

Arthroscopic repair for bucket-handle meniscus tears☆

A 2- to 5-year follow-up of 61 patients

Gu Jian-ming, Feng Hua, Hong Lei, Geng Xiang-su, Zhang Hui, Wang Xue-song, Jiang Xie-yuan

Fourth Clinical Medical School, Peking University, Sports Medical Center of Beijing Jishuitan Hospital, Beijing 100005, China

Gu Jian-ming☆, Doctor, Physician, Fourth Clinical Medical School, Peking University, Sports Medical Center of Beijing Jishuitan Hospital, Beijing 100005, China
pumc_gu@163.com

Correspondence to: Feng Hua, Master, Chief physician, Fourth Clinical Medical School, Peking University, Sports Medical Center of Beijing Jishuitan Hospital, Beijing 100005, China
zyzfh@public3.bta.net.cn

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Abstract

BACKGROUND: Unrepaired bucket handle meniscus tear (BHMT) could result in partial or total meniscectomy, which aggravates the degeneration of knee joint. The long-term, large sample studies regarding the success rate of BHMT repair are few.

OBJECTIVE: To retrospectively analyze the clinical result of arthroscopic BHMT repair and explore the preoperative diagnosis, repair technique, treatment effect evaluation and influential factors, so as to investigate ideal repair method of large meniscus tear injury.

METHODS: From May 2002 to November 2005, 90 patients with repairable BHMT were treated in Sports Medical Center of Beijing Jishuitan Hospital. Of the 90 patients, 61 (63 menisci) were followed up for over 2 years with an average duration of 38 months (24–66 months). The indications of BHMT repair include red-red area and red-white area injuries, reductable, meniscus with no compound tear or degeneration.

RESULTS AND CONCLUSION: Of the 61 followed up patients, 53 menisci in 51 patients (84%) were assessed by second-look arthroscopy; 53 of 61 patients (87%) were asymptomatic, 4 (6%) patients were partial asymptomatic and 4 (6%) had recurrent locking showing failure. Second-look arthroscopic examination showed that 44 menisci (83%) were healed completely, 5 (9%) partially healed, and 4 (7%) not healed. The total failure rate was 8% (5/63), and success rate was 92%, including complete healed, partial healed, asymptomatic and partial asymptomatic patients. For large bucket-handle meniscus tears involving red-red and red-white zones, reliable arthroscopic hybrid suture technique, provides stable suture strength along the whole length of injured region and consequently achieves improved clinical outcomes in combination with anterior cruciate ligament.

INTRODUCTION

When the inner fragment of a torn meniscus displaces into the intercondylar notch, it is commonly referred to as a bucket handle tear, leading to acute or recurrent locking of the knee^[1-10]. Isolated bucket handle meniscus tears (BHMT) are uncommon. They are mostly associated with anterior cruciate ligament (ACL) injuries. There are two signs in MRI considered to be relatively specific for the diagnosis of displaced BHMT^[4]: one is the double posterior cruciate ligament (PCL) sign (in sagittal section, the additional tissue in front of the normal PCL represents a torn displaced bucket-handle tear); the other is the coronal truncation sign (a displaced torn meniscus fragment identified in the notch in the coronal image). Bucket handle tears that are not reparable could result in partial or total meniscectomy. In order to prevent early occurrence of osteoarthropathy, the torn meniscus repair should be attempted when salvageable. However, there are few clinical studies regarding the success rate of BHMT repair^[5]. The present study introduced 90 patients with repairable bucket-handle meniscus tears treated under arthroscopy. Among them, 61 cases with 63 menisci were followed up for over 2 years, consisting the basis of this study.

SUBJECTS AND METHODS

Design: Retrospective analysis.

Time and setting: The study was performed in Sports Medical Center in Beijing Jishuitan Hospital

from May 2002 to November 2005.

Subjects

A total of 90 BHMT repair under arthroscopy were consecutively performed. Clinical diagnosis of BHMT was made according to the specific double PCL sign (Figure 1) and coronal truncation sign (Figure 2) in MRI^[4], while the reparability was determined under arthroscopy.



