Early Experience with a Novel Nonmetallic Cable in Reconstructive Hip Surgery

Nicholas T. Ting BA, Glenn D. Wera MD,
Brett R. Levine MD, Craig J. Della Valle MD

Published online: 5 March 2010
© The Association of Bone and Joint Surgeons® 2010

Abstract

Background Metallic wires and cables are commonly used in primary and revision THA for fixation of periprosthetic fractures and osteotomies of the greater trochanter. These systems provide secure fixation and high healing rates but fraying, third-body generation, accelerated wear of the bearing surface, and injury to the surgical team remain concerning.

Questions/purposes We determined the rate of cable failure, union, and complications associated with a novel, nonmetallic cerclage cable in periprosthetic fracture and osteotomy fixation during THA.

Methods We retrospectively reviewed 29 patients who had primary and revision THAs using nonmetallic cables. Indications for use included fixation of an extended trochanteric osteotomy, intraoperative fracture of the proximal femur, strut allograft fixation, and a Vancouver B1 periprosthetic fracture of the femur. All patients were evaluated clinically and radiographically immediately postoperatively, at 3 weeks, 6 weeks, 3 months, and then annually thereafter. The minimum followup was 13 months (mean, 21 months; range, 13–30 months).

Results Two of the 29 patients (7%) developed a non-union; all remaining osteotomies, fractures and allografts had healed at the time of most recent evaluation. Four patients (14%) dislocated postoperatively; two were treated successfully with closed reduction, while the other two required reoperation. We identified no evidence of breakage or other complications directly attributable to the cables.

Conclusions The nonmetallic periprosthetic cables used in this series provided adequate fixation to allow for both osteotomy and fracture healing. We did not observe any complications directly related to the cables.

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

Introduction

Metallic cables and wires are commonly used in complex primary and revision THA for fixation of periprosthetic fractures and osteotomies of the greater trochanter [10]. Currently, single-filament wires [6], multifilament cables [9], and cable-plate systems [4] are in widespread use. These fixation options share the goal of counteracting deforming forces about the femur and providing secure fixation and reliable healing of the osteotomy [9, 22]. These systems have been effective for these purposes but fraying, third-body generation, accelerated wear of the bearing surface, and injury to the surgical team by cut wire ends remain concerns [2, 26]. Recently nonmetallic cables have been introduced to address these concerns.

The purpose of this report is to (1) determine the union rate of osteotomies and fractures where the nonmetallic cable was utilized; (2) identify any complications

CJDV: Consulting for Biomet, Kinamed, Smith Nephew. BRL: Consulting for Zimmer.

Each author certifies that his institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

N. T. Ting, G. D. Wera, B. R. Levine, C. J. Della Valle (✉)
Department of Orthopaedic Surgery, Rush University Medical
Center, 1725 West Harrison, Suite 1063, Chicago, IL 60612,
USA
e-mail: craigdv@yahoo.com

associated with use of the nonmetallic cable such as breakage; (3) identify any other associated complications in this series of complex primary and revision total hip arthroplasties.

Patients and Methods

We retrospectively reviewed all 29 patients in whom nonmetallic cables (SuperCable™; Kinamed Inc, Camarillo, CA) were used in complex primary ($n = 6$) and revision THA ($n = 23$) between November 2006 and April 2008. The cable design consists of a nylon core encased in a jacket of UHMWPE braided fibers, with a metal clasp for tightening and locking (Fig. 1). The mean age of the 29 patients was 63.9 years (range, 34–94 years), and the cohort included 18 women (62%) and 11 men (38%). Indications for cerclage included fixation of an extended trochanteric osteotomy (ETO) (22 patients), intraoperative fracture of the proximal femur during THA (four patients; three primary and one revision THA), isolated strut allograft fixation (two patients), and a Vancouver B1 periprosthetic fracture of the femur (one patient). The 29 patients were followed for a minimum of 13 months (mean, 21 months; range, 13–30 months). No patients were lost to followup. The study was approved by our institutional review board.

