Effect of articular capsule repair on postoperative dislocation after primary total hip replacement by the anterolateral approach

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Abstract

Objective: Artificial hip dislocation is one of the most serious complications following total hip replacement. This study was performed to assess articular capsule repair in primary total hip replacement with the anterolateral approach (Watson-Jones incision) and its effect on postoperative dislocation.

Methods: Patients who underwent primary total hip replacement by the anterolateral approach in Tongren Hospital of Shanghai Jiao Tong University School of Medicine from June 2007 to June 2014 were retrospectively analyzed. The patients were divided into the repair and dissection groups based on the articular capsule repair status during surgery. Postoperative dislocation rates were compared between the two groups using the chi-squared test.

Results: The repair and dissection groups comprised 137 and 248 patients, respectively. All patients were followed up for 6 months to 5 years (average, 3.75 years). The mean age, sex, disease composition, and follow-up time were not significantly different between the two groups. Early postoperative dislocation occurred in 1 hip (0.7%) in the repair group and 13 hips (5.2%) in the dissection group.

Conclusions: During the anterolateral approach for primary total hip replacement, articular capsule repair may reduce the occurrence of early postoperative dislocation of the hip joint.

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Introduction

Total hip arthroplasty (THA), also known as total hip replacement, is performed to restore the natural biomechanics of the hip joint.[1] THA is among the most cost-effective and successful operations in orthopedics and provides reliable outcomes in patients with end-stage degenerative hip osteoarthritis; e.g. pain relief, functional restoration, and an ameliorated quality of life.[2,3] Contraindications for THA include active infection and pronounced limb ischemia.[4] With the continuous advancement of artificial joint materials and surgical technologies, artificial joint replacement has become one of the most widely used and effective surgical methods in orthopedics.[5] Artificial THA is also employed for the treatment of various diseases such as rheumatoid arthritis, congenital hip dysplasia, femoral head aseptic necrosis/ischemic necrosis, femoral neck fracture, and hip tumors.[6–11]

Although relatively rare, prosthetic hip dislocation is one of the most common postoperative complications in patients undergoing THA. The incidence of this serious complication is second only to that of aseptic loosening of artificial joints.[12] Prosthetic hip dislocation aggravates pain, prolongs hospitalization and rehabilitation times, and increases medical expenses, seriously affecting the physical and mental health of the patient.[13,14] The risk of dislocation is influenced by many factors including the surgical approach, implant position, soft tissue tension or instability, disruption of the trochanteric abductor mechanism, impingement, and lack of patient cooperation.[15–17] Particularly with a posterior approach, studies have shown that stability of the soft tissue (including the muscle and integrity of the articular capsule) is an important factor related to the occurrence of hip dislocation.[16,17] Articular capsule repair during THA decreases the rate of hip dislocation.[17,18]

The anterolateral approach for THA is minimally invasive, resulting in a low rate of hip dislocation.[19] Previous studies have shown that articular capsule repair is also feasible during primary artificial THA by the anterolateral approach, decreasing the rate of early postoperative hip dislocation.[15,18,20,21] However, because the rate of hip joint dislocation is generally quite low in this approach, and because previous studies on the clinical value of capsule repair have mainly concentrated on the posterior approach, more studies are needed to further evaluate the effect of articular capsule repair on postoperative dislocation after primary THA.

We performed the present retrospective study to provide more information on articular capsule repair in primary THA with the anterolateral approach. Specifically, we assessed articular capsule repair in primary THA with the anterolateral approach and its effect on postoperative dislocation.

Methods

Patients

Patients who underwent primary THA by the anterolateral approach in Tongren

Hospital of Shanghai Jiao Tong University School of Medicine from June 2007 to June 2014 were retrospectively analyzed. This study was approved by the Ethics Committee of Tongren Hospital of Shanghai Jiao Tong University School of Medicine, and the need for written informed consent was waived by the committee because of the retrospective nature of the study.

Surgical methods

All surgeries were performed by the same group of doctors. The patients were divided into repair and dissection groups based on the articular capsule repair status during surgery.

After induction of anesthesia, the patients were placed in the lateral position with the affected side upward and treated by the anterolateral approach (Watson-Jones incision) according to standard methods.