Figure 1 Double posterior cruciate ligament sign

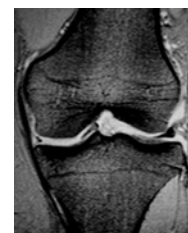
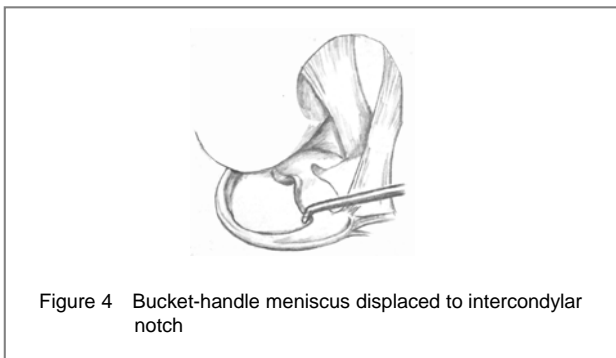
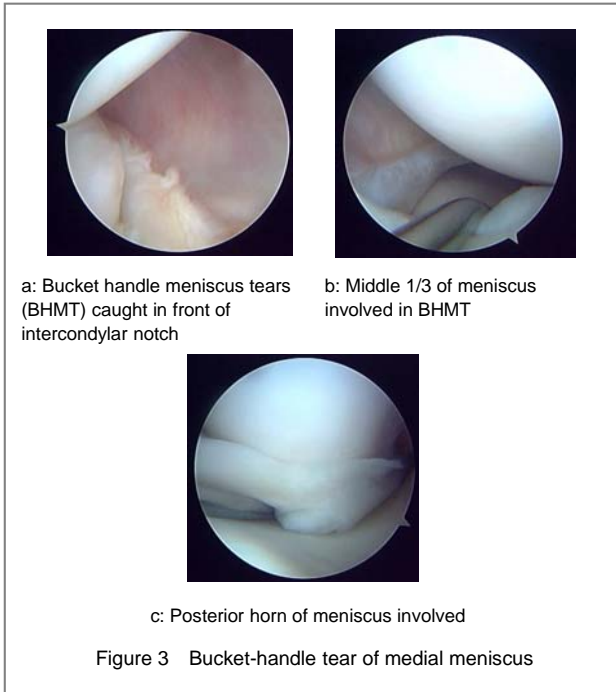


Figure 2 Truncation sign

The indications for bucket handle meniscus tears (BHMT) repair were: ① displaced BHMT when

probing, ②reducible inner fragment for chronic cases, ③ red-red and red-white zone without obvious additional complex tears or tissue degeneration, and ④isolated BHMT and BHMT with concomitant anterior cruciate ligament injuries (Figures 3, 4)

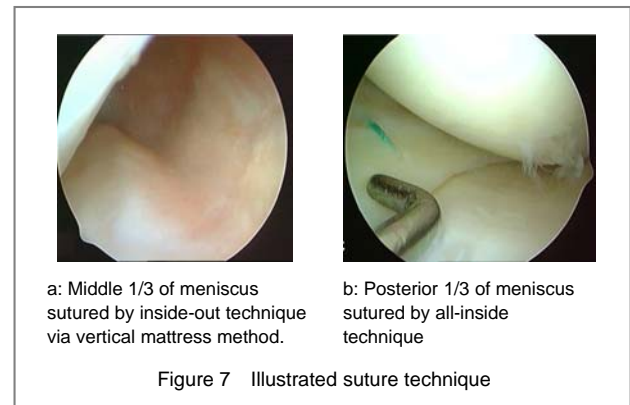
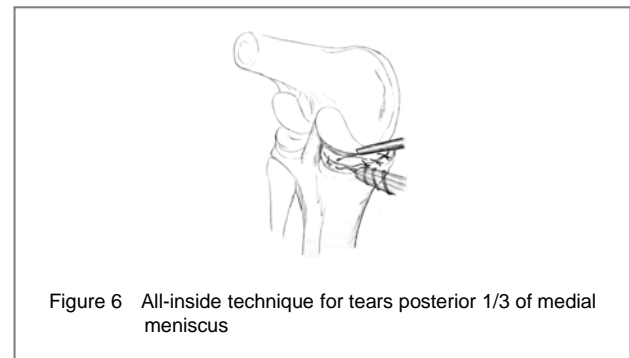
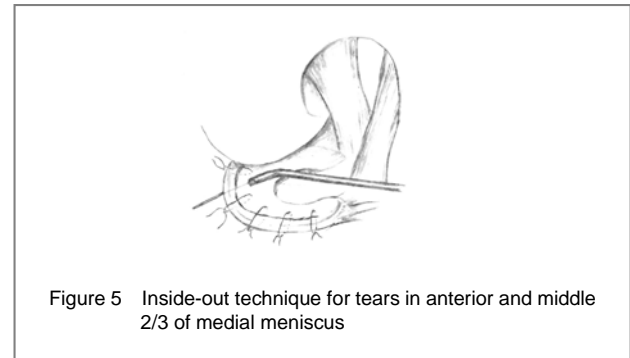


