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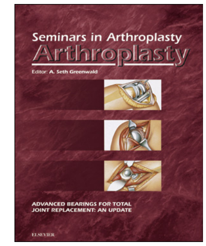

Limited femorotomy: Removing a well-fixed, cementless femoral stem

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ARTICLE INFO

Keywords:
hip arthroplasty
stem design
cementless
explant
femorotomy
ostetomy

ABSTRACT

We present a technique of a longitudinal posterior femorotomy that does not extend to the greater trochanter leaving the abductors intact. This technique allows safe, effective removal of well-fixed proximally coated cementless femoral stems with minimal bone loss and allows revision to metaphyseal fitting stems. We present results of this technique in 18 patients with a minimum 6-year follow-up. Harris hip scores increased from 68.2 to 92.4, all stems had evidence of good bony ingrowth, no evidence of migration, all femorotomies healed and there is no evidence of stress shielding or osteolysis. None required re-revision of femoral prosthesis.

1. Introduction

Revision hip surgical procedures are increasing due to the increase in popularity of total hip arthroplasty and ageing demographics of the population in general. Likewise the population with a primary arthroplasty in situ is also ageing. There has been an increase in the use of cementless stem designs, and consequently the revision burden for the well-fixed, cementless stem is rising. The indications for stem removal include hip instability, thigh pain, loosening, infection or trunion mismatch or damage during cup revision.

Revision hip surgery poses many challenges that vary with the type of prosthesis. However, the main tenet in all procedures is to minimize soft-tissue damage and bone loss [1]. Extraction methods for cementless femoral stems depend on stem design, location and intensity of ingrowth. The popularity of various designs of cementless femoral stems has evolved with decreasing use of fully coated varieties due to concerns about an association with thigh pain [2]. The current Australian Joint Registry shows that six out of the ten most popular femoral stems have a proximal ingrowth surface on the metaphysis only [3]. One of the techniques advocated for removal of the well-fixed, cementless prosthesis involves an extended trochanteric osteotomy (ETO) described by Paprosky et al [4]. This technique allows excellent access to the stem and has been widely used in both cemented and cementless revisions [1,5–7]. This technique has the disadvantage of losing the circumferential integrity of the bone and may be difficult to adequately fix back together. At best it involves a short period of non-weight bearing and may involve a permanent limp if inadequate fixation is achieved.

We present a surgical technique for removing a well-fixed, proximally coated, cementless femoral stem using a limited posterior slot femorotomy.

2. Surgical technique

The distance from the greater trochanter to the proximal section of the ingrowth section is measured on the pre-operative-scaled radiographs. This is measured and recorded along with the length of the ingrowth surface.

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1045-4527/$ - see front matter
http://dx.doi.org/10.1053/j.sart.2013.08.001

The patient is positioned in lateral decubitus and a posterior approach is performed. Care is taken to completely clear the area of the greater trochanter adjacent to the shoulder of the prosthesis with rongeurs and a high-speed burr. Flexible osteotomes are used to separate the bone from the prosthesis proximally. Care is taken to pass the osteotome as close to the prosthesis as possible to preserve bone stock. This can be enough to remove stems without undue force but if this is not possible we proceed with femorotomy.

Femorotomy is performed using a micro sagittal saw along the line of the posterior border of the vastus lateralis, lateral to the linea aspera in the postero-lateral meta-diaphyseal region. The femorotomy is centered on the distal margin of the ingrowth surface as this has been shown to be a common location for spot-welds [8]. This is located by measuring the same distance from the scaled radiographs on the bone itself (Fig. 1). The proximal extent of the femorotomy does not extend the length of the greater trochanter leaving the muscular attachments intact. The typical length of osteotomy is 3–5 cm but can be extended depending on the extent of spot-weld formation. It is not usually necessary to extend the femorotomy proximally to the level of the neck cut.

The next step is to introduce a solid 2-cm osteotome into the femorotomy along the bone–implant interface (Fig. 2). A gentle levering action from medial to lateral in the transverse plane helps to de-bond the bone and the stem. There is occasionally an audible crack but more often the de-bonding is felt rather than heard. This process can be likened to removing a cake from a sprung cake tin (Fig. 3). The stem is released by a combination of releasing the bone–prosthesis interface proximally with flexible osteotomes and dilation of the metaphyseal–diaphyseal region using the limited slot femorotomy. The stem is then struck in an antegrade direction to disrupt any remaining areas of bone ingrowth before backslapping the stem out using the appropriate stem-removal device without undue force. Failure to remove the stem at this stage involves repeating the previous sequence of steps to gently disrupt the bone–implant interface circumferentially. It is possible to extend the femorotomy to an ETO described by Paprosky et al. [4], but in our experience this has not been necessary.

