Combined Anterior and Lateral Approaches for Bone Tumors of the Femoral Neck and Head

YONG-CHENG HU, MD; DENG-XING LUN, MSc; SHANG-KUN ZHAO, MSc

Abstract

Few reports in the literature describe the treatment experience of benign lesions of the femoral head and neck. Between July 2005 and August 2009, twenty-four patients with bone tumor of the femoral neck and head were treated at the authors’ institution. Fourteen patients had pathological fractures of the femoral neck; in the other 10 patients, the bone cortex was involved. Average tumor size was 78 cc (range, 45-130 cc). The patients were treated by curettage plus bone grafting via an anterior approach (Smith-Petersen incision) and internal fixation via a lateral approach (Hardinge approach). Average follow-up was 34 months (range, 10-68 months).

Average blood loss and operative time were 450 mL and 87 minutes, respectively. Six patients experienced complications: 2 superficial wound infections, 2 immunological rejections, and 2 hollow screw loosenings and slight limps at 12 and 16 months postoperatively, respectively. No recurrence or other serious complications, such as pathological fracture, ischemic necrosis of the femoral head, or joint degeneration, occurred. Average Musculoskeletal Tumor Society score for lower extremity function was 29.2 (range, 27-30) at final follow-up, and all patients resumed their normal preoperative work and were pain free postoperatively, although 1 patient had a slight limp at final follow-up.

A combination of anterior and lateral approaches may produce good clinical and functional results with minimal complications in bone tumors of the femoral neck.

Drs Hu and Lun are from the Department of Bone Oncology, and Dr Zhao is from the Research Institution of Orthopaedics, Tianjin Hospital, Tianjin, China.

Drs Hu, Lun, and Zhao have no relevant financial relationships to disclose.

The authors thank Qun Xia, MD, PhD, Jun Miao, MD, Ning Ji, MD, and Baoshan Xu, MD, Department of Orthopaedic Surgery, Tianjin Hospital, for their contributions to this study.

Correspondence should be addressed to: Yong-cheng Hu, MD, Department of Bone Oncology, Tianjin Hospital, Tianjin 300211, China (yongchenghu@sina.cn).

doi: 10.3928/01477447-20120426-14
Pathologic fractures or impending fractures secondary to benign lesions of the femoral head and neck are a treatment challenge because of the specific anatomic location and high recurrence rate. One possible explanation for this phenomenon is difficulty with gaining access to these lesions because of the complicated anatomy of the femoral head and neck combined with the surgeon’s concern about compromising the blood supply to the femoral head.

Several attempts, including the trapdoor procedure and an extra-articular approach with or without endoscopic assistance, may be helpful in decreasing the rate of local recurrence and complications. The trapdoor procedure is an easy and safe approach for subchondral lesions of the femoral head, and it allows sufficient access to complete curettage and bone grafting. However, the application of the procedure is limited by the size of the lesion. Mont et al reported that the size of the trapdoor should be less than 30% of the cartilage surface of the femoral head because large trapdoors increased the risk of secondary osteoarthritis. Advantages of the extra-articular approach include easy soft tissue dissection and obviating the need for arthroscopy. However, visualization of the entire lesion in the femoral head is often not possible with this approach. Extra-articular endoscopy through a window in the lateral femur just distal to the greater trochanter can also provide access to subchondral lesions and allow bone grafting without disrupting the weight-bearing cartilage. However, one drawback of the technique is that simultaneous curettage and arthroscopic visualization is not possible with standard instruments, and this approach also violates the proximal femoral physis and cannot be recommended for skeletally immature children. Thus, a better surgical approach is needed for lesions in the femoral neck and head.

Bone tumors may weaken the bone locally, and surgical procedures, such as enlarging fenestration and intracapsular curettage, can further compromise local bone stability. Therefore, internal fixation is required to prevent postoperative fracture of the femoral neck; a lateral approach facilitates internal fixation of the femoral neck. In addition, the anterior or anterolateral approach affords better visualization and easier curettage.