Methods

Surgical technique

Arthroscopic meniscus repair techniques consisted of inside-out, all-inside suture repair techniques and meniscus implants^[6], according to the involved sides and zones. The anterior and middle one-third portion of the medial meniscus and the anterior popliteal tendon portion of the lateral meniscus were repaired using a standard inside-out technique (Figure 5). All of the inside-out repairs were performed with multiple nonabsorbable 2-0 Ethibond sutures (Ethicon, Somerville, NJ) that stacked vertically in both the superior and inferior surface and were placed at 2- to 4-mm intervals to ensure repair strength (Figures 6, 7). The posterior one-third portion of the medial meniscus was repaired using all-inside suture technique through 2 posteromedial portals (Figures 6, 7). Forty-five degree suture hook (Suture Hook CorkScrew; Linvatec, Largo, FL) preloaded with absorbable No. 0 polydioxanone-II sutures was inserted through the lower posteromedial portal and

proceeded to the procedure of all-inside suture repair with the arthroscope viewing from the higher posteromedial portal. The posterior popliteal tendon portion of lateral meniscus was repaired using a transanteromedial portal technique for all-inside suture. With the knee in the figure-four position, a suture hook was introduced into the joint through the regular anteromedial arthroscopic portal and reached the posterior horn of the lateral meniscus while using the arthroscope to view through the anterolateral portal^[7]. For red-white zone tears, Fibrin clots were implanted into the repair region to stimulate healing.



Postoperative rehabilitation protocol

The knee was immobilized in a full extension brace, and crutches were used for 4 to 6 weeks postoperatively to protect the ACL graft and repair meniscus. Range of motion exercises (0°-90°) began immediately after removal of the drainage to achieve 90° of knee flexion and 0° of extension within 4 weeks. Partial weight bearing was allowed after 4 weeks and gradually increased to full weight bearing by the sixth week postoperatively. Squatting was not allowed until 12 weeks postoperatively. Sports activity was restricted for 6 to 10 months postoperatively.

Second-look arthroscopic evaluation

A total of 51 patients (53 repairs, 84%) underwent second-look arthroscopic evaluation by the indications of: ① patients who were asymptomatic but demanding on removal of the metal interference screws; ② patients who were symptomatic with recurrent locking, extension deficiency and patellofemoral pain; ③ second stage reconstruction of ACL. The meniscus healing status was assessed according to the criteria recommended by Morgan^[8].

Design, enforcement and evaluation

All authors participated in design, performance and evaluation of the study.

Main outcome measures

At follow-up, patients were evaluated with regards to clinical symptoms, physical examination and MRI. Patients accorded with the indications of arthroscopy underwent a second-look operation and meniscus healing was evaluated.