For treatment of the articular capsule, the anterior portion of the hip articular capsule was cut along the direction of the femoral neck, and the articular capsule was transversely cut to yield an "H"-shaped articular capsule incision. The articular capsule was pulled to both sides to fully expose the femoral head, femoral neck, and upper edge of the acetabulum (Figure 1). In the dissection group, the articular capsule including 40% to 60% of the surrounding acetabulum was directly resected, and the above-described treatment was not performed.

For femoral head and neck treatment, the hip joint underwent extorsion, adduction, and mild flexion. The femoral neck was cut at about 1.5 cm above the femoral lesser trochanter. A head lifter was screwed into the head to remove the femoral head and residual intra-acetabular round ligament (Figure 2(a)).

For acetabulum treatment and acetabular cup placement, three Hoffmann hooks were placed in the bone around the acetabulum, and the glenoid labrum, synovial membrane, and osteophyte around the acetabulum were removed. An acetabular file was used to remove the acetabular cartilage, and the selected cup prosthesis was placed into the acetabular bed at 45 degrees of abduction and a 20-degree forward angle, with the matched lining of the cup inside.

Pinnacle® + Corail® AMT uncemented, fully hydroxyapatite-coated biotype total hip prostheses (DePuy Synthes, Raynham, MA, USA) were used. The affected limb was bent at the hip, adducted and gently sagged, and extorted. The proximal femur was raised, and the medullary cavity was gradually reamed. The femoral prosthesis was then inserted into the medullary cavity to the appropriate position, maintaining an angle of 10 degrees. Finally, the femoral head prosthesis was installed (Figure 2(b)).

The stability of the hip joint was assessed in both the repair and dissection groups, with the hip joint at 40 degrees of extorsion, 90 degrees of flexion, or 40 degrees of intorsion. For repair, articular capsule flaps were encircled to the front of the femoral neck and appropriately overlapped with a 7/0 silk suture (Mersilk; Ethicon, Johnson & Johnson, Somerville, NJ, USA). Additional details are shown in Figure 3.

Finally, negative-pressure drainage was established, and the gluteus minimus, gluteus medius, lateral femoral muscle, and tensor fascia were repaired and sutured. The incision was closed layer by layer. The lengths of the lower limbs were compared again. A C-arm X-ray instrument was used to observe the prosthesis positions.

Postoperative guidance of rehabilitation training

The patient was placed in the supine position after surgery, and a soft pillow was
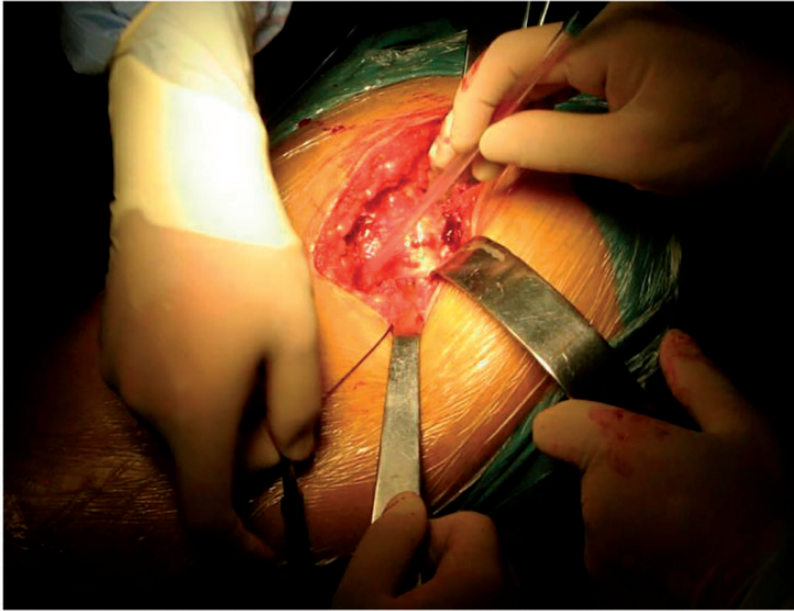
Figure 1. "H"-shaped incision of the articular capsule. The anterior portion of the hip articular capsule was cut along the direction of the femoral neck and the articular capsule was transversely cut at the upper edge of the acetabulum and base of the femoral neck to yield an "H"-shaped articular capsule incision. The articular capsule was pulled to both sides to fully expose the femoral head, femoral neck, and upper edge of the acetabulum.

placed under the affected limb to achieve flexion of about 15 degrees. "T"-shaped shoes were then used, or skin traction and immobilization of the affected limb was performed, if necessary. A soft pillow was placed between the legs when the patient was turned over. Excessive flexion, adduction, intorsion, extension, or extorsion of the affected hip was avoided.

