A New Technique to Reattach an Extended Trochanteric Osteotomy in Revision THA Using Suture Cord

Renuka Reddy Kuruvalli MRCS, Ronald Landsmeer MD,
Ujjwal Kanti Debnath FRCS, Shivakolundu Pachai Suresh FRCS,
Tudor Lloyd Thomas FRCS

Received: 15 October 2007 / Accepted: 10 March 2008 / Published online: 3 April 2008
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Abstract The extended trochanteric osteotomy (ETO) is widely used for revision total hip arthroplasty (THA). We describe a novel technique to reattach the extended trochanteric osteotomy using a suture cord. We retrospectively reviewed 20 patients who underwent revision by this technique with a minimum followup of 2 years (mean, 2.2 years; range, 2–4 years). Bony union of the osteotomy occurred in 19 patients and fibrous union in one patient who remained asymptomatic. We observed proximal migration of the osteotomy fragment in one patient (5 mm) who had bony union of the osteotomy. This technique of anchoring the osteotomy fragment directly onto the prosthetic stem using a suture cord provides a secure fixation and does not endanger the blood supply of the osteotomy. It also has the advantage of avoiding the morbidity associated with cerclage wires and the costs associated with cabling systems.

Level of Evidence: Level IV, therapeutic study. See the Guidelines for Authors for a complete description of levels of evidence.

Introduction

Revision THA is a difficult and demanding procedure requiring removal of existing cemented or uncemented implants, reconstruction of deficient bone stock, and solid fixation of a new component [1, 4–11]. For safe, easy, thorough removal of a prosthesis, cement mantle, and fibrous tissue without risking the distal femur, several femoral osteotomy approaches are used. The conventional trochanteric osteotomy or a transfemoral approach described by Wagner [11] or an ETO popularized by Younger et al. [12] are used for revision THA. In all approaches, the bone window must be secured at the end of the procedure although Wagner [11] did not reattach the osteotomy fragment.

We describe a novel technique to fix the ETO in revision THA using a suture cord and asked whether this method leads to reliable union without displacement.

Materials and Methods

We reviewed records and radiographs of the first 20 consecutive patients who had revision THAs using ETO between 2002 and 2005. The patients (eight men; 12 women) had an average age of 75 years (range, 56–87 years) and a minimum followup of 2 years (mean, 2.2 years; range, 2–4 years). No patients were lost to followup.

The reasons for the revision surgery were aseptic loosening of the acetabular and femoral components in seven patients and aseptic loosening of the femoral stem in 13.

All authors certify they not have signed any agreement with a commercial interest related to this study which would in any way limit publication of any and all data generated for the study or to delay publication for any reason.

This study was conducted in the UK, and owing to the laws of the UK, informed consent for participation in such a study is not required.

R. R. Kuruvalli, R. Landsmeer, S. P. Suresh, T. L. Thomas
Orthopaedic Department, Colchester General Hospital, Essex,
UK

R. R. Kuruvalli (✉)
Nevill Hall Hospital, Flat 1, Ty meddyg, Abergavenny,
Monmouthshire NP7 7EG, UK
e-mail: kuruvallirenukareddy@yahoo.co.in

U. K. Debnath
Orthopaedic Department, Nevill Hall Hospital, Abergavenny,
UK

All patients had primary cemented THA. We used the extensile approach in these patients to facilitate thorough removal of cement and fibrous tissue without fracturing the femur and to preserve the bone stock of the osteolytic proximal femur. The preoperative femoral defects according to the classification of Della Valle and Paprosky [2] were: Type I—three femora; Type II—11 femora; and Type IIIA—six femora.

Four types of prostheses were used. A Wagner SL (Zimmer Ltd, Winterthur, Switzerland) was used in one patient, a Revitan (Zimmer Ltd) in four, a PFMR (Wright Medical Technology, Memphis, TN) in three, and an MP prosthesis (Waldemar Link, Hamburg, Germany) in 12.

