Comparative study of anterolateral approach versus posterior approach for total hip replacement in the treatment of femoral neck fractures in elderly patients

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【Abstract】Objective: To compare the clinical outcome of anterolateral minimally invasive approach versus conventional posterior approach for total hip replacement against femoral neck fractures in elderly patients.

Methods: The retrospective study was carried out on 42 patients who suffered from displaced femoral neck fractures (19 cases of Garden type III, 23 cases of Garden type IV) treated by total hip replacement via anterolateral minimally invasive approach or conventional posterior approach by the same experienced surgeon. The average age of the patients was 78.1 years (range: 65-89 years). They were divided into anterolateral mini-invasive group (22 cases) and posterior group (20 cases). The mean time of follow-up was 13 months (range: 6-36 months). The anterolateral approach described by Hardinge goes through between anterior 1/3 and posterior 2/3 of the gluteus medius muscle, reaching the femoral neck from anterior capsule. The traditional posterior approach described by Moore (Southern incision) goes through the insertions of short external rotation muscles, reaching the femoral neck from posterior capsule. The related variables under observation were length of incision, operation time, postoperative limp, length of hospital stay and bed stay and dislocation rate.

Results: The length of the skin incision varied between 7 cm and 12 cm with the anterolateral minimally invasive technique, compared to 15-22 cm in the conventional procedure. It took less time (average 15 minutes) to complete the anterolateral minimally invasive approach (72 min±15 min), compared with the conventional approach (87 min±10 min). The average Harris hip score was 91.23±10.20 in anterolateral approach, 90.03±11.05 in the posterior approach. The average length of hospital stay for patients with the anterolateral approach was (6.4±2.2) days (range: 4-9 days), while that in posterior approach was (9.2±3.1) days (range: 6-13 days). The average length of bed stay was (3.4±1.1) days (range: 2-5 days) in anterolateral group and (6.2±2.8) days (range: 3-10 days) in posterior group. No patients in anterolateral group experienced dislocation. One (5%) hip in posterior approach had dislocation.

Conclusions: Anterolateral mini-invasive approach can decrease trauma, operation time, length of hospital stay and bed stay and rehabilitation time. The stability and minimal muscular damage permit the acceleration of postoperative rehabilitation, which can subsequently reduce the perioperative risk in the treatment of femoral neck fractures in the elderly undergoing total hip replacement.

Key words: Arthroplasty, replacement, hip; Surgical procedures, minimal invasive; Femoral neck fractures

Fracture involving the femoral neck is a common and serious injury in the elderly, with high associated perioperative mortality (14%-47%).1 The treatment of femoral neck fracture in senile patients is much more dangerous and complicated because of osteoporosis and severe medical comorbidities. Although there have been reports with satisfactory results of total hip arthroplasty, orthopaedic surgeons are confronted with tremendous pressure to make the decision against as high as 10% mortality and 30-40% perioperative morbidity from the fracture and operation. The majority of fatal morbidities are related to prolonged bed stay, such as bedsore, hypostatic pneumonia and...
fatal pulmonary embolism. Therefore, how to reduce the operative injury and time of bed-stay is essential for the outcome of this procedure. The minimally invasive total hip arthroplasty has been shown to be safe and effective in achieving early postoperative improvements in pain, function and accelerated postoperative recovery. Minimally invasive total hip arthroplasty has been defined by an incision length of 10-12 cm or less. The modified Hardinge anterolateral mini-invasive approach is supposed to offer excellent results because it leaves the majority of abductor function (gluteus medius and minimus) intact, as well as all the posterior tendon and capsule elements. Because of this, it can offer excellent clinical results, permitting less rehabilitation and more rapid functional recovery. Therefore, we made a comparative study of the anterolateral mini-invasive approach versus traditional posterior approach for primary total hip replacement of femoral neck fractures in elderly patients.