The outcomes of 24 patients with bone tumor of the femoral neck treated via the combined anterior and lateral approaches were investigated.

**Materials and Methods**

Between July 2005 and August 2009, twenty-four patients with bone tumor of the femoral neck were admitted to the authors’ institution. Of these, 20 patients were treated by curettage plus bone grafting via an anterior approach and with internal fixation with anatomical plates (Waldemar LINK GmbH & Co, Hamburg, Germany) via a lateral approach, and 4 were treated by curettage plus bone grafting via an anterior approach and percutaneous fixation with hollow screws via a lateral approach. The patients included 14 men and 10 women with a mean age of 34 years (range, 17-68 years). Mean volume of the defect was 78 cc (range, 45-130 cc). Eight tumors were chondroblastomas, 4 were giant cell tumors of bone, 6 were fibrous dysplasia, and 6 were aneurysmal bone cyst. Fourteen patients had associated pathological fractures, and 10 had thinned bone cortex in the femoral neck. According to the International Society of Limb Salvage classification of bone tumors of the femoral neck, 1 tumor was in the H1 zone, 14 were in the H2 zone, and 12 were in the H1/H2 zone (Figure 1).

All patients were placed in a supine position and administered epidural anesthesia. After routine disinfection and draping, the skin, subcutaneous layer, and superficial fascia were incised via an anterior approach. The attachment points of the tensor fascia lata and gluteus medius to the iliac crest were separated, and the attachment points of the gluteus medius and glutus minimus to the lateral ilium were stripped off with a periosteal dissector. Then, the articular capsule was exposed by entering through the gap between the tensor fascia lata and sartorius. Care was taken to protect the lateral femoral cutaneous nerves and ascending branches of the lateral circumflex femoral arteries approximately 5 cm from the distal articular capsule and approximately 2.5 cm from the distal anterior superior iliac spine as they cross the sartorius surface.

A T-shaped incision was made in the articular capsule to expose the femoral neck and head (Figure 2). After fully exposing the diseased part of the bone cortex, fenestration of the surrounding area was accomplished with a bone drill. To avoid causing a splitting fracture, the bone cortex was cut open along the drilled holes in the bone with a bone knife. The
fenestration was large enough to allow direct vision of the whole tumor cavity. The tumor walls were carefully scraped with curettes of various sizes, and the tumor cavity was flushed with normal saline (Figure 3). The bony crest on the internal surface of the tumor cavity was carefully abraded in various directions with a high-speed abrasion drill under direct vision. The tumor cavity was then filled with distilled water at 60°C for 10 to 15 minutes. Care was taken to protect normal soft tissues and prevent the tumor cells from contaminating the surrounding soft tissues.

After curettage, the tumor cavity was packed with bone replacement materials. Twenty-one patients were treated by morselized bone allograft, 2 by allograft fibula and filling the space between host bone and allograft fibula with morselized bone, and 1 by frozen allograft and dried femoral head plus particle allograft bone grafting (Shanxi Aorui Biological Material Co, Ltd, Shanxi City, China). A lateral approach was then made. For patients undergoing fixation with plate and screws, the greater trochanter and lateral femoral shaft were exposed. Next, the insertion angle of a control needle was determined under direct vision, and the needle was inserted under C-arm guidance to ensure that the anatomical plate penetrated the normal bone of the greater trochanter and passed through the diseased area to enter the normal bone tissue of the femoral head. For patients undergoing fixation with hollow screws, there was no need to expose the greater trochanter or lateral femoral shaft. The hollow screws were implanted percutaneously under direct vision via an anterior approach using a Smith-Petersen incision. To ensure the hollow screws passed through the bone grafting area and entered normal bone tissue without breaking through the articular capsule, this step was performed under C-arm guidance.