Following stem removal, a single cerclage wire is sited around the center of the femorotomy. This can be augmented by further wires if a longer femorotomy necessitates it. The canal is then prepared in the usual antegrade fashion and a cementless stem of appropriate size is inserted. This technique allows the use of metaphyseal fixing prosthesis, such as the S-ROM (DePuy, Warsaw, IN), to avoid complications associated with distally fitting stems.

Figure 1 – Measuring the distance from the shoulder of the prosthesis to the distal margin of surface coating. (Color version of figure is available online.)

Figure 2 – Introducing a 2 cm osteotome to disrupt bone implant interface using gentle levering action. (Color version of figure is available online.)

3. Materials and methods

We prospectively collected data since 1996 and included patients who had undergone revision total hip arthroplasty where the primary implant had a proximal ingrowth surface on the metaphysis only. We retrospectively examined the radiographs and only included those patients whose implant had good ingrowth based on the criteria of Engh et al. [9].

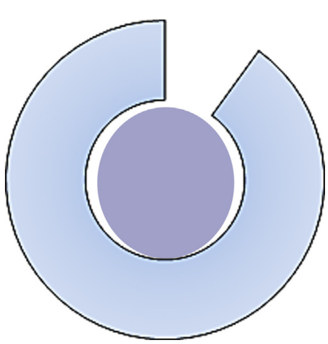

Figure 3 – Cross-section of bone containing prosthesis at level of osteotomy demonstrating the release of the "sprung cake-tin." (Color version of figure is available online.)

Patients with less than two years follow-up were excluded. The case notes were reviewed to ensure all patients had a femorotomy using the described technique without any unusual additional steps and the reason for revision was recorded.

Each patient was scored pre- and post-operatively using the 'Standard System of Reporting Results' [10], which includes a modified Harris Hip Score [11]. Pain and satisfaction scores were also recorded using a visual analogue scale. Clinical reviews assessing range of movement, leg length and gait assessment were carried out by the operating surgeon. Radiographs were also assessed by independent reviewers for signs of subsidence, loosening, osteolysis and lucent lines using the criteria of Engh et al. [12].

4. Results

Between 1996 and 2007, the senior author (WKW) performed 18 hip revisions in 15 patients using the described femorotomy. Nine patients were female and six were male. There were eight right and ten left hips. The average age of patients was 58.5 years (31.6–75.9). The average weight was 68.3 kg (41.0–100.0 kg), average height was 162.9 cm (150.0–185.0 cm). Fifteen of the cases were revised for osteolysis; the remaining hips were revised for pelvic fracture in one, thigh pain in one and dislocation in another.

The original stem was the ABGI (Stryker, Kalamazoo, MI) in 11 hips, the PCA (Howmedica, Rutherford, NJ) in three hips, one Harris–Galante (Zimmer, Warsaw, IN), two PSL (Biologically Oriented Prosthesis, MI) stems and one Margron stem (Portland Orthopaedics). The ABGI is an anatomic stem with metaphyseal hydroxyapatite (HA) and grit-blasted diaphyseal stem, the PCA is anatomic with proximal sintered bead porous ingrowth surface, the Harris–Galante has porous-coated areas for ongrowth, the PSL has proximal coating and trapezoidal distal grit-blasted diaphyseal stem and the Margron has a porous-coated stem and double-threaded cone. Seventeen hips were revised to S-ROM stems with three getting a Securfit stem (Stryker, Kalamazoo, MI).

Follow-up was an average of 122.4 months (range 72.4 to 160.6 months). Average pre-operative Harris hip scores were 68.2 (range 18.0 to 97.0). Post-operative scores improved to an average 92.4 (range 62.0–100.0). Post-operative Postel score was 16.2 (12.0–18.0) and post-operative Oxford score was 13.8 (12.0–24.0). Trendelenburg status did not change after revision surgery. No patient reported thigh pain post-operatively.

Radiographic follow-up confirmed that all revision stems had satisfactory bony ingrowth and none showed evidence of migration, peri-prosthetic fracture nor non-union of femorotomy (Fig. 4). One patient had Booker grade I heterotopic classification and a second had grade II. To date, there is no evidence of stress shielding or osteolysis in any of the cases.

No patient has required re-revision on the femoral side. No pulmonary emboli or deep vein thrombosis were recorded. No patient developed an infection. One patient dislocated at 106.6 months post revision. This was treated with closed reduction and the patient has had no further complications. Three patients died during the study of unrelated causes. They were known not to have been re-revised before their deaths.