We secured the osteotomy fragment to the prosthesis using a loop of absorbable suture material consisting of eight strands. The breaking strength of this suture construct has been tested in the laboratory and was greater than 1000 Newtons [3]. The method avoids cerclage wires and cables which potentially could damage the local blood supply, avoids problems associated with passing the cerclage wires, and avoids metal contact between the cerclage wires and the prosthesis.

An ETO [12] was performed through a direct lateral approach with the patient in the lateral decubitus position. In this osteotomy, the soft tissue attachments to the bone window were preserved [12]. The length of the osteotomy varied from 9 to 17 cm. Once the osteotomy window was reflected, it was easy to remove the prosthesis and cement. An uncemented femoral prosthesis then was implanted and the osteotomy window was closed by reattaching the

osteomuscular flap with the absorbable suture cord. Any gaps left in the osteotomy window were filled with a combination of bone graft and bone substitute. There is usually a gap left as a result of the shape of the prosthesis. In 17 patients, bone from the femoral canal reaming and in three, a combination of host bone and bone substitute (a synthetic hydroxyapatite, Apapore 70; Apa Tech Ltd, Hertfordshire, UK) were used as grafts.

We previously described the method to make a strong cord using Number 2 Vicryl (Ethicon, Edinburgh, UK) and its mechanical strength [3]. Four strands of Number 2 Vicryl are tied together at both ends with a single knot. One knot is held with an artery forceps and the other is placed in the chuck of the power or hand drill (Fig. 1A). The drill is rotated keeping tension on the material until a tight helix is formed without buckling. A Lane's tissue forceps is hung on the middle of the helix. The two knotted ends are brought together while pulling down the forceps to prevent kinking (Fig. 1B). The forceps is now allowed to spin freely as the cord twists on itself (Fig. 1C). The cord stops twisting automatically after the whole length has been entwined. At this stage, the cord is stable, and finally a standard reef knot was made at the free end of the cord (Fig. 1D). To prevent subsequent slippage of the knot, the ends of the cord were left quite long. The strands of the cord away from the knot were untwisted and additional throws (at least four) were made to strengthen the knot. The cord now is ready for use.

Two drill holes were made in the proximal part of the osteotomy fragment using a 3.2-mm drill. One end of the

Fig. 1A–D The steps to prepare the suture cord are shown. (A) The drill is rotated keeping tension on the Number 2 Vicryl strands until a tight helix is formed without buckling. (B) The two knotted ends are brought together while pulling the forceps down to prevent kinking. (C) The forceps is now allowed to spin freely as the cord

twists on itself. (D) A final knot is made at the free end of the cord. The cord now is ready for use. (Reprinted with permission from Landsmeer R, Khanduja V, New A, Suresh SP, Shah K, Loeffler M. Making strong cords from surgical sutures. *Acta Orthop Belg.* 2006;72:210–213.).

cord is tied to a single strand of suture (Number 2 Vicryl) having a curved needle at its end. This needle with suture is used to navigate the cord around the prosthesis and through the drill holes in the osteotomy fragment. The cord was passed around the proximal part of the prosthesis (immediately below the shoulder of the prosthesis, which is at the junction of the stem and the modular proximal part). The curved needle with suture was passed through the drill hole; by gently pulling the Vicryl suture, the attached suture cord was pulled through the hole of the osteotomy fragment and then passed back through another hole (Fig. 2A). Finally, a secure surgical knot with extra throws was tied on the side of the osteotomy window anchoring the osteotomy fragment to the femoral stem (Fig. 2B). The knot was placed over the osteotomy and rested on the bone. This resists the upward pull of the abductors of the hip and prevents proximal migration of the osteotomy fragment. A few interrupted sutures were applied between the soft tissues of the osteotomy and lateral intermuscular septum.

For 6 weeks postoperatively, the patient wore a derotation boot when in bed. Partial weightbearing was allowed initially progressing to full weightbearing during the course of 4 to 6 weeks. Continuous passive mobilization was used routinely during the early postoperative period to regain knee movement. We used a hip brace for patients who

experienced dislocation during the postoperative period. This was constructed by our plaster technician using a hip hinge with a plaster sleeve to the knee and a waist band. In this way flexion and rotation can be controlled.