Five thousand IU dalteparin sodium was administered subcutaneously within 24 hours postoperatively, then daily for 7 days, to prevent deep venous thrombosis. The patients were required to walk without weight bearing for 4 to 12 weeks. Musculoskeletal Tumor Society scores were used to evaluate the postoperative function of the lower extremities. Follow-up was performed every 3 months during the first year postoperatively, every 6 months during the second year, and once a year thereafter.

RESULTS

Average blood loss was 450 mL (range, 270-1200 mL). The shortest operative time was 60 minutes, and the longest time was 150 minutes (average, 87 minutes).

All patients underwent follow-up for 12 to 68 months (mean, 34 months). No recurrences or distant metastases occurred. Six patients experienced complications (Table). One had a chondroblastoma in the femoral neck with an associated pathological fracture. This patient was treated by allograft femoral head transplantation with hollow screws and allowed ambulation 3 months postoperatively. Loosening of the hollow screws and unequal lower extremities, the diseased side being approximately 1 cm shorter, gradually developed by 12 months postoperatively, accompanied by a slight limp (Figure 4). A possible reason for these complications is that the allograft and host bone may not have completely united with each other before the patient began weight bearing, resulting in local trabecular fracture collapse and screw loosening; however, the patient reported no discomfort on walking and was able to resume normal work.

Another patient with loosening of internal fixation had a temporary slight limp, which resolved 3 months postoperatively with no treatment. Two patients had superficial wound infections that resolved with postoperative dressing changes and treatment with antibiotics for 7 days and 10 days, respectively. Two patients developed immunological rejection, which resolved after 4 and 6 weeks of continuous dressing.
changes. The other 18 patients achieved primary wound healing. The complications of pathological fracture, ischemic necrosis of the femoral head, and secondary arthritis did not occur in any patient.

All patients experienced clinical improvement in range of hip flexion, extension, and adduction and pain postoperatively. They were able to resume their normal preoperative work. One patient experienced adduction weakness, possibly due to damage to the gluteus medius and gluteus minimus intraoperatively. In the other 23 patients, a normal range of hip motion was achieved, with flexion of 120° to 135° (average, 131°), extension of 9° to 15° (average, 12°), and adduction of 30° to 45° (average, 37°). Average Musculoskeletal Tumor Society score for lower extremity function was 29.2 (range, 27-30) at final follow-up. After internal fixation with percutaneous hollow screws, the average score was 28 (range, 27-29) (Figure 5), and after internal fixation with an anatomic plate, it was 29.4 (range, 28-30) (Figure 6). No statistically significant differences were found in Musculoskeletal Tumor Society scores between the hollow screws and anatomical plate groups because of the small number of patients.