METHODS

Patient population

Forty-two patients with displaced femoral neck fractures (19 cases of Garden type III, 23 cases of Garden type IV) were treated in our hospital from September 2003 to September 2008. In order to make a reliable preoperative assessment of operative risk related to medical comorbidities, all cases were evaluated by operative risk assessment software (ORAS1), in which the variables were based on the patients' comprehensive physical and laboratory examinations preoperatively. There were 16 males and 26 females, with an average age of 78.1 years (65-89 years), which were randomly divided into anterolateral mini-invasive group (22 cases) and posterior group (20 cases). The mean time of follow-up was 13 months (6-36 months). In all cases, there was no selection with respect to weight, size, or body mass index.

All cases had the medical comorbidities, such as hypertension, diabetes, arteriosclerosis, high blood lipid, cerebral thrombosis, cerebral infarct, cardio-dysfunction, to some extents.

Surgical technique

In order to minimize the influence of technical skills of different surgeons, all surgical procedures were carried out under general anesthesia by the same orthopaedic surgeon. In order to minimize the influence of prosthesis type, the prostheses of elderly osteoporotic patients in our study all consisted of cemented femoral stem and cemented acetabular implant.

Modified Hardinge anterolateral mini-invasive approach The patient was placed lateral on the normal table with the affected limb on the top. The skin and subcutaneous tissue were opened through a straight longitudinal incision on the center of the greater trochanter. The caudal half to the trochanter tip was straight; the rest cranial half to the trochanter tip was curved slightly to the dorsal side of the greater trochanter. The length of the skin incision varied between 7 and 12 cm (all incisions were less than 10 cm except for one male patient who had 12 cm incision for strong muscle), depending on the physical condition of the patient and the anticipated size of the implanted components. Divide the fascia lata in line with the skin incision and centered over the greater trochanter. Retract the tensor fasciae latae anteriorly and the gluteus maximus posteriorly exposing the origin of the vastus lateralis and the insertion of the gluteus medius. There is no difference in the mini-incision technique in the release of the anterior 1/3 of the abductors, leaving the posterior 2/3 still attached to the trochanter. Carry the incision proximally in line with the fibers of the gluteus medius at the junction of the middle and anterior 1/3 of the muscle. Distally, carry the incision anteriorly in line with the fibers of the vastus lateralis down to bone along the anterolateral surface of the femur. The neck was exposed with two Hohmann hooks. After making a double door-shaped opening in the capsule (i.e. proximally along the rim of the acetabulum and distally), remove the head-neck fragment in situ or after dislocation. With the leg in slight hyperextension, adduction, and external rotation, further capsule release was performed with preservation of the dorsal capsular structures and sparing of the major attachments of gluteus medius and minimus. After removal of the capsule,

| Table 1. Demographic characteristics of patients |
|-----------------|-----------------|-----------------|
| Variables       | Mini-incision (n=22) | Long incision (n=20) |
| Weight (kg)     | 68.3±12.0 (48.0-90.3) | 69.6±13.4 (47.0-92.5) |
| Height (m)      | 1.6±0.1 (1.52-1.84) | 1.6±0.1 (1.50-1.86) |
| Body mass index | 24.6±2.9 (21-27)   | 24.2±2.8 (21-27)   |
the surgeon exposed the acetabulum with three standard retractors (at posterior, anterosuperior, and anteroinferior edges of the acetabulum). The acetabulum was reamed and the acetabular component was inserted using the conventional surgical technique. Then, the surgeon placed the femur in adduction, and external rotation, and prepared the femoral shaft for implantation of the prosthesis using the rasps. After attaching the selected neck module and head, the surgeon performed a trial reduction, tested the stability, and checked the length of the limb. The next steps were implantation of the cemented prosthetic component, reduction, and closure of the wound. During closure, repair the tendon of the gluteus medius with nonabsorbable braided sutures.