For the 23 revision THAs, femoral deficiency was classified according to the system of Della Valle and Paprosky [11]; there were seven Type II, 12 Type IIIA, three Type IIIB, and one Type IV femur. Of these 23 revision THAs, 14 had undergone one prior hip

arthroplasty, four had undergone two prior hip arthroplasties, and five patients had undergone more than two prior hip arthroplasties. The primary indication for revision included aseptic femoral component loosening in 12 patients (including three patients with a Vancouver B2 periprosthetic fracture [5, 12, 19]), a fractured femoral component in two patients, recurrent instability in two patients, and a deep periprosthetic infection in seven patients (including one patient with an infected Vancouver B2 periprosthetic fracture). Of the seven patients with a deep periprosthetic infection, three had the cables placed at the time of removal of the infected femoral component and four at the time of second-stage reimplantation. For the three patients who had the cables placed at the time of resection arthroplasty, the cables were not removed at the time of reimplantation.

The technique described by Della Valle et al. and Paprosky et al. [10, 21] was used for the ETO. Cortical strut allografts were used in five patients; two of the struts were used in a complex primary THA to protect an area of a prior plate, and in three, the strut was used in conjunction with an ETO. Cables were passed under the vastus lateralis muscle with a semicircular passer and then stabilized using the provided tensioning device (Fig. 1). The average number of cables used was 3.1 (range, 1–6 cables).

The rehabilitation protocol included early mobilization and transfers with inpatient physical therapy. Activity orders included toe-touch weightbearing on the involved side and the avoidance of active abduction after an ETO for six weeks. Subsequently, patients are allowed active abduction and weight bearing as tolerated.

All patients underwent both clinical and radiographic evaluations immediately postoperatively, at 3 weeks, 6 weeks, 3 months, and then annually thereafter (Fig. 2). Clinical and radiographic evaluation was performed by three observers (GDW, NTT, BRL) who were not part of the operating team. Healing of the osteotomy or fracture was determined by clinical examination and serial postoperative hip and femur radiographs. At each time point, a direct digital measurement of the osteotomy or fracture length was obtained. Healing of the ETO or fracture was based upon bridging bone on orthogonal radiographic views, absence of migration of greater than 3 mm, by direct digital measurement, and absence of fixation failure [17]. A judgment of healing was by consensus of the two observers. Femoral component stability was evaluated radiographically using the criteria of Engh et al. [7, 13]. Osteointegration of stems was determined by increased density of bone adjacent to the porous coating and absence of diverging radiolucent lines, prosthetic subsidence, or a pedestal sign [20]. Fracture or osteotomy healing was defined when these radiographic criteria were met and there was no pain with weightbearing [17, 18].

Fig. 1 A photograph shows the nonmetallic cable and tightener.

Fig. 2A–C (A) A preoperative AP radiograph shows an infected THA. (B) A radiograph taken 6 weeks postoperatively after ETO for removal of the well-fixed cementless femoral component and antibiotic spacer placement; nonmetallic cables were used to repair the ETO. (C) A 1-year followup radiograph shows healing of the ETO and stable components.

Results

Two patients developed a nonunion (7%): one after an ETO and the second after open reduction and internal fixation (ORIF) of a Vancouver B1 periprosthetic fracture. At last followup, 27 of the 29 patients (93%) had healed the osteotomy, allograft or fracture. The first nonunion occurred after an ETO in a 58-year-old man who had been treated at an outside hospital for a deep periprosthetic infection with four prior operations. At the time of initial presentation and cable placement, he had a nonunion of an ETO that had been present for 18 months. The ETO was refixed at the time of reimplantation with three cables but failed to heal. The patient subsequently sustained three anterior dislocations and was revised at 8 months postoperatively. The femoral neck length was increased and repeat fixation of the trochanter was performed with a cable plate using metallic cables. The patient has not redislocated; however, at last followup the ETO showed no radiographic evidence of healing. The second nonunion occurred after a Vancouver B1 fracture treated with a locking plate. The nonmetallic cables were used for internal fixation proximally around the femoral component. A nonunion developed but went on to successful union after repeat ORIF with iliac crest bone grafting.

There were no cases of breakage or failure of the cables based on radiographic appearance. We performed revisions on two patients after 8 and 13 months and in neither did we observe breakage of the cables or clasps at the time of revision.

Four of the 29 patients (14%) dislocated postoperatively (including the one previously described in association with

an ETO nonunion). One of the revision THAs developed an early postoperative deep infection that was successfully treated with irrigation, débridement, and antibiotics with retention of the implants. There was no evidence of loosening of any of the prosthetic components.

Discussion

Traditional options for cerclage fixation in reconstructive hip surgery include monofilament wires, multifilament cables, and cable grip systems [15]. While these modalities are in widespread use, their metallic composition poses a number of limitations and potential complications, including fraying, third-body generation, accelerated wear of the bearing surface, and injury to the surgical team [2, 3, 26]. These concerns necessitate the continued development of alternative materials for cerclage fixation. This study demonstrated no cable failures, an acceptable nonunion rate (7%), no interference with osseointegration of cementless implants, and an overall complication rate comparable to other revision studies.

