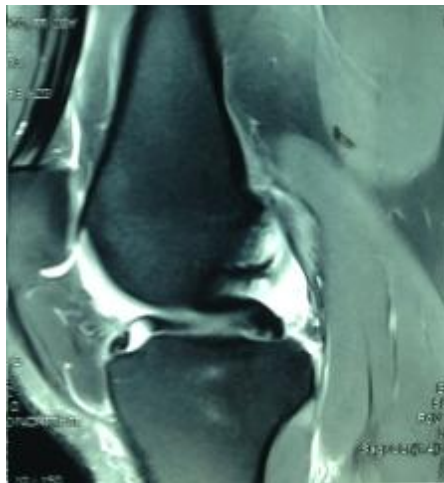
No.	Age (years)	Side	Follow-up (months)	LKS Pre	LKS Post	LKS Final	Knee ROM PRE(°)	Knee ROM POST(°)
1	49	Rt	32	24	89	92	0	115
2	38	Lt	29	61	79	79	70	110
3	21	Rt	29	24	87	94	0	130
4	19	Rt	27	59	81	83	90	115
5	15	Rt	24	20	78	85	80	130
Avg.	28.4		28.2	37.6	82.8	86.6	48	120

LKS: Lysholm Knee Score; Avg.: Average; ROM: range of motion.

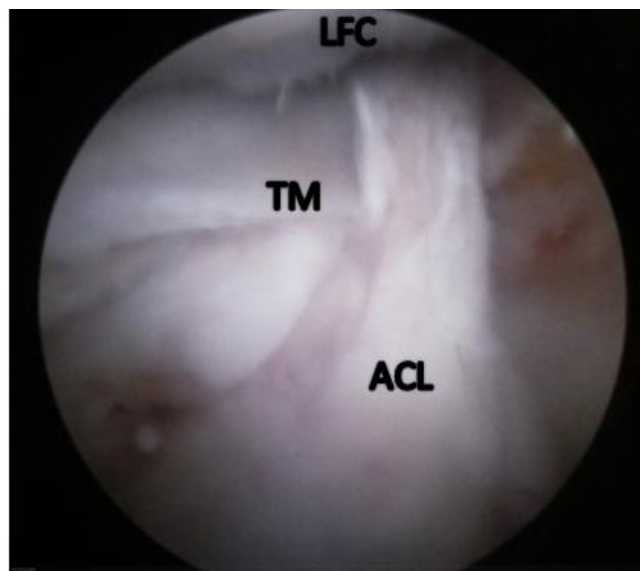
**Fig. 1: (A) Sagittal T2W M.R.I. showing “double PCL sign”; (B) M.R.I. of the same patient showing remnants of posterior horn and “double delta sign” anteriorly: displaced meniscus next to the anterior horn on sagittal cut.**



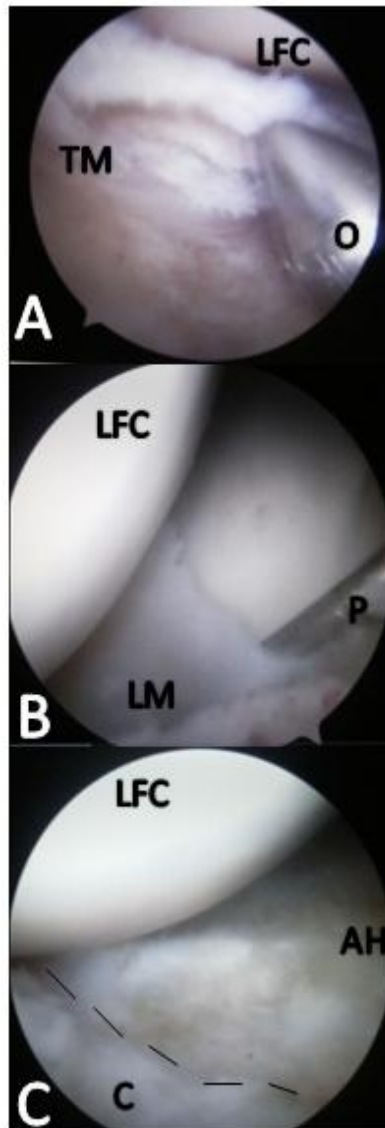
**Fig. 2: 'Double PCL' and a double anterior horn signs on sagittal M.R.I. of another patient showing the torn meniscus.**



**Fig. 3: The displaced torn meniscus (TM), seen beneath the lateral femoral condyle (LFC) in the intercondylar notch and lying beneath anterior cruciate ligament (ACL) remnants.**