We followed patients at 6 weeks, 3, 6, and 12 months postoperatively, and annually thereafter. Clinical assessment was performed by independent observers who recorded pain in the hip and thigh, limp, wound infection, limb-length discrepancy, Trendelenburg gait, and any other complications. Radiographs were reviewed by two observers (RK, SPS) for bony union, proximal migration of the osteotomy, and stem subsidence.

Results

Bony union of the osteotomy occurred (Fig. 3A–B) in 19 of the 20 patients. In one patient, there was a fibrous union that was asymptomatic at 24 months postoperatively. We observed 5 mm proximal migration of the osteotomy fragment in one patient who had bony union of the osteotomy. Prosthesis subsidence occurred in two patients (5 mm in one and 10 mm in the other). None of these patients needed additional revision surgery.

Two patients had dislocations during the immediate postoperative period. Both underwent closed reduction under anesthesia followed by stabilization with a hip brace for 3 months. Neither required additional surgery. One patient had residual thigh pain, which resolved gradually and the other had symptoms of trochanteric bursitis that responded to steroid injections.

There was some degree of leg-length discrepancy in five patients (three had lengthening; two had shortening); this was managed with appropriate shoe raises. One patient had a deep infection that was treated with débridement and antibiotics.

Discussion

The extended trochanteric osteotomy is widely used for revision THA. However, the approach requires some sort of fixation of the osteotomy fragment. We described a novel technique to reattach the ETO using a suture cord, avoiding wires or cables, and asked whether this method leads to reliable union without displacement.

The major limitations of our study are the small number of patients and absence of controls using other fixation methods. Nonetheless, with adequate followup in 20 patients, all but one achieved healing and that patient had a stable fibrous union. We suspect this degree of reliability would compare with fixation for other approaches. We did not use any clinical scoring systems but our primary aim was to ascertain whether the technique would lead to reliable healing.

Fig. 2A–B (A) The femoral osteotomy with intact muscular attachments is shown. Suture cord is passed around the prosthesis stem and through the holes drilled in the osteotomy fragment. (B) The osteotomy window is closed by tying the knot and the gap is filled with bone graft and hydroxyapatite blocks.

Fig. 3A–B (A) An anteroposterior radiograph taken immediately postoperative shows the hip of a 70-year-old man who underwent revision THA with the ETO. The osteotomy was closed with the described technique. (B) An anteroposterior radiograph obtained 6 months postoperative shows bony union of the ETO.

The trapdoor osteotomy described by Wagner involves the greater trochanter and $\frac{1}{2}$ the circumference of the femoral cortex [11]. There is a paucity of published evidence favoring this form of transfemoral osteotomy which might be attributable to the lack of reports of results and complications [4]. The advantages of ETO in revision THA outweigh those of the standard trochanteric osteotomy techniques [1, 4–8, 10, 11]. It can facilitate cement removal or removal of a well-fixed uncemented stem. In the presence of proximal femoral bony deformity, this technique facilitates implantation of the components and reduces the risk of additional compromise of the remaining femoral bone stock [1]. In cases of aseptic loosening of a hip prosthesis, increasing bone resorption occurs in the prosthetic bed, which no longer provides mechanical stability for the revision component. This problem was first addressed by Wagner [11], who used a distally fixed uncemented stem in a revision scenario. This stem, bridging the damaged prosthetic bed, allowed the bone tissue to proliferate, thus making up for the lost bone stock.

To protect the weak proximal femoral prosthetic bed, for easy removal of the prosthesis and cement, we performed ETO preserving the muscular attachments as described by Younger et al. [12]. This technique preserves the vastus lateralis and abductors thus preserving the blood supply at the osteotomy [8]. This osteotomy must be securely attached to allow healing of the osteotomy and to restore the efficiency of the abductor mechanism of the hip. This approach led to reliable union of the osteotomy without displacement.

