SURGICAL TECHNIQUE

A “Two-incision” Approach for En Bloc Resection of Periacetabular Tumors with Illustrations from a Cadaver

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A “two-incision” approach for en bloc resection of periacetabular tumors and prosthesis reconstruction is described. The first incision begins in the middle of the iliac crest, continues over the inguinal ligament, extends to the symphysis pubis and then turns down to ischial tuberosity. The muscles attached to the iliac crest are only separated from its internal side. All the attachments of the abductor muscles to the iliac crest are left intact. The second incision runs from the sacroiliac joint to the greater trochanter and is curved in shape, providing external exposure of the sciatic notch and ischial tuberosity. Communication between the two approaches is possible inside and outside under the abductor muscles or through the sciatic notch. En bloc resection of the tumor is performed by cutting the pubic symphysis and iliac as planned preoperatively. The iliac osteotomy is performed by using a Gigli saw that has been led through the sciatic notch and under the abductor muscles. This “two-incision” approach not only provides enough exposure to perform en bloc resection of periacetabular tumors, but also protects the continuity of the abductor muscles between the pelvis and greater trochanter, thus preventing prosthesis dislocation.

Key words: En bloc resection; Periacetabular tumor; “Two-incision” approach

Introduction

Resection of periacetabular tumors and subsequent reconstruction are challenging for orthopedic surgeons. Because of the anatomic complexity of the pelvis, postoperative complications frequently occur. In 1981, Harrington reported a series of 58 patients, 40 of whom were ambulant preoperatively and 18 who were non-ambulant. Complications included infection, nonfatal pulmonary embolism, iatrogenic femoral nerve palsy and perioperative death due to massive intraoperative blood loss¹.

Recently, surgical and imaging techniques and prosthesis design have been improved, making en bloc tumor resection and modular prosthesis reconstruction appealing to patients and surgeons because of the long-term survival benefits, low local recurrence rate and good functional recovery^{2,3}. However, postoperative dislocation of the reconstruction prosthesis, an obstacle to postoperative function, is still a major challenge. Although various factors, including deep infection, avulsion of

the cage and poor muscle tone can result in dislocation, the involved abductor muscles and/or abductor denervation play a crucial role in the causation of this complication. We have developed a “two-incision” approach for en bloc tumor resection and modular prosthesis reconstruction for periacetabular tumors. The aim of the “two-incision” approach is to dissect periacetabular tumors without removing the abductor muscles from the pelvis and greater trochanter, and then to reconstruct the hip joint with a prosthesis without subsequent dislocation caused by weakness or denervation of the abductor muscles.

Surgical Technique

A 32 year old male patient was diagnosed with a giant cell tumor located in the II and III periacetabular areas (Fig. 1a–c). The patient was placed in the lateral position and stabilized with sponge bags on the chest and back. The abdomen, hip, pelvis and leg on the affected side were prepped and draped in the standard fashion. The first incision was

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Fig. 1 (a) Preoperative X-ray film of the patient's pelvis. (b) Preoperative CT scan image. (c) Three-dimensional reconstruction image. (d) Photograph of en bloc dissection specimen. 1, acetabulum; 2, ischium; 3, pubis; 4, the severed iliac bone. (e) Schematic diagram of computer-aided design modular hemipelvic prosthesis reconstruction. (f) Post-operative X-ray film.

begun from the middle of the iliac crest, continued over the inguinal ligament, extended to the symphysis pubis and then turned down to the ischial tuberosity (Figs 2a,4a). The abdominal muscles and rectus abdominis were then detached from the pubis. The muscles attached to the iliac crest were only separated from its internal side. All the attachments of the abductor muscles on the iliac crest were left intact. The femoral nerve,

artery and vein and the iliopsoas muscle were mobilized and elevated using gauze strips. (The moving window technique can be utilized to facilitate exposure). Intrapelvic dissection was then performed to isolate the major neurovascular structures and separate any tumor in the pelvis from surrounding viscera with wide margins according to the naked eye. Dissection was performed around the pubic rami. After the spermatic cord (or

Fig. 2 Photographs illustrating the anterior approach (a). Left panel: Patient's incision 2 months postoperatively (black arrow); Right panel: Line of incision shown on a cadaver. (b) Operative field after performing the anterior incision. 1, sciatic notch, through which communication with the posterior approach could be achieved; 2, Gigli saw, which was led through the sciatic notch and around the iliac bone; 3, femoral nerve, artery and vein and iliopsoas muscle have been mobilized and elevated by using a gauze slip; 4, spermatic cord; 5, 6, gauze slip to mobilize the neurovascular bundle and spermatic cord, respectively.

Fig. 3 Photographs illustrating the posterior approach (a) Left panel: Patient's incision 2 months postoperatively (black arrow). Right panel: Line of incision shown on a cadaver. 1, greater trochanter; 2, thigh. (b) Operative field after performing the posterior incision. 1, superior gluteal vessels; 2, gluteus maximus; 3, gluteus medius; 4, greater trochanter; 5, piriformis; 6, sciatic nerve. (c) Operative field during the posterior approach. 1, gluteus maximus; 2, gluteus medius; 3, greater trochanter; 4, severed piriformis; 5, exposed hip joint; 6, sciatic nerve. (d) Operative field during the posterior approach. 1, Gigli saw, which has been led through the sciatic notch from the anterior approach; 2, gluteus medius; 3, greater trochanter; 4, exposed femoral head; 5, cut piriformis; 6, sciatic nerve; 7, sciatic notch. (e) Intraoperative photograph illustrating communication between the two approaches. 1, a distractor that has been inserted from the anterior to the posterior approach; 2, abductor muscles; 3, another distractor that has been inserted from the posterior to the anterior approach; 4, severed femoral neck; 5, posterior aspect of acetabulum.

round ligament of the uterus in female patients) was identified and protected, all the adductor muscles were detached and muscle attachments to the pubis and ischium separated until the ischial tuberosity was exposed (Fig. 2b). The obturator vessel was identified and ligated. The anterior hip joint capsule was exposed and dissected. The femoral head could be seen under the femoral neurovascular bundle.