**Traditional posterior approach (Southern approach):** Place the patient on the unaffected side. Start the incision approximately 10 cm distal to the posterosuperior iliac spine and extend it distally and laterally parallel with the fibers of the gluteus maximus to the posterior margin of the greater trochanter. Then direct the incision distally 10 to 13 cm parallel with the femoral shaft. Expose and divide the deep fascia in line with the skin incision. By blunt dissection, separate the fibers of the gluteus maximus. Retract the proximal fibers of the gluteus maximus proximally and expose the greater trochanter. Retract the distal fibers distally and partially divide their insertion into the linea aspera in line with the skin incision. By blunt dissection, separate the fibers of the gluteus maximus. Retract the proximal fibers of the gluteus maximus proximally and expose the greater trochanter. Retract the distal fibers distally and partially divide their insertion into the linea aspera in line with the incision. Next, expose and divide the gemelli and obturator internus and the tendon of the piriformis at their insertion on the femur and retract the muscles medially. The posterior part of the joint capsule was well exposed. Incise it from distal to proximal along the line of the femoral neck to the rim of the acetabulum. Detach the distal part of the capsule from the femur. Flex the thigh and knee by 90°, internally rotate the thigh, and dislocate the hip posteriorly. The acetabular component and femoral shaft component were inserted using the conventional surgical technique.

Patients were evaluated for limp and dislocation using the Harris hip score. All patients who were seen in clinic for a 1-year follow-up and all patients who could be contacted by telephone or letter were included in the study.

**Statistical analysis**

Statistical analysis was done using the SPSS software package. A chi-square test was used for dichotomous values, and t tests were done for continuous values. \( P < 0.05 \) was considered as significant difference.

**RESULTS**

There were no infections, neurological or wound complications in these two groups.

**Length of incision**

The length of the skin incision varied between 7 and 12 cm in the minimally invasive group (all incisions were less than 10 cm except for one male patient who had 12 cm incision for strong muscle), compared to 15-22 cm in the conventional procedure.

**Operation time**

The duration of the procedure was \( (72 \pm 15) \) minutes in minimally invasive group, and \( (87 \pm 10) \) minutes in conventional group. It took less time (average, 15 minutes) to complete the minimal incision compared with the standard approach.

**Harris score**

The average Harris hip score for the anterolateral approach was 91.23±10.20 (range, 35-100 points) and the average pain score was 40.26±6.31. For the posterior approach, the average Harris hip score was 90.03±11.05 (range, 25-100 points), and the average pain score was 42.33±5.06.

**Length of hospital stay**

The average length of hospital stay was (6.4±2.2) days (range, 4-9 days) for patients with the anterolateral approach, and (9.2±3.1) days (range, 6-13 days) for patients with the posterior approach.

**Length of bed stay**

The average length of bed stay was (3.4±1.1) days...
(range, 2-5 days) for patients with the anterolateral approach, and (6.2±2.8) days (range, 3-10 days) for patients with the posterior approach.

**Dislocation**

No patients with the anterolateral approach experienced dislocation. One hip (5%) in the posterior group had dislocation.

**Positioning of the implants**

Positioning of the implants was satisfactory in both groups. The abduction angle of the cup showed no statistical significance between two groups. Cup abduction angle was (45.2°±4.8°) in anterolateral group and (44.3°±5.2°) in posterior group.

**DISCUSSION**

Total hip arthroplasty through minimally invasive procedures potentially reduces operative trauma, which is expected to improve recovery and rehabilitation. We performed total hip arthroplasty using minimally invasive techniques via anterolateral modification of the Hardinge approach.

For a hip replacement procedure to be truly “minimally invasive”, it is not necessary to perform the operation via the smallest possible skin incision, but it is essential that the procedure be performed with minimal soft tissue trauma. Tissue structures that are not divided cannot cause the pain, while over-stretched soft tissues can cause pain and delay healing. Consequently, the optimal soft tissue sparing incision for total hip replacement balances the desire to minimize the size of the entry portal with the need to provide the required intraoperative view and atraumatic access to the femur and acetabulum.

Minimally invasive surgery through the anterolateral approach potentially leads to a reduction in operative trauma, less blood loss, smaller soft tissue wound, a reduction in postoperative pain, and earlier mobilization accomplished by preserving muscle insertions of gluteus medius and minimus. Theoretically, these improvements may result in shorter hospitalization, convalescence, and rehabilitation periods, as well as better cosmetic results through smaller skin incision and atraumatic wound closure. For choosing this approach, our aim was to allow the surgeon to perform the procedure under direct vision using the usual anatomic landmarks for orientation. The results of our study showed that the minimally invasive anterolateral approach has no side effects on the position or the alignment of the prosthetic components.