We note several limitations. First, this was a small cohort with short-term followup. Longer-term results of a larger group of patients will be necessary to determine if any of the drawbacks associated with metal cables can be avoided in the long term, namely, the avoidance of fraying, intraarticular migration, third body wear, and prevention of osteolysis. Nevertheless, we believed it was important to report early results given the potential utility of this novel device. Second, we did not directly compare our findings with those using traditional techniques with wires or

Table 1. Rates of failure reported for cerclage cables

Investigation	Number of subjects	Followup (months)	Cerclage type	Breakage rate	Nonunion rate
Clarke et al. [8]	277	12–72	Wire	33.2%	9%
Schutzer and Harris [25]	188	34	Multiple wire	27%	3%
Chen et al. [7]	46	44	Cable	0%	2%
Silverton et al. [26]	68	12	Cable grip	44%	25%
Ritter et al. [23]	40	23.7†	Cable grip	32.5%	37.5%
Ting et al. [current study]	29	21	Nonmetallic	0%	7%

† Average from published data.

cables; therefore, we cannot suggest nonmetallic cable fixation is superior to those techniques.

While we observed no patients with cable failure (signified by migration of the radioopaque clasps or lytic lines at the level of the cable), we acknowledge that the radiolucent appearance of the cables may prevent radiographic assessment of the condition of the cables in the long term. There were, however, two failures that were subsequently revised and the nonmetallic cables were intact at the time of revision as well. Degradation of the cable or its outer jacket was not observed in either case. Although radiographic assessment may be limited by the material properties of the cable, these early term results suggests that cable breakage is not a clinical problem. Concerns with the use of metallic cables, however, primarily relate to cable fretting or even breakage and the associated generation of metallic debris [26], particularly with intraarticular migration, and if they come in direct contact with the femoral component [24]. This debris has been implicated as a third-body generator that may accelerate polyethylene wear and has been associated with an increased rate of acetabular component loosening [1, 2, 14, 16].

The nonmetallic periprosthetic cable fixation provided adequate early fixation strength to allow for both osteotomy, allograft and fracture union. The published rate of failure associated with cerclage devices ranges from approximately 7–37.5% with an accompanying breakage rate of 0–44% (Table 1). We found a rate of union of ETOS (21 of 22) similar to that in several previous studies using an ETO in both complex primary and revision THA but with traditional metal fixation [7, 17, 18].

The most common complication in this series was postoperative dislocation (14%). In general, the dislocation rate after revision THA ranges from 0–54% with an average of approximately 11% [1]. One patient developed recurrent instability requiring reoperation and in this case the dislocation was related to nonunion of an ETO that led to impingement and abductor insufficiency.

While the use of cerclage wires has produced high healing rates and is less costly [24], their popularity has declined secondary to the increased strength and ease of

use associated with cables [15]. The cost of the nonmetallic cables used in this study is comparable to those of the metallic cables already in use.

Our early results suggest the nonmetallic cable we used was not associated with material failure and had an rate of union of both fractures and osteotomies similar to that in the literature for other forms of fixation. We observed no direct complication related to the cables.