Isometric exercises of the quadriceps femoris and active flexion and extension exercises of the ankle joint were performed the day after surgery, and the amounts of these exercises were gradually increased. Abduction and active joint movement were allowed after drainage tube removal. A continuous passive motion machine was used to assist functional restoration. The timing of getting out of bed was determined according to the patient's constitution, bone substance, and prosthesis fixation.

Generally, standing training was performed from 4 days to the third week after surgery. Crutches with weight-bearing walking training were gradually used until the patient was normally walking.

Follow-up and evaluation of therapeutic effects

Regular follow-up was performed in the outpatient clinic to assess clinical function and perform radiological examinations at 1, 3, 6, and 12 months after discharge and once a year thereafter. The Harris hip score and pain score (visual analog scale score) were evaluated for all patients. Orthotopic radiography of the pelvis and lateral radiography of the affected hip were performed to assess complications such as prosthesis loosening and dislocation.
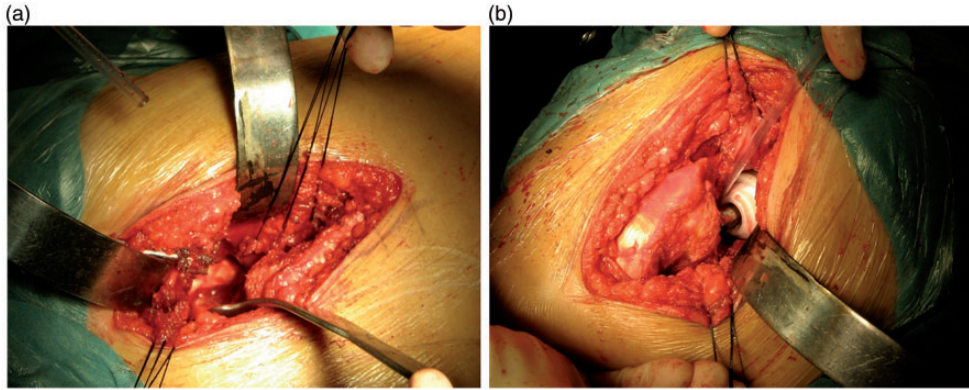
Figure 2. Retained articular capsule and prosthesis position. (a) The hip joint underwent extorsion, adduction, and mild flexion. The femoral neck was cut by a pendulum saw at about 1.5 cm above the femoral lesser trochanter. A head lifter was screwed into the head to remove the femoral head and the residual intra-acetabular round ligament. (b) Three Hoffmann hooks were placed in the bone around the acetabulum for full revelation. The glenoid labrum, synovial membrane, and osteophyte around the acetabulum were removed. An acetabular file was used to remove the acetabular cartilage, maintained at 45 degrees of abduction and a 20-degree forward angle to gradually deepen and enlarge the acetabulum to the proper position. The selected cup prosthesis was placed into the acetabular bed at 45 degrees of abduction and a 20-degree forward angle, with the matched lining of the cup inside. The affected limb was bent at the hip, adducted and gently sagged, and extorted. The proximal femur was raised and the medullary cavity was gradually reamed. The femoral prosthesis was then inserted into the medullary cavity to the appropriate position, maintaining an angle of 10 degrees. Finally, the femoral head prosthesis was installed.
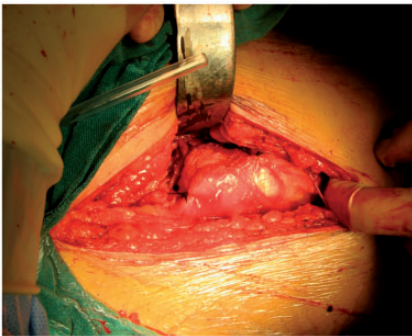

Figure 3. The repaired articular capsule. Articular capsule flaps were encircled to the front of the femoral neck and appropriately overlapped with a 7/0 silk suture (Mersilk; Ethicon, Johnson & Johnson, Somerville, NJ, USA). The incisal edge of the articular capsule was sutured in a figure 8 shape with the anterior cancellous bone surface and the attached tendinous tissue at the base of the femoral neck by absorbable thread and a bone-piercing needle.

