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ORIGINAL PAPER

Surgical hip dislocation for treatment of synovial chondromatosis of the hip

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Abstract

Purpose In the present study, we aimed to evaluate the clinical outcomes of surgical hip dislocation in patients with synovial chondromatosis (SC) of the hip.

Methods Seven patients with primary SC of the hip treated with open synovectomy and removal of loose bodies by surgical hip dislocation from 2016 to 2019 were retrospectively reviewed. All patients had numerous and widespread loose bodies based on pre-operative images, including routine radiographs, CT, and MRI. The visual analog scale (VAS) score and Harris hip score (HHS) were collected and analyzed before and after surgery. The post-operative radiographs were reviewed to evaluate disease recurrence and osteoarthritis progression.

Results The mean operative time was 61 minutes (range, 42–75 min). An average of 33 loose bodies in each patient (range, 16–67) was removed, and extra-articular pathology was found in one patient. Patients were followed up for a mean duration of 30 months (range, 18–42 months). The average VAS scores were decreased from 3.7 (range, 2–6) pre-operatively to 0.9 (range, 0–2) at the last follow-up, and the HHS was improved from 60.1 (range, 50–73) to 90.1 (range, 82–95). All results demonstrated significant improvements ($P < 0.05$). Post-operative radiographs showed no recurrence, osteoarthritis progression, or osteonecrosis of the femoral head in all hips.

Conclusions Surgical hip dislocation was a practical approach for managing both intra-articular and extra-articular pathologic lesions around the hip. It was an effective treatment for SC of the hip with short surgical time, good joint functions, a lower recurrence rate, and few complications.

Keywords Synovial chondromatosis · Hip dislocation · Loose body · Synovectomy

Introduction

As a rare and benign disease, synovial chondromatosis (SC) of the hip is characterized by metaplasia of the synovium and the formation of multiple osteochondral bodies [1]. The exact aetiology is not yet clarified [2, 3]. Patients with this disorder usually experience dull joint pain, catching, snapping, and limitation of range of motion (ROM). If the condition is left untreated, extensive cartilage erosions and secondary osteoarthritis may arise due to persistent mechanical damage from the multiple intra-articular loose bodies. Therefore, removal of loose bodies in combination with synovectomy is accepted as the treatment for this disease [1, 4, 5]. With advances in arthroscopic techniques, an increasing number of patients with SC of the hip have been treated by arthroscopy [6–9]. However, removal of arthroscopic loose bodies and synovectomy can be technically demanding and time-consuming when dealing with countless and widespread pathologic lesions [10]. As a result, complications, such as neural paralysis and perineal skin problems, may occur due to a long traction time [10–12]. Besides, high recurrence and reoperation rates after the arthroscopy have been reported [9, 10, 13, 14], which are probably related to incomplete synovectomy and remaining loose bodies locating in the posterior-inferior and media-inferior area in the hip joint or in the extra-articular area. In contrast, an open surgical procedure with dislocation of the femoral head can address all pathologic lesions with an unobstructed view of the whole hip joint, making it possible and convenient

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to remove all loose bodies and perform total synovectomy [15–18].

In the present study, we aimed to demonstrate the clinical outcomes of surgical hip dislocation as a treatment option for SC of the hip with numerous and widespread pathologic lesions. We hypothesized that surgical hip dislocation was an effective treatment for this rare condition with short operative time, low recurrence rate, and few complications.

Materials and methods

Participants

Patients who underwent surgical hip dislocation from March 2016 to January 2019 and had confirmed diagnosis of SC were retrospectively reviewed by histopathological examination. Pre-operative radiographs, computed tomography (CT), and magnetic resonance imaging (MRI) were obtained to assess the pathologic lesions and evaluate the degree of osteoarthritis according to the Tönnis classification.

Inclusion criteria were set as follows: (i) typical symptoms, such as hip pain, catching, snapping, or limitation of ROM; (ii) the diagnosis of SC was established by pre-operative imaging and characterized by numerous and widespread loose bodies; and (iii) failure of conservative treatment for more than three months.