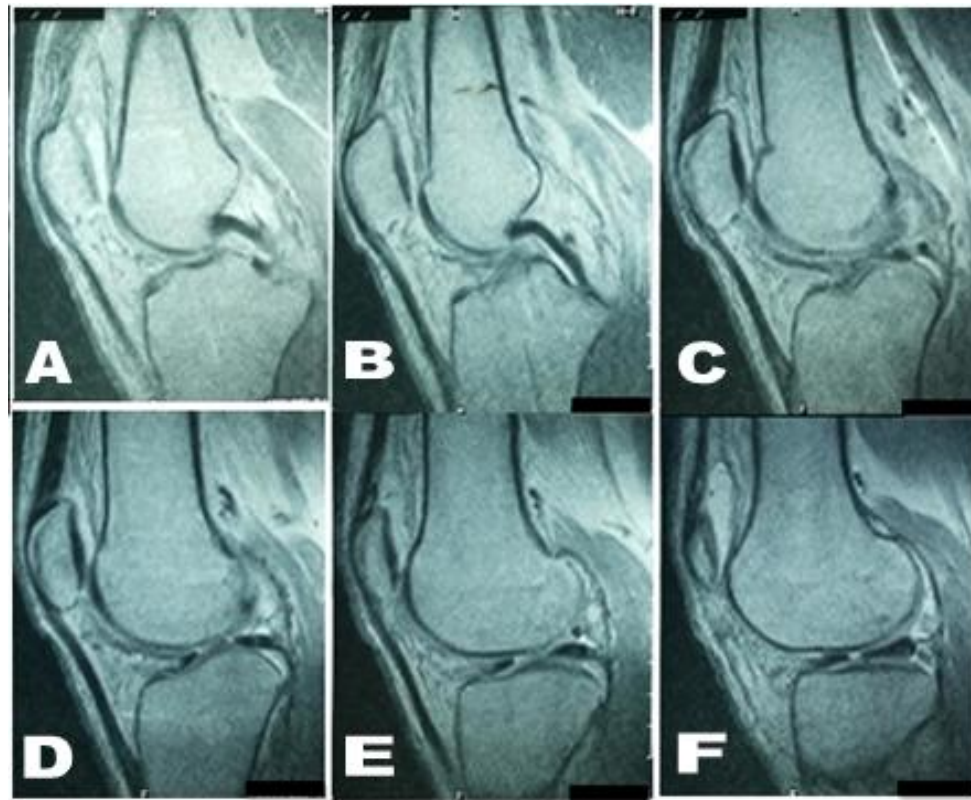
**Fig. 4:** A: Viewing from antero-lateral portal, displaced torn meniscus (TM) seen in the notch and blunt obturator (O) used to reduce it; B: lateral compartment after meniscal reduction and probe (P) used to pull on the lateral meniscus (LM) showing intact posterior horn; C: the dashed line outlines the extent of the tear, separated from the capsule (C), reaching an intact anterior horn (AH) attachment.



**Fig. 5:** Knots of 2 sutures shown subcutaneously prior to taking another suture in a case with medial meniscal tear.



**Fig. 6: Postoperative M.R.I. at 1 year showing intact healed lateral meniscus and absence of the “double PCL” sign. In images D-F, evidence of the healed tear can still be seen.**



### Discussion:

This study reports on five cases of a large separation of the meniscus at the capsule, which presented as a bucket-handle tear. However, at arthroscopy they were diagnosed as meniscocapsular separation. To our knowledge, this is the first report on displaced large meniscocapsular separation initially presenting as bucket-handle tears. All cases were easily reduced and the meniscus was repaired to the capsule using an outside-in suture technique.

Although many classifications of meniscal tears have been described in the literature, they fail to encompass this sizeable meniscocapsular separation. This lesion is a rare entity that may easily be mistaken as bucket-handle tears. Bucket-handle meniscal tears may be vertical or oblique in direction, with the tear fragment, attached at both horns, displacing from the remaining meniscus periphery. On the contrary, no residual meniscal tissue is seen between the displaced meniscus and the capsule in meniscocapsular separation. M.R.I. signs are widely used in the diagnosis of bucket-handle tears, including the ‘*fragment within the intercondylar notch sign*’, ‘*flipped meniscus sign*’, ‘*double anterior horn sign*’ and ‘*double posterior cruciate ligament sign*’.[4] However, a high index of suspicion and vigilance are needed in order to diagnose large meniscocapsular separation.

While meniscocapsular separation may affect the lateral meniscus, the medial meniscus is more commonly affected because it is tightly adherent to the capsule.[5] Most tears are small, with small avulsed corners affecting the medial meniscus or along the posterolateral corner due to disruption of meniscopopliteal fascicles.[5] It is typical for the posterior meniscal horn to separate from the capsule and displace by more than 8-10 mm.[6] Also, George et al. described anterolateral meniscocapsular tears of the lateral meniscus that were not seen on MRI. Identified at arthroscopy, no meniscal tear was seen with only the separation from the capsule. These separations may also occur along the posterolateral corner via rupture of the meniscopopliteal fascicles.[7] Most literature reports involve separation of the meniscal horns. The five cases reported here showed intact horns, with displaced meniscal body.