### Table

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Tumor Properties</th>
<th>Internal Fixation</th>
<th>Bone Grafting Method</th>
<th>Recurrence</th>
<th>Complications</th>
<th>MSTS Score</th>
<th>Recovery Time, mo</th>
<th>Follow-up, mo</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chondroblastoma</td>
<td>Anatomical board</td>
<td>MBG</td>
<td>None</td>
<td>Infection, limp</td>
<td>28</td>
<td>3</td>
<td>68</td>
</tr>
<tr>
<td>2</td>
<td>Chondroblastoma</td>
<td>Anatomical board</td>
<td>MBG</td>
<td>None</td>
<td>None</td>
<td>30</td>
<td>3</td>
<td>67</td>
</tr>
<tr>
<td>3</td>
<td>Fibrous dysplasia</td>
<td>Anatomical board</td>
<td>MBG</td>
<td>None</td>
<td>None</td>
<td>30</td>
<td>10</td>
<td>53</td>
</tr>
<tr>
<td>4</td>
<td>Bone cyst</td>
<td>Anatomical board</td>
<td>MBG</td>
<td>None</td>
<td>None</td>
<td>30</td>
<td>5</td>
<td>52</td>
</tr>
<tr>
<td>5</td>
<td>Fibrous dysplasia</td>
<td>Anatomical board</td>
<td>MBG</td>
<td>None</td>
<td>None</td>
<td>29</td>
<td>4</td>
<td>51</td>
</tr>
<tr>
<td>6</td>
<td>GCT of bone</td>
<td>Anatomical board</td>
<td>MBG</td>
<td>None</td>
<td>Immuno rejection</td>
<td>28</td>
<td>6</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>Fibrous dysplasia</td>
<td>Anatomical board</td>
<td>MBG</td>
<td>None</td>
<td>None</td>
<td>30</td>
<td>12</td>
<td>47</td>
</tr>
<tr>
<td>8</td>
<td>Bone cyst</td>
<td>Anatomical board</td>
<td>MBG</td>
<td>None</td>
<td>None</td>
<td>29</td>
<td>5</td>
<td>47</td>
</tr>
<tr>
<td>9</td>
<td>Bone cyst</td>
<td>Anatomical board</td>
<td>MBG</td>
<td>None</td>
<td>None</td>
<td>30</td>
<td>3</td>
<td>46</td>
</tr>
<tr>
<td>10</td>
<td>Chondroblastoma</td>
<td>2 hollow screws</td>
<td>MBG</td>
<td>None</td>
<td>None</td>
<td>29</td>
<td>5</td>
<td>43</td>
</tr>
<tr>
<td>11</td>
<td>GCT of bone</td>
<td>Anatomical board</td>
<td>MBG</td>
<td>None</td>
<td>None</td>
<td>30</td>
<td>3</td>
<td>42</td>
</tr>
<tr>
<td>12</td>
<td>Chondroblastoma</td>
<td>3 hollow screws</td>
<td>MBG</td>
<td>None</td>
<td>Screw loosening, limp</td>
<td>27</td>
<td>9</td>
<td>41</td>
</tr>
<tr>
<td>13</td>
<td>Chondroblastoma</td>
<td>Anatomical board</td>
<td>MBG</td>
<td>None</td>
<td>Infection, limp</td>
<td>28</td>
<td>3</td>
<td>41</td>
</tr>
<tr>
<td>14</td>
<td>Chondroblastoma</td>
<td>Anatomical board</td>
<td>MBG</td>
<td>None</td>
<td>None</td>
<td>30</td>
<td>3</td>
<td>40</td>
</tr>
<tr>
<td>15</td>
<td>Fibrous dysplasia</td>
<td>Anatomical board</td>
<td>MBG</td>
<td>None</td>
<td>None</td>
<td>30</td>
<td>10</td>
<td>38</td>
</tr>
<tr>
<td>16</td>
<td>Bone cyst</td>
<td>Anatomical board</td>
<td>MBG</td>
<td>None</td>
<td>None</td>
<td>30</td>
<td>5</td>
<td>37</td>
</tr>
<tr>
<td>17</td>
<td>Fibrous dysplasia</td>
<td>Anatomical board</td>
<td>MBG</td>
<td>None</td>
<td>None</td>
<td>29</td>
<td>4</td>
<td>35</td>
</tr>
<tr>
<td>18</td>
<td>GCT of bone</td>
<td>Anatomical board</td>
<td>MBG</td>
<td>None</td>
<td>Immuno rejection</td>
<td>28</td>
<td>6</td>
<td>34</td>
</tr>
<tr>
<td>19</td>
<td>Fibrous dysplasia</td>
<td>Anatomical board</td>
<td>Allograft fibula+MBG</td>
<td>None</td>
<td>None</td>
<td>30</td>
<td>12</td>
<td>30</td>
</tr>
<tr>
<td>20</td>
<td>Bone cyst</td>
<td>Anatomical board</td>
<td>MBG</td>
<td>None</td>
<td>None</td>
<td>29</td>
<td>5</td>
<td>26</td>
</tr>
<tr>
<td>21</td>
<td>Bone cyst</td>
<td>Anatomical board</td>
<td>MBG</td>
<td>None</td>
<td>None</td>
<td>30</td>
<td>3</td>
<td>24</td>
</tr>
<tr>
<td>22</td>
<td>Chondroblastoma</td>
<td>2 hollow screws</td>
<td>MBG</td>
<td>None</td>
<td>None</td>
<td>29</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td>23</td>
<td>GCT of bone</td>
<td>Anatomical board</td>
<td>MBG</td>
<td>None</td>
<td>None</td>
<td>30</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>24</td>
<td>Chondroblastoma</td>
<td>3 hollow screws</td>
<td>Allograft femoral head+MBG</td>
<td>None</td>
<td>Screw loosening, limp</td>
<td>27</td>
<td>9</td>
<td>12</td>
</tr>
</tbody>
</table>