References

1. Alberton GM, High WA, Morrey BF. Dislocation after revision total hip arthroplasty: an analysis of risk factors and treatment options. *J Bone Joint Surg Am.* 2002;84:1788–1792.
2. Altenburg AJ, Callaghan JJ, Yehyawi TM, Pedersen DR, Liu SS, Leinen JA, Dahl KA, Goetz DD, Brown TD, Johnston RC. Cemented total hip replacement cable debris and acetabular construct durability. *J Bone Joint Surg Am.* 2009;91:1664–1670.
3. Bauer TW, Ming J, D'Antonio JA, Morawa LG. Abrasive three-body wear of polyethylene caused by broken multifilament cables of a total hip prosthesis: a report of these cases. *J Bone Joint Surg Am.* 1996;78:1244–1247.
4. Barrack RL, Butler RA. Current status of trochanteric reattachment in complex total hip arthroplasty. *Clin Orthop Relat Res.* 2005;441:237–42.
5. Brady OH, Garbuz DS, Masri BA, Duncan CP. The reliability and validity of the Vancouver classification of femoral fractures after hip replacement. *J Arthroplasty.* 2000;15:59–62.
6. Charnley J. Total hip replacement by low-friction arthroplasty. *Clin Orthop Relat Res.* 1970;72:7–21.
7. Chen WM, McAuley JP, Engh CA Jr, Hopper RH Jr, Engh CA. Extended slide trochanteric osteotomy for revision total hip arthroplasty. *J Bone Joint Surg Am.* 2000;82:1215–1219.
8. Clarke RP, Shea WD, Bierbaum BE. Trochanteric osteotomy: Analysis of pattern of wire fixation failure and complications. *Clin Orthop Relat Res.* 1979;141:102–110.
9. Dall DM, Miles AW. Re-attachment of the greater trochanter: the use of the trochanter cable-grip system. *J Bone Joint Surg Br.* 1983;65:55–59.
10. Della Valle CJ, Berger RA, Rosenberg AG, Jacobs JJ, Sheinkop MB, Paprosky WG. Extended trochanteric osteotomy in complex primary total hip arthroplasty: a brief note. *J Bone Joint Surg Am.* 2003;85:2385–2390.
11. Della Valle CJ, Paprosky WG. Classification and an algorithmic approach to the reconstruction of femoral deficiency in revision total hip arthroplasty. *J Bone Joint Surg Am.* 2003;85:1–6.

12. Duncan CP, Masri BA. Fractures of the femur after hip replacement. *Instr Course Lect.* 1995;44:293–304.
13. Engh CA, Massin P, Suthers KE. Roentgenographic assessment of the biologic fixation of porous-surfaced femoral components. *Clin Orthop Relat Res.* 1990;257:107–128.
14. Hop JD, Callaghan JJ, Olejniczak JP, Pedersen DR, Brown TD, Johnston RC. The Frank Stinchfield Award. Contribution of cable debris generation to accelerated polyethylene wear. *Clin Orthop Relat Res.* 1997;344:20–32.
15. Jarit GJ, Sathappan SS, Panchal A, Strauss E, Di Cesare PE. Fixation systems of greater trochanteric osteotomies: biomechanical and clinical outcomes. *J Am Acad Orthop Surg.* 2007; 15:614–624.
16. Kelley SS, Johnston RC. Debris from cobalt-chrome cable may cause acetabular loosening. *Clin Orthop Relat Res.* 1992; 285:140–146.
17. Levine BR, Della Valle CJ, Hamming M, Sporer SM, Berger RA, Paprosky WG. Use of the extended trochanteric osteotomy in treating prosthetic hip infection. *J Arthroplasty.* 2009;24:49–55.
18. Levine BR, Della Valle CJ, Lewis P, Berger RA, Sporer SM, Paprosky W. Extended trochanteric osteotomy for the treatment of Vancouver B2/B3 periprosthetic fractures of the femur. *J Arthroplasty.* 2008;23:527–533.
19. Masri BA, Meek RM, Duncan CP. Periprosthetic fractures evaluation and treatment. *Clin Orthop Relat Res.* 2004;420:80–95.
20. O'Shea K, Quinlan JF, Kuttly S, Mulcahy D, Brady OH. The use of uncemented extensively porous-coated femoral components in the management of Vancouver B2 and B3 periprosthetic femoral fractures. *J Bone Joint Surg Br.* 2005;87:1617–1621.
21. Paprosky WG, Weeden SH, Bowling JW Jr. Component removal in revision total hip arthroplasty. *Clin Orthop Relat Res.* 2001; 393:181–193.
22. Pritchett JW. Fracture of the greater trochanter after hip replacement. *Clin Orthop Relat Res.* 2001;390:221–226.
23. Ritter MA, Eizember LE, Keating EM, Faris PM. Trochanteric fixation by cable grip in hip replacement. *J Bone Joint Surg Br.* 1991;73:580–581.
24. Ritter MA, Lutgring JD, Davis KE, Berend ME, Meding JB. A clinical, radiographic, and cost comparison of cerclage techniques: wires vs cables. *J Arthroplasty.* 2006;21:1064–1067.
25. Schutzer SF, Harris WH. Trochanteric osteotomy for revision total hip arthroplasty: 97% union rate using a comprehensive approach. *Clin Orthop Relat Res.* 1988;227:172–183.
26. Silverton CD, Jacobs JJ, Rosenberg AG, Kull L, Conley A, Galante JO. Complications of a cable grip system. *J Arthroplasty.* 1996;11:400–404.