With higher impact trauma to the knee, Bikkina et al. in 2005 described another entity of meniscal injury namely the ‘*floating meniscus*’. Absence of a tear within the meniscal substance allows fluid to collect between the meniscus and the capsule, but there is no gross displacement of the meniscus. [5] To our knowledge, this is the first report on



large meniscocapsular separation, where the extent of separation was beyond 20 mm and with displacement of the torn meniscus into the notch. Potter et al. reported meniscocapsular separation as very common in dislocated knees. The authors mentioned 13 medial and 19 lateral meniscocapsular separations with detachment of the meniscal horn from the capsule but without displacement into the intercondylar area. They also emphasized that lateral meniscocapsular separations that fail to remodel can lead to significant symptoms. However, they failed to report on magnitude of separation or any treatment done for these patients.[8] This study reports large separations that interfered with normal knee range of motion.

Most patients with meniscal injury develop late swelling of their knees. This is in contrast to large meniscocapsular separation, where patients usually develop acute knee swelling. Injury at the vascular periphery of the meniscus usually causes a moderate to severe haemarthrosis. Despite this, tears at the red-red zone are expected to culminate in enhanced healing capacity. Rapid knee swelling should alert the orthopaedic surgeon to this injury or associated anterior cruciate ligament (ACL) tear. Nevertheless, meniscocapsular separation may commonly be associated with torn ACL.[8] A complete ACL rupture enhances the chances of such peripheral detachment at the capsule due to translation of the tibia, which allows lateral fascicular rupture.[8] A relation between ACL injury and meniscocapsular separation may exist.

The importance of pre-operative planning cannot be overemphasized. Not infrequently, M.R.I. is used to identify the location, size, pattern and stability of the tear. Although M.R.I. is the gold standard for diagnosis, findings of a thinned posterior horn in coronal images may be misleading. A thinned-out posterior horn of the meniscus may be due to flipped meniscus, with a flip of a torn flap of the posterior horn [9] or due to meniscal separation. The finding of a “double PCL sign” can help direct the diagnosis to bucket-handle tear or meniscocapsular separation.

Although the literature is scant regarding large meniscocapsular separation, there are reports of similar rare meniscal injury patterns. Yue et al. reported 4 cases of flipped meniscal fragment of a Wrisberg variant of the discoid lateral meniscus.[10] Lawler and Pereira reported a meniscocapsular tear involving the posterior horn of the medial meniscus associated with an ACL tear in a soccer player, which was repaired along with ACL reconstruction.[11] The cases reported by Yue et al. resembled bucket-handle tear, and the diagnosis was made only during arthroscopy.[10] Similarly in our work, cases were diagnosed as large meniscocapsular separation only during arthroscopy. In the remaining cases, meniscocapsular separation was suspected from M.R.I. images and confirmed intra-operatively.

Complete peripheral vertical tear of the posterior horn and body of the lateral meniscus allows the majority of the posterior horn to displace into the intercondylar notch, and the body to lie directly posterior to a truncated anterior horn.[12] The M.R.I. shows a double PCL sign and a “double delta sign” anteriorly on sagittal images.[12] These signs were similar to findings in our cases. As such, careful M.R.I. reading and interpretation are fundamental to make a diagnosis, since M.R.I. signs may represent more than one injury pattern.

Hetsroni et al.[2] reported 6 cases of small meniscocapsular separation, 5 of which were due to sports injury. The current study reports four patients suffering a twisting injury during sports, being in agreement with findings by Hetsroni and co-workers. These findings may signify a possible role for twisting injury in causing this meniscal tear pattern.

After reduction of the displaced meniscus, secure fixation to the capsule must be ensured. This may be accomplished using any of the commercially available meniscal repair kits. The outside-in technique was found effective, since it allowed placing multiple horizontal sutures to secure the meniscus as well as allowing trephination of the periphery of the meniscus, inviting healing through channels created using the needle. Reduction of the displaced meniscus and adequate suture fixation restored knee function, with satisfactory functional outcomes and avoided future re-displacement.

Limitations of this study include the small number of patients involved. However, it is acknowledged that this injury pattern is rare. Also, it was not possible to perform a second look arthroscopy, although follow-up M.R.I. has shown no re-displacement.

## Conclusion:

Large meniscocapsular separation can present as a bucket-handle tear. A great length of the meniscus is involved. Vigorous twisting and locking should raise suspicion. M.R.I. may be elusive of this injury. Nevertheless, a high index of suspicion is required to anticipate the injury, especially with large effusion and vacant meniscus or double PCL signs. Reduction and repair ensures meniscal preservation. Adequate suture placement from posterior to anterior prevents further displacement and allows healing.

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