**Abbreviations:** GCT, giant cell tumor; MBG, morselized bone graft; MSTS, Musculoskeletal Tumor Society.
The anatomical structure of the femoral neck and head is complex, making it difficult to clearly expose the required surgical field and achieve complete curettage. Therefore, selection of an appropriate surgical approach plays a key role in improving exposure of the surgical field and reducing recurrence. However, few published studies report the treatment strategies for pathologic fractures or impending fractures secondary to benign bone tumors in these anatomic sites. The first purpose of the current study was to ascertain whether fewer postoperative complications occurred and pain and function improved after resection of benign lesions of the femoral neck and head via combined anterior and lateral double incisions. The second purpose was to offer preliminary suggestions for indications for such a combined approach.

The limitations of the current study included the small number of patients and the absence of a control group. The authors were therefore unable to perform sound analyses to determine whether the approach is superior in controlling local recurrence, relieving pain, and improving function. Additionally, the authors selected the patients for the procedure on the basis of imaging findings. This would have introduced some selection bias. However, given that the authors were selecting patients with pathologic fractures or impending fractures, they presumed that this bias would have made the results less favorable. Prospective studies of larger numbers of patients and randomized controlled trials are needed to confirm the results of our treatment strategy for benign lesions in the femoral head and neck.

**Advantages of Combining Surgical Approaches**

The advantage of an anterior approach is that it ensures that the surgical field is accessible, thus allowing complete curettage and exposure of the femoral neck and articular cartilage of the distal femoral head without dislocation. Thus, this approach may reduce the recurrence rate. Wai et al reported 11 pathologic frac-
tures of the proximal femur secondary to benign bone tumors, including 3 cases of giant cell tumor. All 11 pathologic fractures were managed with aggressive tumor curettage through an anterolateral Watson-Jones approach. No recurrences or complications occurred, and all fractures healed. Strong et al performed intracapsular curettage plus bone grafting in 10 patients with chondroblastoma. In 5 patients, an anterolateral approach was used with no recurrences, and in the other 5, a lateral approach was used with a recurrence rate of 40%. Cho et al reported their results in 12 patients with giant cell tumor in the femoral neck and head. An anterolateral Watson-Jones approach was used in 7 patients with 2 (29%) recurrences, and a lateral Watson-Jones approach was used in 5 patients with 3 (60%) recurrences. In the current study, the combined approach was used in all 24 patients with no recurrences.

For patients with actual or impending pathologic fractures, internal fixation is an effective means of preventing complications. Although internal fixation required an extra lateral incision, the rate of postoperative complications was low. The patients were permitted to walk with weight bearing at an early stage, and the range of motion of their joints was not compromised. Shih et al treated 35 patients with benign bone tumors (including giant cell tumor of bone and chondroblastoma) of the femoral neck or greater trochanter area with structural support bone grafting plus internal fixation via a lateral approach. No postoperative recurrences or complications occurred in any patient, and postoperative function was better than that found preoperatively. Günther et al resected diseased tissue and reconstructed the tumor cavity with minimally invasive surgery via an anterolateral approach and provided dynamic hip screw internal fixation via a lateral approach with good results. In the current study, the authors performed internal fixation with an anatomical board or hollow screws via a lateral approach and encountered no complications of pathological fracture or ischemic necrosis in any patient.