A second curved incision was made from the sacroiliac joint to the greater trochanter (Figs 3a,4a). The gluteus maximus was separated bluntly along the muscle fiber. The superior gluteal neurovascular bundle was identified and the superior gluteal vessel ligated (Fig. 3b). The gluteus medius and gluteus minimus were elevated and distracted anteriorly. The leg was then rotated internally and the sciatic nerve exposed along its course and protected. The short external rotator muscles and piriformis tendon were severed from their attachments to the femur. Posterior hip capsulectomy was then performed (Fig. 3c). The femoral head was dislocated from the acetabulum and the femoral head and a portion of the neck excised. The sacrotuberal and sacrospinal ligaments were cut, providing external exposure of the sciatic notch and ischial tuberosity. Communication between the two approaches was possible inside and outside under the abductor muscles or through the sciatic notch (Figs 2b,3d,e).

Next, an osteotome was used to cut the pubic symphysis and a Gigli saw led through the sciatic notch. Iliac osteotomy was performed as planned preoperatively (Fig. 5a,b). When the

Gigli saw was in danger of cutting soft tissue on completion of the iliac osteotomy, its external portion was passed internally under the abductor muscles to cut the residual iliac bone (Figs 2b,3d). Once the osteotomies had been completed, the en

Fig. 4 The schematic diagram of two-incision (a) The first incision begins in the middle of the iliac crest, continues over the inguinal ligament, extends to the symphysis pubis and then turns down to ischial tuberosity. (b) The second incision runs from the sacroiliac joint to the greater trochanter and is curved in shape, providing external exposure of the sciatic notch and ischial tuberosity.

Fig. 5 (a) Diagrammatic representation of anterior view of osteotomy. 1, osteotomy of the pubic symphysis; 2, osteotomy of the ilium; 3, osteotomy of the femoral neck. (b) Diagrammatic representation of lateral view of osteotomy. 1, osteotomy of the femoral neck; 2, osteotomy of the ilium.

bloc specimen was rotated gently around the femoral neurovascular bundle out of the field with severance of any remaining soft tissue attachments (Fig. 1d). The wound then was irrigated copiously with normal saline. Bone wax was placed over the bleeding bone surfaces if necessary and electrocautery used to ensure hemostasis of the wound bed.

A computer-aided, individually designed, modular hemipelvic prosthesis was then implanted. The iliac wing prosthesis supported the residual iliac crest with a bush. Four to five screws were fixed to the sacrum by passing through specifically designed holes on the bush and sacroiliac joint. The tips of the screws could be observed or touched through the first incision. The pubic component was fixed with two screws to the contralateral pubis. The excised femoral head and neck were fragmented and grafted around the connection areas of the iliac component to the ilium and pubic component to the contralateral pubis. A polyethylene cup was cemented into the acetabular component cavity and a femoral component was implanted in the standard fashion (Fig. 1e,f).

After surgery, external fixation to limit the patient's hip motion was not necessary. After removal of the drains at 48 h, the patient was encouraged to ambulate with a crutch and partial weight bearing. After 6–8 weeks, the patient could walk with full weight bearing.

Discussion

Chondrosarcoma and giant cell tumors occur most frequently in the periacetabular area of adults; their prognosis depends on the surgical margin^{4,5}. Karakousis *et al.* stated that exposure should be wide enough to permit access to the sacroiliac joint, pubic symphysis and ischial tuberosity^{6,7}. They achieved this with a “reverse Y” approach, during which the abductor muscles may be injured. The sacroiliac joint, pubic symphysis and ischial tuberosity can be exposed adequately through the “two-incision” approach described here. This exposure facilitates a safe surgical margin and en

bloc dissection of periacetabular tumors. The intrapelvic neurovascular structures can be separated from the periacetabular tumors through the first incision, whereas the extrapelvic neurovascular structures can be separated through the second incision. This provides adequate exposure for en bloc dissection of periacetabular tumors while avoiding iatrogenic injury.

Another advantage of the “two-incision” approach for periacetabular tumors is that the continuity of the abductor mass is preserved, enabling immediate postoperative weight bearing without dislocation. Although the dislocation rate is partially determined by the extent of resection and type of prosthesis, poor muscle function after tumor resection is the crucial reason for such dislocation^{3,8,9}. The “two-incision” approach for periacetabular tumor not only provides enough exposure to perform safe surgical margin dissection, but also protects the continuity of the abductor muscles between the pelvis and greater trochanter without a trochanteric osteotomy. In addition, implantation of a reconstruction prosthesis is facilitated by the “two-incision” approach. The modular components can be fixed to the contralateral pubis and sacrum through the relevant incisions.

However, this “two-incision” approach does have some limitations. It is indicated for periacetabular tumors which are located in II or II and III areas of the acetabulum according to Enneking pelvic classification¹⁰. When tumors are located in the area between the two incisions, their separation can be achieved under the abductor muscles. However, when the abductor muscles are invaded by malignant tumor, this “two-incision” approach is contraindicated.

Primary malignant or aggressive tumors that are located in II or II and III areas of the acetabulum are suitable for en bloc resection and functional reconstruction. Adequate exposure and continuity of abductor muscles can be obtained through the “two-incision” approach. Reconstruction with a prosthesis can also be readily performed through the “two-incision” approach.

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