Safety can be defined as not placing patients at an increased risk of complications. These complications may be intraoperative, immediately postoperative, or long-term by component malposition. The long-term outcome of total hip arthroplasty may be influenced by component positioning. Component malposition may lead to decreased implant longevity and other debilitating complications such as recurrent dislocations. Any short-term benefits of a new surgical approach should not be at the cost of long-term outcomes. The previous studies have suggested that there is an increased chance of malposition using the minimal incision. The major risk is placing the acetabular component in over-abduction. There was no difference between the minimization group and the control group with respect to acetabular and femoral component alignment.

Many reports suggest that minimal incision surgery is a reproducible technique that does not compromise component positioning or increase postoperative complications. The malalignment of component positioning in minimally invasive approach may be due to less favorable field of vision. According to our experience, the appropriate abduction angle of the acetabulum can be achieved by adjusting the patient’s position instead of direct vision. If the patient is in standard lateral decubitus with the body perpendicular to the operating table and the table parallel to the ground, anteversion and abduction of the acetabular component could be well established with reference to the operating table. Anteversion of the femoral component could be well established with reference to the knee joint. The satisfactory vision of acetabulum during operation would be achieved by retractors at posterior, anterosuperior, and anteroinferior edge of the acetabulum.

In principle, each case of femoral neck fracture is amenable to the minimally invasive approach that we have used. However, the minimally invasive operative technique makes higher demands on the experience and skill of the surgeon. The presence of severe hip dislocation, a failed acetabular component from previ-
ous hip replacement, destructive rheumatoid arthritis, multiple previous operations on the joint, and major leg length differences all represent relative contraindications for the minimally invasive approach. Nevertheless, when correctly performed, the minimally invasive approach provides the patient with a functional result on discharge similar to that obtained 6 weeks after conventional surgery.

Some studies have shown a higher dislocation rate with the posterior approach as compared with the anterolateral approach. The current findings support these observations with one dislocation occurring in patients in the posterior group as opposed to no dislocations in the anterolateral group. Some researchers suggested that this increased dislocation rate might attribute to inadequate acetabular exposure and consequent malposition of the acetabular component.

Theoretically, minimally invasive total hip arthroplasty seems beneficial. It causes less surgical trauma, but not at the expense of decreased observation, which potentially increased complications related to the soft tissue envelope and component positioning. Our study showed that there are no substantial safety concerns using the minimal incision anterolateral approach. The mini-incision approach has produced less operative time, decreased length of hospital stay and bed stay, and improved early postoperative functions. The goal of additional investigations was to objectively determine rehabilitation benefits with gait analysis, and a longer follow-up.

There are several reports that investigated the learning curve of minimally invasive total hip arthroplasty in details. D’Arrigo et al considered the learning curve to be the first 20 cases for a single surgeon. Seng noted that after 6 months, more than 50% of 37 patients received primary total joint arthroplasty comfortably by the anterior-supine intermuscular technique. Mears et al reported a learning curve of 10 cases with regards to complications. Archibeck and colleagues reported increased proficiency as indicated by decreased operative time and fluoroscopy use in the first 10 cases. According to our study, the learning curve includes the first 10 cases, which was indicated by a drop and then a plateau in operating time.

Despite the learning curve required to master the anterolateral mini-invasive approach, the early functional results of our study in patients treated using this approach showed the advantages of decreased trauma, operation time, length of hospital stay and bed stay, rehabilitation time, and dislocation rate. Success of total hip arthroplasty using a minimally invasive approach depends on excellent operative technique and experience with standard hip approaches rather than on the use of special instruments.

Thus, once the learning period is passed, the stability and minimal muscular damage should permit the acceleration of postoperative rehabilitation, which can subsequently reduce the perioperative risk in the treatment of femoral neck fractures in the elderly with total hip replacement.

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