Indications for Preventive Application of Internal Fixation

Because the biomechanical demands on the femoral neck are high, selection of an appropriate means of achieving internal fixation has a great influence on postoperative functional recovery. Currently, the indications for preventative application of internal fixation in bone tumors are unclear. To reduce the risk of postoperative pathological fracture of the femoral neck, single intracapsular curettage plus bone grafting or palliative care may be used for smaller tumors, and internal fixation may be used for larger tumors without involvement of the joint surface to reduce the risk of postoperative pathological fracture of the femoral neck. Shih et al recommended internal fixation for larger tumors accompanied by pathological fracture or considered prone to pathological fracture, and in patients with slow-growing tumors. Günther et al reported that preventive internal fixation is indicated where the area affected by the tumor is >50% of the diameter of the femoral neck; if the tumor has already affected the bone cortex, preventive internal fixation is indicated. Jaffe et al recommend internal fixation for patients with the following tumors: those affecting at least 50% of the bone cortex of the femoral neck or with a diameter no less than 2.5 cm, slow-growing tumors, causing pain or deformity, and tumors likely to result in pathological fracture. Zhang et al recommended external fixation for tumors >50% of the femoral neck because insufficient bone cortex exists to hold internal fixation. The more bone cortex present, the greater the postoperative stability of internal fixation. However, for patients with less bone cortex, internal fixation after complete packing and bone grafting may also be effective.

The indications for the preventative application of internal fixation are as follows: tumor accompanied by pathological fracture, whatever the tumor size; imaging showing the maximum diameter of the diseased area >50% of the femoral neck and compromised mechanical strength of the femoral neck; and tumor with extensive bone cortex destruction where curettage may further damage the bone cortex and result in pathological fracture.

Selection of Internal Fixation Methods

Three screws or hollow screws on an anatomical board have stronger holding strength, which may prevent the femoral head from rotating. Thus, these procedures provide better stability of the femoral head or neck, which is helpful for earlier recovery, especially for patients in whom pathological fractures have already occurred. However, some patients need locking plates to avoid screw loosening (Figure 4). Because the mechanical strength of allograft bone decreases when creeping substitution occurs, the femoral neck may collapse if the patient has been actively weight bearing, resulting in unequal lower extremities or limping. Percutaneous internal fixation with hollow screws has the advantages of being simple and resulting in few complications. Thus, provided the surgeon observes appropriate indications, it may be one of the most effective internal fixation methods for bone tumors in the femoral neck (Figure 5). When a tumor is in the proximal basal part of the femoral neck and, consequently, the bone cortex of the residual greater trochanter is of normal thickness, single hollow screws provide greater holding strength and better stability and are unlikely to loosen. However, when a tumor is near the greater trochanter, the bone cortex of the residual greater trochanter is thinner than normal, considerably changing its biomechanical characteristics. In such cases, the use of single hollow screws for fixation may result in local bone cortex collapse and a high rate of screw loosening; thus, a locking plate or anatomical board is indicated to prevent greater trochanter collapse and reduce complications.
CONCLUSION

The benefits of the anterior or anterolateral approach are better visualization and more complete exposure, a wide surgical field, and a low recurrence rate. The advantage of the lateral approach is easy internal fixation implantation, which helps to prevent postoperative pathological fractures. Therefore, a combination of the anterior and lateral approaches may produce good results in bone tumors of the femoral neck. Although 6 complications occurred in the current study, they were connected more to the reconstruction methods used than to the surgical approaches. In future studies, the authors will research the most appropriate reconstruction materials to use after curettage of benign lesions of the femoral neck and head.

REFERENCES