The most commonly used methods of fixation are using stainless steel cerclage wires or cables [1, 4–6, 10]. Cerclage wires may compress the bone and soft tissues and can cause vascular interruption, which could affect healing adversely. Passing cerclage wires is not without risk; for example, sciatic nerve injury. Commercial cabling systems are expensive. In addition, wires and cables can break and unravel [5, 10]. Complications like proximal migration, early and late fracture of the osteotomy, and nonunion needing reoperation have been described (Table 1) [1, 4–7, 10].

For these reasons, we searched for a fixation method with a relatively better rate of safety, stability, and healing. To avoid the complications of wire or cable fixation, we considered using a thick cord made of Vicryl suture material. The steps to make the cord using Vicryl and laboratory testing of its breaking strength were described by Landsmeer et al. [3]. Initially, we used this cord, with good results, to tie the clavicle to the coracoid process in reconstruction of the acromioclavicular joint. We extended its use to anchor the osteotomy in revision hip arthroplasty.

With this simple fixation method, only one patient experienced problems with union of the osteotomy. Even in this case of nonunion, there was no proximal migration of the trochanter, probably because of the strong fibrous union. One patient did experience proximal migration of the osteotomy but without any major limp. There were no intraoperative or late fractures of the osteotomy fragment, and none of the patients needed reoperation.

Table 1. Review of results of different femoral osteotomy fixation methods

Study	Method	Results and complications
Schutzer and Harris [10]	Trochanteric osteotomy reattached with a three- or four-wire method	Total cases, 188; wire breakage, 27%; nonunion, 3%; trochanter proximal migration, 1%
McCarthy et al. [5]	Trochanteric reattachment using Dall Miles cables	Total cases, 251; nonunion, 10%; cable breakage, 10%; unraveling of cable, 18%
Chen et al. [1]	Extended slide trochanteric osteotomy fixed using cables	Total cases, 46; nonunion, 1; fracture of osteotomy and proximal migration of trochanter, 2
Miner et al. [7]	ETO fixed with cables	Total cases, 166; nonunion and proximal migration of osteotomy, 1.2%; fracture of osteotomy, 2.4%
MacDonald et al. [6]	ETO closed with cerclage wires or cables	Total cases, 45; nonunion, 11%; trochanteric escape (reoperated), 2; fracture of the osteotomy, 2
Mardones et al. [4]	ETO fixed with cerclage cables	Total cases, 75; nonunion, 1; osteotomy migration, 5; intraoperative fracture of osteotomy, 3; late fracture of osteotomy, 1
Current study	ETO fixed with a Vicryl cord	Total cases, 20; nonunion, 1; osteotomy migration, 1; intraoperative fracture of osteotomy, none; late fracture of osteotomy, none; reoperations, none

ETO = extended trochanteric osteotomy.

It could be argued whether one suture cord is efficient enough to hold the osteotomy. We used just one cord directed around the shoulder of the femoral component, which helped to achieve effective anchorage of the osteotomy. On followup radiographs, we observed no considerable proximal migration of the osteotomy. Although using a double suture cord was considered, we believed one cord was of sufficient strength to hold the osteotomy fragment to the femur until union occurred. Our concern with using two cords was the number of fenestrations required in the osteotomy fragment, which could increase the risk of fracture. Also, although we believe the bending forces exerted by the cord on the femoral component might increase the risk of stem loosening, the followup radiographs did not show such effects at the distal fixation site.

The advantages of our technique of anchoring a femoral osteotomy are: (1) Vicryl is readily available and easily braided into a cord in the operating room; it is a simple and cost-effective method, useful especially in developing countries where cost is a major concern; (2) because the suture cord is passed through holes drilled in the osteotomy fragment, there is better control over the fragment which helps to adjust the tension in the abductor muscles while fixing; (3) the osteotomy fragment is anchored directly onto the prosthetic stem; it provides more secure fixation than cerclage wire, directly countering the abductor pull on the osteotomy; and (4) the cord does not encircle the femur and the osteotomy, thus preserving the local blood supply and facilitating healing of the osteotomy. Our technique makes fixation of the femoral osteotomy easier and quicker, resulting in a successful outcome.

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