RESULTS

Quantitative analysis of patients

A total of 61 patients who received second-look arthroscopic evaluation surgery comprised the current study group, including 38 males and 23 females, aged 27 years (range from 16 to 47 years). Of the 61 cases, 58 had concomitant ACL injuries, and among them, 57 patients underwent one-stage meniscus repair in combination with ACL reconstruction; the other case underwent second-stage ACL reconstruction due to skeletal immaturity. Three isolated BHMT patients underwent meniscus repair. A total of 55 medial and 9 lateral menisci were repaired; 54 knees had single meniscus tears, and 2 had both medial and lateral menisci injuries. The mean interval from injury to surgery was 26 months (range from 1 day to 20 years). A total of 17 cases underwent acute stage repairs (within 6 weeks after injury), and 44 cases underwent repairs for a chronic condition.

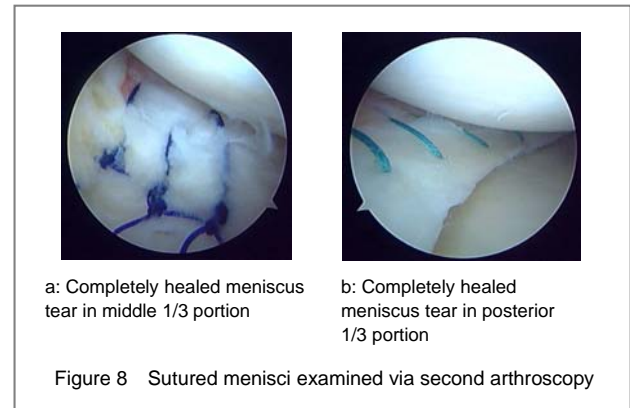
Repaired BHMT healing status evaluation

Arthroscopic evaluation

The healing statuses were assessed arthroscopically according to the criteria recommended by Morgan^[8] ① healed (Figure 8): A healed repair showed no defects or areas of hypermobility upon probing at the repair site and had no secondary tear in the meniscus in an area different from the repair site; ② incompletely healed (Figure 9): an incompletely healed repair had a partial defect of < 50% of the original repair length or height that was stable to probing and had no secondary tear in the meniscus in an area different from the repair site; ③ failed: A failed repair had either a mobile (unstable) meniscus fragment secondary to rerupture at the original repair site or a second tear in the meniscal substance in an area different from the original repair site with a healed peripheral repair.

Among the 53 repairs, 44 (83%) were completely healed (39 medial and 5 lateral; 9 acute and 44 chronic), 5 (9%) were incompletely healed (4 medial and 1 lateral; 3 acute and 1 chronic), including 2 undergoing repeated repair and 3 asymptomatic cases punctured due to their small defect

(< 1 cm) and relatively intact integrity, and 4 (8%) failed repairs were all in the medial menisci (3 acute and 1 chronic), treated by partial or total meniscectomy.



Clinical assessment

The available 61 cases were comprehensively evaluated, including swelling, locking, joint line tenderness, and McMurray testing^[9]. During follow-up, 53 (87%) patients had no positive findings identified, regarded as “asymptomatic”; 4 patients (6%) had joint line tenderness were classified as “partial symptomatic”, and 4 patients (6%) with recurrent locking identified as “failure”.

Among the 63 repairs, the overall success rate (including completely healed, incompletely healed, asymptomatic and partial symptomatic patients), was 92.1% with a failure rate of 8% (5/63). The failed 5 repairs all located in the medial meniscus, thus the success rates for medial and lateral menisci were 90.6% (48/53) and 100% respectively; 1 of 15 acute and 4 of 48 chronic injury repairs failed, with a success rate of 93.3% (14/15) and 91.7% (44/48).

MRI evaluation

A total of 52 menisci were examined by MRI in GRE or PD series for the observation of the menisci signal in coronal and sagittal plane. MRI signal of repaired meniscus region, represented as mixed intensity, was different from that of the normal meniscus. Grade 3 signals were not found in 33 repaired menisci, of which 27 healed and 2 incompletely healed confirmed by second-look arthroscopy evaluation. A total of 17 repaired menisci represented Grade 3 signal in some slides with a confirmed diagnosis of healed in 10 menisci, 1 incompletely healed, and 1 failed. Grade 3 signals in consecutive multiple slides were detected in 2 repaired menisci, which were considered as failure under arthroscopy.