5. Discussion

The modern day hip revision surgeon needs a diverse armamentarium of techniques to remove implants while maintaining bone stock and minimising soft-tissue damage. The increasing use of coated femoral stems along with the increasing ageing demographic and trend towards lowering the age threshold for total hip arthroplasty necessitates familiarity with all the available techniques to remove them. A sound knowledge of the implant design is also essential as the techniques differ. A proximally coated cementless stem should not bond to the bone beyond the distal margin of the coating rendering exposure of the entire prosthesis unnecessary. Despite the increased use of this type of stem design, there is a paucity of research in the literature on the results of revision surgery.

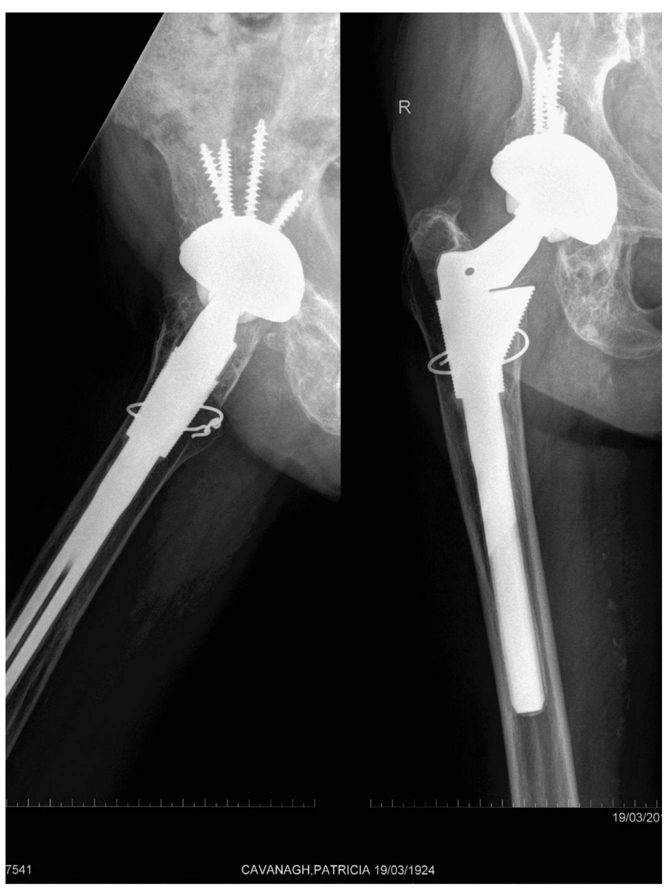

Figure 4 – AP and lateral radiographs of revised femoral component with healed femorotomy.

Galssman et al. [13] described a technique for removal of a proximally coated stem, which involves a complete osteotomy requiring fixation of the greater trochanter. This has been advocated by several authors [5,14] but has the potential problems associated with the unopposed pull of the abductor muscles on the trochanteric fragment leading to non-union and/or Trendelenburg gait [15,16].

Blom et al. [17] described the Omega approach utilizing the direct lateral access reflecting the entire abductor mechanism anteriorly. They reported a 28.9% dislocation rate in their series of 38 patients.

Bauze et al. [18] described a posterior longitudinal split that includes the greater trochanter for cementless femoral stems with a small amount of bony ingrowth or stable fibrous fixation. The revision stem is then cemented in place. They reported one case of dislocation requiring open-reduction two weeks post-operation and one patient requiring removal of the trochanteric cerclage wire.

Taylor and Rorabeck [19] described a less invasive, anterior episiotomy of the femoral cortex through the lateral approach for removing cemented stems. However, there are no reported results of this technique available in the literature.

Paprosky et al. [14] examined the numerous techniques used during the extraction of acetabular and femoral components and reported a 6% dislocation rate after acetabular revision and a 9% dislocation rate after femoral component revision. They also reported a high level of thigh pain in their group of revised patients with 32% reporting pain that did not limit activity, 18% with frequent pain that limited activity and 3% with constant severe pain. When an ETO is performed it is necessary to use a distally fixed stem as no method of fixation reliably restores the integrity of the metaphysis. These types of stem are thought to contribute to thigh pain due to a postulated modulus mismatch between prosthesis and bone [20,21].

The limited posterior slot femorotomy can be used for any proximally coated stem with little or no distal ongrowth. Modular stems without distal ongrowth surfaces can also be removed using this technique. More recently it has been successfully used to remove proximally coated stems with modular necks.