Exclusion criteria were set as follows: (i) radiographic findings of severe hip osteoarthritis (Tönnis grade III); (ii) developmental dysplasia of the hip (DDH) with a lateral centre–edge angle (LCEA) < 20°; (iii) femoral head necrosis; (iv) trauma, infection, or any other operative history of the hip; and (iv) the follow-up time less than 12 months.

The study was approved by the internal review board and ethical committee of our institution.

Surgical technique

All surgeries were performed by one senior surgeon (H. L). Under general anaesthesia, patients were placed in the lateral decubitus position with the operative side up. The Kocher-Langenbeck approach was conducted with a skin incision of 12 cm centered over the greater trochanter. After the gluteus maximus and tensor fascia lata were separated and retracted apart, a longitudinal trochanteric osteotomy with a thickness of 1–1.5 cm was performed along the posterior border of the vastus lateralis extending proximally to the posterior part of the gluteus medius. The trochanteric fragment was then flipped anteriorly along with the gluteus medius and vastus lateralis. The anterior capsule was exposed after retracting the gluteus minimus. (Fig. 1d) After a Z-shaped capsulotomy was performed as described by Ganz, the hip joint was then dislocated by making the leg flexed, adducted, externally rotated, and placed in a sterile bag with the release of the ligamentum teres (Fig. 1e–f). Surgical debridement in combination with synovectomy was performed until all accessible loose bodies and proliferative synovial tissue were resected. Intra-operative fluoroscopy was carried out following copious pressurized irrigation to ensure no residual loose bodies before the reduction of the femoral head. The articular capsule was repaired, and the greater trochanter was reattached to its bony-bed with two or three cortical screws. Removed loose bodies and synovium were sent for histopathological examination (Fig. 1g).

All patients received prophylactic antibiotic therapy for 24 hours post-operatively. Tolerable ROM of the hip and partial weight-bearing with crutches was permitted on the second post-operative day. Full weight-bearing was allowed after four weeks.

Outcome assessment

Follow-up was performed at three, six and 12 months after discharge and then at one or two year intervals until the final follow-up visit. Visual analog scale (VAS) score and Harris hip score (HHS) were recorded to determine the pain and clinical function of the hip, respectively. Standard anteroposterior (AP) pelvis view radiographs were performed at each follow-up to assess the recurrence of the lesion, necrosis of the femoral head, and the degree of osteoarthritis according to the Tönnis classification.

Statistical analysis

Statistical analyses were carried out using SPSS v11 (IBM, Armonk, NY, USA). Comparisons between pre- and post-operative scores were performed with a paired t test. A $p < 0.05$ was considered statistically significant.

Results

Demographics and pre-operative radiographic findings

Seven patients, including five males and two females, met the inclusion criteria and constituted our study cohort. The mean age at surgery was 42 years (range, 31–62 years). The mean time for symptom onset pre-operatively was 30 months (range, 18–42 months). Hip pain and limitation of ROM presented in all patients, and other symptoms included hinge (three patients), snapping (one patient), and limping (one patient). All patients were followed for a mean duration of 39 months (range, 20–56 months) post-operatively.

Pre-operative AP radiographs demonstrated radiopaque loose bodies in six of the seven hips. CT and MRI

confirmed loose bodies in all seven hips. According to the Tönnis radiographic classification of hip osteoarthritis, four hips were grade 0, two hips were grade 1, and one hip was grade 2 (Figs. 1a–c and 2a–c).

Operative findings and outcomes

The mean operative time was 61 minutes (range, 42–75 min), and there were 33 loose bodies (range, 16–67) averagely in each patient. The loose bodies were variable in size, and the maximum diameter recorded was 3.6 cm. In most cases, loose bodies were gray-white and often aggregated as clumps in both the central and peripheral compartments of the hip joint. The acetabular fossa and capsular recesses were common locations of loose bodies. Extra-articular lesions were found near the iliopsoas region in one patient. There were mild chondral defects in two patients. All patients underwent synovectomy following the removal of multiple loose bodies. Three patients with labral fraying underwent labral repair or debridement. Histological examination showed that characteristic findings were consistent with primary SC in all patients. (Fig. 1h) According to Milgram's criteria for SC staging, two hips were stage 2, and five hips were stage 3.