Complications

Complications were identified in 7 patients, with extension deficit in 4 patients underwent concurrent ACL reconstruction operation. Second-look arthroscopy revealed impingement and scar formation in the notch. Extension deficit resolved after notchplasty or debridement. One patient suffering from medial and lateral BHMT associated with ACL injury developed tourniquet paralysis, which was due to an elongated tourniquet time. The common peroneal nerve palsy recovered during the 6-month follow-up. One patient got a limited knee flexion ($< 90^\circ$) at 8 weeks after operation. Manipulate under anesthesia was performed and achieved a 10° extension deficit as well as a less than 10° loss of flexion. One patient got a symptomatic ganglion near the posteromedial portal due to suture knot. After removal of the knot, patient's symptoms relieved completely.

DISCUSSION

Key points

The evaluation of repaired BHMT could be performed by means of clinical assessment, second-look arthroscopic examination and MRI. None of them is completely accurate. Therefore, the present study performed the comparison among these three methods in an attempt to demonstrate their relationships.

Creativity

84% patients underwent second-look arthroscopic evaluation, which provided accurate data. We recommend individualized suture techniques according to the involved sides and zones of the BHMT, thus ensured a safe, stable, and optimal repair.

Analysis of BHMT repair

In the present study, the overall success rate was 92% including healed, incomplete healed, asymptomatic and partial symptomatic patients. And the success rate of 92% confirmed under second-look arthroscopy compares favorably with other studies. O'Shea and Shelbourne reported on 59 patients with BHMT repaired under arthroscopy followed by a second stage ACL reconstruction. His success rate was 89%, which was comparable to the present study^[5]. In his study, the complete healing rate (55%) was lower and the incomplete healing rate (34%) was higher than those in our study. The reasons could be: ①the vascularity of the torn menisci played an essential role in the healing process. BHMTs were located mainly in white-white zone (43 in 55)^[6], while all the tears in the study involved the red-red or red-white zone. ②The meticulous combined suture repair technique ensured stable suture of the menisci and improved suture fixation strength in the entire length, which guaranteed complete healing.

Characteristics of BHMT and its repair technique

BHMT is unstable injury of the meniscus, thus requiring stable repairs with good tissue reapproximation and solid suture strength. To achieve this goal, we combined all-inside and inside-out suture techniques according to the injured zones of menisci. Medial BHMT usually involves a greater portion of the meniscus. Due to the concern of vascular risks, repair of the medial BHMT is often insufficient. We used combined technique of inside-out technique for tears in middle and anterior 1/3

potions and all-inside technique for tears in the posterior horn through posteromedial portals, ensuring the vertical mattress suture in the entire length. Unlike medial BHMT, the main torn area of lateral BHMT usually located in the posterior 1/3 region, sometimes only involving the posterior popliteal tendon region. We performed all-inside suture technique through anteromedial portal for tears in posterior 1/3 portion and inside-out suture technique for tears in anterior popliteal tendon region. Isolated use of meniscus fixator is not recommended for BHMT repair because its repair strength is weaker than vertical suture, especially for tears at synovial margin, and good tissue reapproximation could not be ensured by meniscus implants. Therefore, the suture repair technique is advocated in the treatment of BHMT.

Analysis of reasons for failure

Three of 5 failed repairs occurred with concurrent ACL surgery failure, including 2 reconstructed and 1 thermal shrinkage ACL. The reasons for other 2 failure cases remained unknown. In the present study, failure of BHMT was highly associated with ACL deficiency, suggesting reliable ACL reconstruction to restore joint stability. ACL reconstruction could be done during menisci repair as presented in the present study or at a separate operation^[5], which suggested staged operation for better rehabilitation. This study revealed one stage operation did not interfere with the recovery of joint range of motion. Passive knee extension exercises after surgery were important for patients with preoperational extension deficit due to a chronic locked knee situation. Besides, BHMT and ACL reconstruction follow the same rehabilitation protocol, indicating a benefit to reduce the patients' rehabilitation period and their expense for treatment. Therefore, a same-stage BHMT repair and ACL reconstruction is recommended, and the period between stage operations should be shortened to avoid the influence on menisci healing due to an unstable joint.