Our technique does not disrupt the greater trochanter leaving the abductors and vastus lateralis intact. It allows the surgeon to prepare the femur in the standard antegrade fashion and can accept a metaphyseal fit stem. None of the cohort required re-revision of the femoral component. There were no complications of deep vein thrombosis, pulmonary embolus, infection or thigh pain. Although the number of patients in this study is small, the results have been encouraging.

Conclusion

Limited posterior slot osteotomy is a safe, effective technique for removing well-fixed proximally coated stems. The main advantages of this technique are that the proximal musculature is no more disrupted than during a primary hip replacement, complications associated with ETO can be avoided and a metaphyseal fitting stem can be used in revision surgery.

REFERENCES

[1] Berry D. Removal of cementless stems. Instructional Course Lectures 2003;52:331–6.
[2] Havelin LI, Engesaeter LB, Espehaug B, et al. The Norwegian arthroplasty register: 11 years and 73,000 arthroplasties. Acta Orthopaedica Scandinavica 2000;71:337.
[3] Australian Orthopaedic Association National Joint Registry Annual Report. Adelaide, Australia: AOA; 2010.
[4] Younger TI, Bradford MS, Paprosky WG. Removal of a well-fixed cementless femoral component with an extended proximal femoral osteotomy. Contemporary Orthopaedics 1995:375–80.
[5] Burnstein G, Yoon P, Saleh K. Component removal in revision total hip arthroplasty. Clinical Orthopaedics 2004;420:48.
[6] Glassman AH, Engh CA, Bobyn JD. A technique of extensile exposure for total hip arthroplasty. Journal of Arthro-plasty 1987;2:11.
[7] Hozack WJ. Component and cement removal. In: Steinberg ME, Garino JP, et al., editors. Revision total hip arthroplasty. Philadelphia: Lippincott; 1999. p. 193.
[8] D'Antonio JA, Capello WN, Manley MT. Remodeling of bone around hydroxyapatite-coated femoral stems. The Journal of Bone and Joint Surgery. American Volume 1996;78:1226–34.
[9] Engh CA, Bobyn JD, Glassman. Porous coated hip replacements: the factors governing bone ingrowth, stress shielding, and clinical results. Journal of Bone and Joint Surgery 1993;75B:14.
[10] Johnston RC, Fitzgerald RH, Harris WH, et al. Clinical and radiographic evaluation of total hip replacement. A standard system of terminology for reporting results. The Journal of Bone and Joint Surgery. American Volume 1990;72:161.
[11] Harris W. Traumatic arthritis of the hip after dislocation and acetabular fractures; treatment by moulded arthroplasty. An end result study using a new method of result evaluation. The Journal of Bone and Joint Surgery. American Volume 1969;51:737.
[12] Engh CA, Massin P, Suthers KE. Roentgenographic assessment of biologic fixation of porous-surfaced femoral components. Clinical Orthopaedics 1990;257:107–28.
[13] Glassman AH, Engh CA, Bobyn JD. A technique of extensile exposure for total hip arthroplasty. Journal of Arthro-plasty 1987;2:11.
[14] Paprosky WG, Weeden SH, Bowling JW. Component removal in revision total hip arthroplasty. Clinical Orthopaedics and Related Research 2001;292:181–93.
[15] Nutton RW, Checketts RG. The effect of trochanteric osteotomy on abductor power. Journal of Bone and Joint Surgery 1984;66B:180.
[16] Amstutz HC, Maki S. Complications of trochanteric osteotomyin total hip replacement. Journal of Bone and Joint Surgery 1978;60A:214.
[17] Blom AW, Astle L, Loveridge J. Revision of an acetabular liner has a high risk of dislocation. The Journal of Bone and Joint Surgery. British Volume 2005;87:1636.
[18] Bauze AJ, Charity J, Tsiridis E, Timperley AJ, Gie GA. Posterior longitudinal spit osteotomy for femoral component extraction in revision total hip arthroplasty. Journal of Arthroplasty 2008;23:86.
[19] Taylor JW, Rorabeck CH. Femoral revision. Clinical Orthopaedics and Related Research 1999;369:208–22.
[20] Krishnamurthy AB, MacDonald SJ, Paprosky WG. 5- to 13-year follow-up study on cementless femoral components in revision surgery. Journal of Arthro-plasty 1997;12(8):839.
[21] Moreland JR, Bernstein ML. Femoral revision hip arthroplasty with uncemented, porous-coated stems. Clinical Orthopaedics and Related Research 1995;319:141.