VAS scores were decreased from 3.7 ± 1.4 (range, 2–6) pre-operatively to 0.9 ± 0.7 (range, 0–2) at the last follow-up. HHS was improved from 60.1 ± 7.5 (range, 50–73) to 90.1 ± 4.9 (range, 82–95). All results demonstrated significant improvements ($P < 0.05$).

Radiographs showed no residual loose bodies in all seven patients before discharge. No recurrence of SC or osteoarthritis progression according to Tönnis classification was observed in all hips at the latest follow-up. (Fig. 1i, Fig. 2d).

There were no complications, such as infection, neurovascular injury, bone nonunion, heterotopic ossification, or osteonecrosis of the femoral head. However, one patient complained about unusual pain following hip weight-bearing post-operatively.

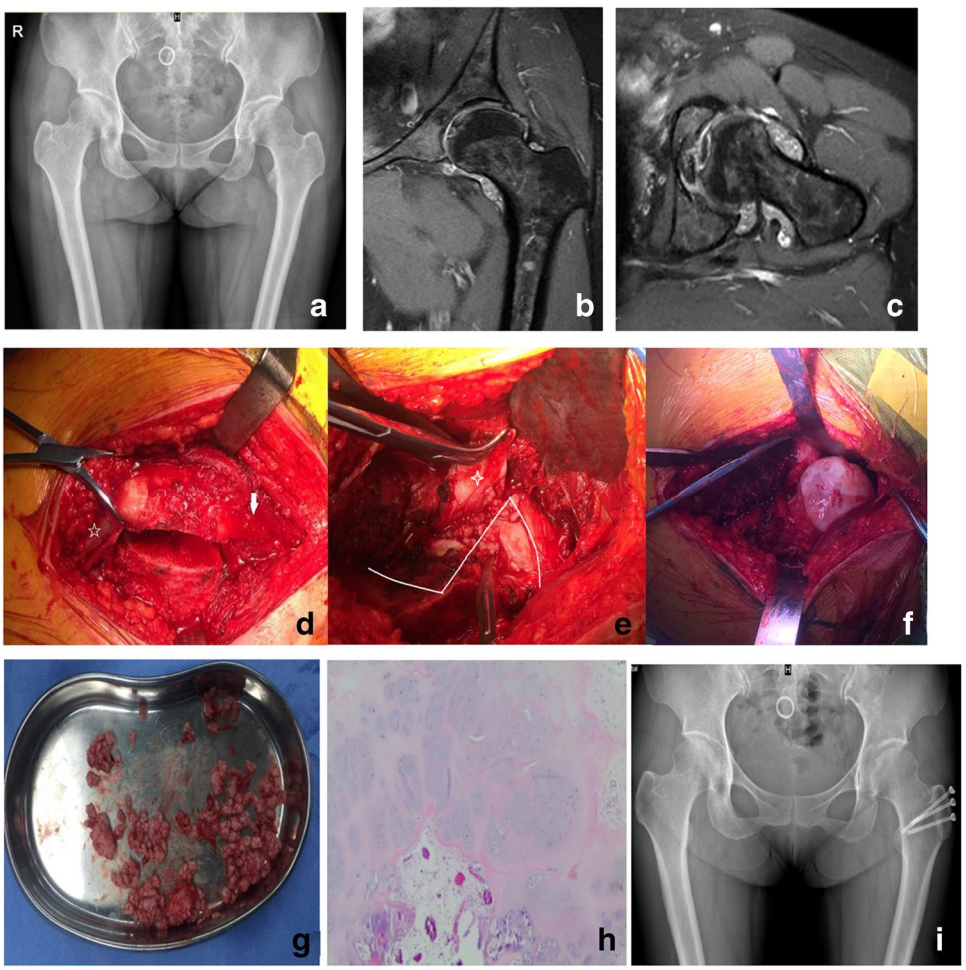

Fig. 1 A 48-year-old woman presents with pain and limited motion in the left hip for 3 years. **a** Pre-operative AP view of hip radiograph showing widening of the medial joint space and radiopaque loose bodies in acetabular fossa. **b-c** Pre-operative MRI revealed that multiple loose bodies occupied the spaces around the femoral neck and acetabular fossa. **d** Trochanteric fragment was flipped over anteriorly along with the gluteus medius (arrow) and vastus lateralis (five star). **e** The anterior capsule (four star) was lifted off after the Z-shaped capsular incision (white line), and multiple loose bodies gushed out. **f** Complete dislocation of the femoral head atter resection of the ligamentum teres. **g** Removed loose bodies. **h** Hematoxylin and eosin staining showed chondrocytes. × 50. **i** Radiograph at 14 months post-operatively