Evaluation of meniscus repair

There are several means of evaluating meniscus healing status including second-look arthroscopy, MRI and clinical examination. Arthroscopic examination could evaluate the integrity and stability, but cannot verify the interstitial component healing status. There is also difficulty in defining complete healing and incomplete healing status. The sensitivity and specificity of MR evaluating the repaired menisci remains controversial. In the present study, complete healing rate of 63% in MR was less than the ratio under arthroscopy (83%). The reasons may involve that grade 3 signal, mainly in the inferior surface, were identified in approximately 30% patients. More efforts should be paid to define which is more accurate in identifying the healing status of posterior horn and interstitial healing situation. MRI arthrography has been reported to provide higher sensitivity and specificity for healing of the postoperative meniscus^[4]. Clinical symptoms are limited in evaluating the healing status of menisci. In the present study, 5 partial healed patients and 1 failed case were asymptomatic and 4 cases with joint line tenderness were completely healed under arthroscopy. These indicated that clinical symptoms could be absent in patients with partial healed or failed BHMT repairs.

Bias and limitations

Of 90 patients undergoing operation, only 68% were followed up. All-inside suture technique is technically demanding and time consuming, which could lead to tourniquet paralysis especially when performing a concurrent ACL reconstruction.

Conclusion

In conclusion, during a follow-up period of 2-5 years, repair of BHTMs in red-red or red-white zone, using combined inside-out and all-inside suture technique, with concurrent ACL reconstruction could achieve a success rate of 92%. In prevention of early occurrence of osteoarthopathy, BHTMs should be well repaired to prevent partial or total meniscectomy.

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半月板桶柄样撕裂的关节镜下修补：61例2~5年随访[☆]

顾建明, 冯 华, 洪 雷, 耿向苏, 张 辉, 王雪松, 蒋协远(北京大学第四临床医学院, 北京积水潭医院运动医学中心, 北京市 100005)

顾建明[☆], 男, 1982年生, 博士, 江苏省人, 汉族, 2007年协和医科大学毕业, 医师, 主要从事骨科疾病诊治工作。

通讯作者: 冯华, 硕士, 主任医师, 积水潭医院运动医学中心, 北京市 100005

摘要

背景: 半月板的桶柄样撕裂如未经早期修补则应采取半月板切除, 可导致膝关节退变的加速, 但目前有关半月板的桶柄样撕裂关节镜下修补的长期、大样本报道较少。

目的: 回顾性分析半月板桶柄样撕裂的关节镜下修补疗效。分析半月板桶柄样撕裂的术前诊断、修补技术、疗效评估及影响因素, 探讨大型半月板撕裂理想的修复途径。

方法: 于2002-05/2005-11在北京积水潭医院运动医学中心连续完成共90例关节镜

下半月板桶柄样撕裂修补手术。对90例患者中的61例、63个半月板进行了2年以上的随访, 平均随访期38个月(24~66个月)。半月板桶柄样撕裂的修补手术适应证为: 红-红区及红-白区损伤、具备可复位性、半月板组织无复合撕裂及明显变性。

结果与结论: 在可随访的61例患者中, 有51例(84%)的53个半月板经过二次手术探查。61例患者中53例(87%)无临床症状; 4例(6%)部分临床症状; 4例(6%)交锁复发。二次关节镜检查发现完全愈合的半月板有44个(83%); 部分愈合者5个(9%), 不愈合者4个(7%)。总体评估失效率为8%(5/63), 成功率92%(包括完全愈合、部分愈合、无临床症状及部分临床症状者)。通过2-5年的随访结果表明对于发生在红-红区或红-白

区的半月板桶柄样撕裂, 采用多种缝合技术进行牢靠的修补缝合, 并且与前十字韧带重建同期进行, 修复效果较好。

关键词: 半月板桶柄样撕裂; 膝关节; 关节镜; 半月板修补; 前十字韧带; 疗效; 随访; 回顾性分析

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