Statistical analysis

Statistical analysis was performed with SPSS 19.0 software (IBM Corp., Armonk, NY, USA). Enumeration data were first assessed for normality. Normally distributed data are expressed as mean ± standard deviation. Comparisons between the two groups were performed by a t-test. Data with a skewed distribution are presented as median (range), and the Mann–Whitney U test was used for comparisons between the two groups. Enumeration data are expressed as frequency and percentage, and the chi-squared test was used for assessment. A P value of <0.05 was considered statistically significant.

Results

Patients' characteristics

The repair group comprised 137 patients [65 men and 72 women aged 37 to

Table 1. Patients' baseline characteristics.

Characteristics	Repair group	Dissection group	P value
Patients, n	137	248	–
Age, years	63.7 ± 10.7	64.5 ± 10.8	0.878
Sex			
Male	65 (47.4)	121 (48.8)	0.645
Female	72 (52.6)	127 (51.2)	
Preoperative diagnosis			
Femoral neck fracture	109 (79.6)	189 (76.2)	0.253
Femoral head necrosis	20 (14.6)	48 (19.4)	
Other diseases	8 (5.8)	11 (4.4)	

Data are presented as mean ± standard deviation or n (%).

75 years (mean, 63.7 years)]. The preoperative hip lesions were mainly fresh femoral neck fracture (n = 103), old femoral neck fracture (n = 6), femoral head necrosis (n = 20), hip osteoarthritis (n = 5), and congenital hip dysplasia (n = 3). One patient underwent bilateral artificial arthroplasty.

The dissection group comprised 248 patients [121 men and 127 women aged 41 to 76 years (mean, 64.5 years)]. The preoperative hip lesions were mainly fresh femoral neck fracture (n = 183), old femoral neck fracture (n = 6), femoral head necrosis (n = 48), hip osteoarthritis (n = 6), and congenital hip dysplasia (n = 5). Two patients underwent bilateral artificial arthroplasty. There were no significant differences in the baseline characteristics between the two groups (Table 1).

Effect of articular capsule repair on treatment outcomes

All patients were followed up for 6 months to 5 years (average, 3.75 years). Within 6 months of surgery, one hip (0.7%) dislocation occurred in the THA repair group (Figure 4). In this case, the muscle strength in the affected side was decreased, the muscle around the hip joint was significantly atrophied and loosened, and the walking ability was poor because the patient was

comorbid with multiple lacunar infarctions before surgery. The joint dislocation occurred during functional exercise after arthroplasty. The patient was discharged after successful closed reduction. A large area of cerebral infarction occurred after discharge, resulting in hemiplegia on the affected side. The patient's family members decided to discontinue treatment. Dislocation occurred in 13 hips (5.2%) in the THA dissection group. The difference in early dislocation rates between the two groups was statistically significant (P < 0.05) (Table 2). Six months after surgery, no delayed dislocation occurred in either group.