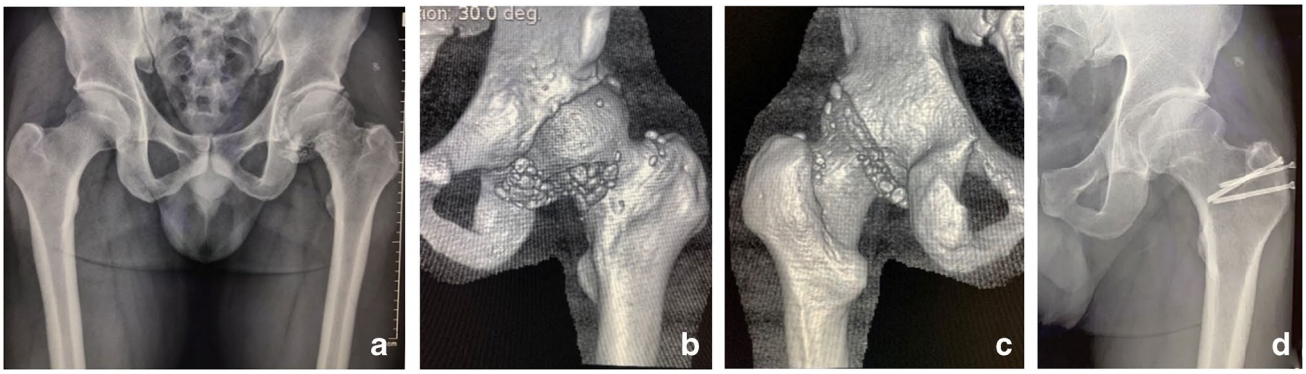

Fig. 2 A 31-year-old man presents with pain and limited motion in the left hip for 2 years. **a-c** Pre-operative radiograph (**a**) and three-dimensional CT (**b–c**) showing multiple loose bodies filling the hip joint. **d** Radiograph at 42 months post-operatively

Discussion

Surgical removal of loose bodies in combination with synovectomy is generally accepted as the optimal treatment for SC of the hip. It can be performed through open or arthroscopic surgery. Arthroscopy has been introduced to treat this disorder. However, there are complex pathology, such as large numbers, huge sizes, and inaccessible locations, which are hard to be handled arthroscopically. In those situations, an open procedure with surgical hip dislocation might be an appropriate alternative. Moreover, described as having a steep learning curve, hip arthroscopy remains a technically demanding procedure with potential complications, such as iatrogenic chondrolabral damage, neurovascular injury, and traction-related neurapraxia [19, 20]. Therefore, we emphasized that an improper patient selection and incorrect performance in the arthroscopic procedure may lead to greater damage and more complications than a standardized open procedure with surgical hip dislocation, the safety and effectiveness of which have been demonstrated in multiple reports [15–18].

In the present study, all enrolled patients were characterized with countless and widely distributed loose bodies, which were extremely challenging to manage by arthroscopy. Marchie [12] has reported an average of 40 and a maximum of 300 loss bodies in 29 hips with SC. It is nearly impossible to remove all these lesions arthroscopically even by the most modern technique. The posterior-inferior and media-inferior area of the hip joint is called the "blind area," where the arthroscopy is hard to access and undetected loose bodies often locate [10, 21]. Besides, extra-articular lesions cannot be handled by arthroscopy yet. As a result, there have been some concerns about the high recurrence and reoperation rates due to remaining loose bodies. de Sa [13] has reported a recurrence rate of 7.1% after hip arthroscopy in a systematic review consisting of 197 patients. Boyer [14] has reported 111 patients who undergo arthroscopic management for SC of the hip, 23 patients (20.7%) receive more than one arthroscopic surgery, and 22 patients (19.8%) finally undergo a total hip replacement.

It is important to emphasize that full exposure of the hip joint is an essential prerequisite for a complete debridement and synovectomy, which can effectively avoid the residual pathologic lesions and prevent a recurrence. The open procedure through surgical hip dislocation, developed by Ganz [18], provides a full 360° view of the femoral head and the acetabulum, which is especially suitable for patients with countless loose bodies or extra-articular lesions. Schoeniger [22] has reported eight patients with SC of the hip who undergo surgical hip dislocation, and there is no recurrence, no notable complications nor signs of avascular necrosis of the femoral head. These findings are comparable with our series. One patient in our study with extra-articular lesions near the iliopsoas region underwent surgical hip dislocation and gained a good outcome. Besides, considering that the recurrence may be related to the persistent metaplastic activity of the remaining synovium, we performed a synovectomy for every patient, which was very important to prevent a recurrence. Moreover, an open procedure with surgical hip dislocation for the treatment of SC of the hip can indeed save much surgical time compared with the arthroscopy. In our present study, the mean operative time was merely 61 minutes (range, 42–75 min), during which an average of 33 loose bodies (range, 16–67) was removed. In contrast, Lee [10] has reported an average operative time of 144 minutes (range, 75–185 min) for arthroscopy, which can result in more traction-related complications. One series [10] has reported perineal skin bruises in one of 13 patients, and another [12] has found neuropraxia of the pudendal nerve in two of 29 patients after arthroscopic treatment for SC of the hip.

The deep branch of the medial femoral circumflex artery (MFCA), as described by Ganz [23], is the primary source for the blood supply to the femoral head, which should be protected throughout the surgery to prevent osteonecrosis of the femoral head. In our series, we did not expose this vessel

intra-operatively. Additionally, we had several recommendations to avoid rupturing this vessel during the procedures. First, it was crucial to ensure the integrity of the obturator externus and external rotators, which could protect the deep branch of the MFCA from being disrupted or stretched during dislocation. Second, the thickness of trochanteric osteotomy should be less than 1.5 cm to keep away from the course of the deep branch of the MFCA, which travels near the posterior border of the greater trochanter. Third, more attention should be paid when dealing with the extra-articular lesions near the iliopsoas region, where the MFCA spreads between the pectineus and the iliopsoas tendon. Moreover, the intracapsular segment of the deep branch of the MFCA running along the posterior aspect of the femoral neck, which is called the retinacular vessel, should be carefully identified and protected during the procedures of debridement and synovectomy. Finally, the capsule should be repaired under low tension to avoid damaging the retinacular vessels and the perfusion of the femoral head.

Besides, we had concerns about the adverse effects of the potential instability of the hip caused by the extensive incision of the capsule and the release of the ligamentum teres. In our series, one patient complained about an unusual pain following hip weight-bearing post-operatively, which was possibly attributed to the instability. We reviewed pre-operative radiographs of this patient, and a so-called borderline developmental dysplasia of the hip (BDDH) with an LCEA of 24° was identified [24]. We supposed that the potential instability might already exist operatively, and the procedures exacerbated it. Therefore, we suggested that patients with either existing or potential hip instability should be contraindicated to undergo the procedure of surgical hip dislocation.

Limitations

There are several limitations in this study, such as its retrospective design, the lack of an arthroscopic control group, and relatively short follow-up periods. The number of patients was small due to the rarity of the condition. Besides, we did not perform a routine post-operative MRI for asymptomatic patients, which might preclude an accurate predictor of disease recurrence.

Conclusions

Nevertheless, this study showed that surgical hip dislocation was a versatile approach to address both intra-articular and extra-articular pathologic lesions around the hip joint, and it provided good operative functions, a low recurrence rate, and few complications. As it continues to be modified without the trochanteric osteotomy, as reported by Schweitzer [25] and Sculco [26], the procedure of surgical hip dislocation will be more popular in hip surgery.

Author contribution Sheng Fang and Huan Li contributed to the study design. Yiming Wang and Peng Xu constructed the database and collated the data guided by Han Sun. Shuxiang Li analyzed the data. Sheng Fang, Zhaoxiang Wei, and Xiaoliang Sun contributed to writing the manuscript. All authors read and approved the final manuscript.

Declarations

Ethics approval The study was approved by the internal review board and ethical committee of the First People's Hospital of Changzhou.

Competing interests The authors declare no competing interests.

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