Discussion

The current study demonstrated that articular capsule repair can prevent early postoperative hip joint dislocation during primary total hip replacement by the anterolateral approach. Anterior, posterior, or superior dislocation of the hip can occur after THA; posterior dislocation is the most common, followed by anterior dislocation. Different surgical approaches have distinct effects on the soft tissue stabilization system of the hip and are associated with different types of dislocation.[22] The most commonly used approach, the
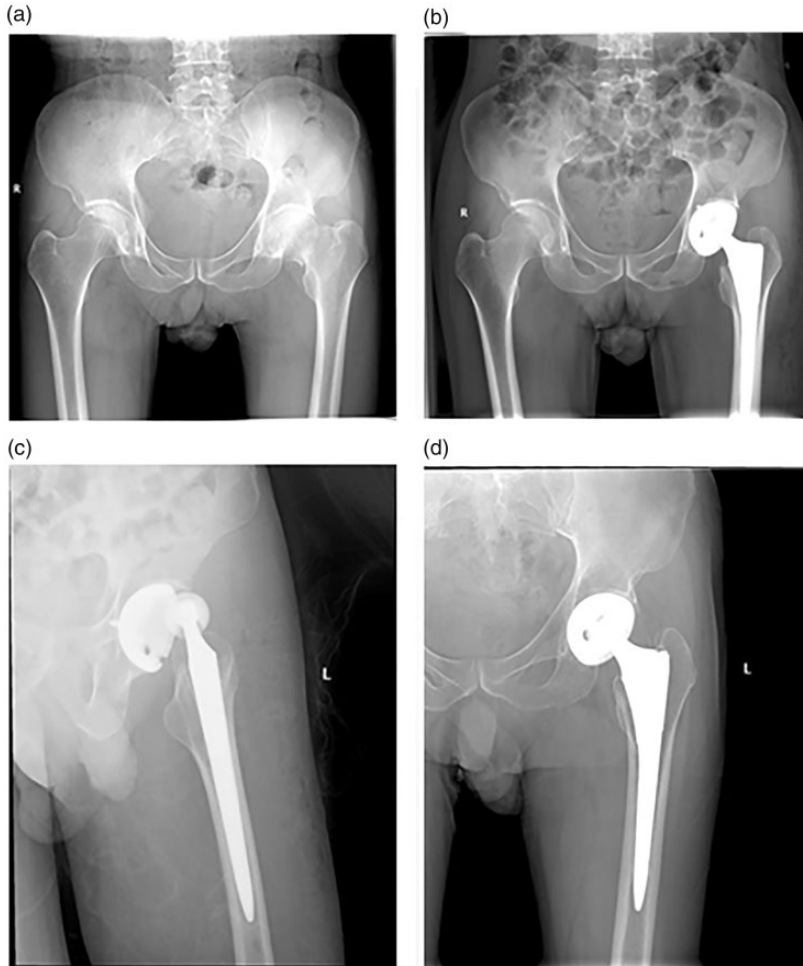
Figure 4. X-ray features of hip dislocation after total hip replacement. (a) A 62-year-old man was diagnosed with a left femoral neck fracture before surgery. (b) He underwent left total hip replacement without articular capsule repair on 9 January 2011. Re-examination by X-ray 3 days after surgery showed that the prosthesis was in place. (c) During postoperative functional restoration exercises, hip dislocation occurred because of improper positioning. Manual reduction was performed immediately. (d) After 3 weeks of skin traction, re-examination by X-ray showed good prosthesis positioning.

Table 2. Dislocation rates 6 months after surgery.

	Repair group (n = 137)	Dissection group (n = 248)	P value
Dislocation	1 (0.7)	13 (5.2)	<0.05
Normal	136 (99.3)	235 (94.8)	

Data are presented as n (%).

posterolateral approach (Moor incision), has a high dislocation rate.[23] The anterolateral approach (Watson-Jones incision) has the characteristics of minimal damage, easy repair, low risk of infection, reduced effects on hip joint function, reduced joint stability damage, and ease of restoration; therefore, it is used by many clinicians. However, it is

still associated with a certain dislocation rate (2.3%), especially anterior dislocation.[24,25] One study involving 1910 patients who underwent THA showed that the highest incidence of dislocation (about 5.8%) was associated with the posterolateral approach; this incidence was twice that of the lateral and anterior approaches.[26]

Pellicci et al.[27] strengthened the posterior soft tissue of the hip joint as a repair technique and achieved satisfactory results. No case of dislocation was found among all 395 patients during follow-up, while a dislocation rate of 4% occurred in the dissection group. Studies by Iorio et al.[20] and Ji et al.[21] also revealed a significantly lower incidence of dislocation after strengthening the posterior soft tissue of the joint in primary THA. In recent years, many studies have assessed the correlation between posterior articular capsule repair and decreased artificial prosthesis dislocation.[28,29]

In the present study, early dislocation was defined as dislocation within 6 months after surgery, taking into account the time for pseudo-articular capsule formation. Generally, the first dislocation after THA occurred early; indeed, about 60% to 70% dislocations occurred within 4 to 6 weeks of THA. Lindberg et al.[30] studied 1739 patients who underwent THA and found 56 cases of dislocation (3.3%), including 41 cases (73.2%) with a first dislocation within 1 month of surgery. It is currently believed that delayed dislocation is less common than early dislocation because of pseudo-articular capsule formation.[31] Notably, in the present study, dislocation mainly occurred in patients with femoral neck fracture. The patient who developed dislocation in the repair group had been diagnosed with a femoral neck fracture preoperatively, and most of the 13 patients who developed dislocation in the dissection group had also been diagnosed with femoral neck fractures preoperatively. However, the exact numbers are not available because of the retrospective nature of this study and a lack of full clinical information.

As described above, we found a significant difference in the dislocation rate between the THA repair and dissection groups, indicating that repair is feasible and effective (Table 2). Intraoperative examination revealed that the femoral head prosthesis was initially inserted within the acetabular lining when the hip joint was gently abducted and externally rotated before suturing the articular capsule; when the hip joint was externally rotated to about 60 degrees, the femoral head was moved to the edge of the liner, causing dislocation. In the initial stage of sliding, applying a slight force on the femoral head prosthesis with a finger can prevent further sliding of the prosthesis and expand the range of motion of the hip joint. The sutured articular capsule was in a relaxed state with the hip joint in the neutral position but it became tight on the anterior side of the femoral head when the hip joint was externally rotated and adducted. This prevented the initial sliding of the femoral head prosthesis in the acetabulum. The initial sliding of the prosthesis is a crucial part of the mechanism of non-impact–induced hip dislocation. From a biomechanical viewpoint, the strength of the repaired articular capsule was insufficient to prevent hip dislocation, but the sutured articular capsule was sufficient to prevent the initial sliding of the femoral head prosthesis. This indicates that the repair method used in the present study can restore the articular capsule integrity, increase the immediate stability of the artificial joint, and effectively reduce early dislocation occurrence.

In the repair group, the articular capsule was cut with an "H"-shaped incision to form two flaps as described above. After restoration, the flap-shaped articular capsule was sutured according to its

pre-incision shape, and its cut edge was sutured to the front side of the base of the femoral neck. White et al.[32] assessed 437 cases of total hip replacement with a similar method of articular capsule repair. During the 6-week follow-up, only three patients (0.7%) developed early postoperative dislocation, while four patients (0.9%) developed a local avulsion fracture. In the present study, no similar complications were observed in the repair group. According to our experience, the articular capsule should not be removed but should instead be cut as much as possible to preserve its integrity. When no tissue defects are present, tension-free sutures can be placed to avoid tearing of the soft tissue or local bone tissue avulsion. In patients with hard bone substance, direct suturing is relatively difficult, and *in situ* reconstruction with TWINFIX anchors (Smith & Nephew, London, UK) could be considered.[33,34] In patients with osteoporosis, the number of sutures should be appropriately increased. The anterior articular capsule may be difficult to reconstruct in patients with severe articular capsule contracture or extremely severe osteoarthropathy, which may limit the use of the repair technique. During the operation, attention should also be paid to maintaining the continuity of the gluteus medius tendon and the lateral femoral tendon membrane to facilitate repair; when recognizing the gluteus minimus and separating it to the front side, the operation should be performed as close as possible to the greater trochanter, and gentle manipulation should be ensured to avoid damage to the inferior branch of the superior gluteal nerve. The fat pad on the surface of the articular capsule can reduce postoperative scar adhesion and should be retained as much as possible. While exposing the anterior capsule of the hip joint, the flexion state of the hip should be properly maintained to ensure that the rectus femoris is relaxed and easy to dissociate; femoral vessels and nerves should also be relaxed and kept away from the surgical region. While cutting the femoral neck with a pendulum saw, the osteotomy line should be perpendicular to the axis of the knee and the double condyles, forming an angle of 45 degrees with the femoral shaft. During placement of the lining of the cup, the upper side of the lining should be located on the anterior–superior aspect of the acetabulum to effectively prevent anterior dislocation of the prosthesis. The medullary cavity file should be inserted as close as possible to the outside of the femur, remaining consistent with the longitudinal axis of the femur to avoid injury or penetration of the femoral shaft.

This study has several limitations. First, this was a retrospective observational trial with inherent shortcomings, including sampling bias and possible interference of other dislocation factors. The patients' full medical information was not available, so the groups could not be compared to ensure that their baseline characteristics were similar. For example, based on the characteristics of Asian patients, the size of the femoral head used in this study was mainly 28 or 32 mm; however, although the size of the femoral head is important because larger heads are associated with lower dislocation rates,[35] the exact data were not available for comparison between the groups. The two groups were allocated according to their surgical information because of the retrospective nature of the study; this meant that some patients in the dissection group may have undergone failed repair, introducing bias. In addition, the difference in long-term efficacy between the repair and dissection groups was not assessed. Finally, the sample was relatively small, and all patients were treated in the same institution. Therefore, future well-designed multicenter studies with large samples are warranted to confirm our findings.

In conclusion, while applying the anterolateral approach for primary THA, articular capsule repair is feasible and effectively reduces the occurrence of early postoperative hip dislocation.

Declaration of conflicting interests

The authors declare that there is no conflict of interest.

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