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Current Status of Trochanteric Reattachment in Complex Total Hip Arthroplasty

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A study was done to determine if cable fixation devices of more recent design were associated with a higher success rate and lower incidence of complications compared with early cable devices. Beginning in 1997 a cable plate device was used in an attempt to restore abductor function more consistently in complex total hip arthroplasties. Cobalt-chrome cables through holes in a trochanteric cable plate with two or more transversely oriented cables at or below the lesser trochanter were used in order to resist migration of the trochanteric fragment better. Other component features included instrumentation that allowed provisional fixation and measurement of the tension in the cables so that cables could be tightened and retightened sequentially to insure a minimum of 80 inch-pounds of tension in all cables before final crimping. Minimum 2-year followup was obtained in 42 patients who had complex arthroplasties (trochanteric nonunions and reattachment to structural grafts) in which such a device was used. Clinical and radiographic results were compared with a series of patients with similar indications in whom wire or and earlier-generation trochanteric cable fixation devices were used. The cable plate of a more recent design was associated with a possible trend for a lower incidence of limp, use of assistive walking devices, dislocation, and abductor weakness and significant decrease in the incidence of breakage and trochanteric nonunion.

Level of Evidence: Therapeutic study, Level III-1 (retrospective comparative study). See the Guidelines for Authors for a complete description of levels of evidence.

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Total hip arthroplasty (THA) as described by Charnley[2] involved osteotomy at the greater trochanter with subsequent reattachment with wires. Problems related to trochanteric fixation emerged as considerable complications of hip replacement and included wire breakage, bursitis, nonunion, and associated limp, weakness, and increase in dislocation rate.[5] Cables were developed more than 20 years ago in an attempt to obtain trochanteric union more reliably and to allow for earlier patient mobilization. Mechanical testing predicted superior performance of multifilament cables compared to traditional stainless steel wires.[8] Early results using cables were promising.[13] With more widespread use, however, the results in terms of trochanteric union were less encouraging with nonunion rates of 9%–37.5% reported.[12,14,15] In addition, a host of new complications emerged related to the use of cables for trochanteric fixation including accelerated wear and acetabular loosening.[9,11] Because of the emergence of these new problems, the enthusiasm for the use of cable for trochanteric fixation waned considerably. In addition, the use of trochanteric osteotomy has declined dramatically particularly with the development of alternative operative approaches.[16]

On the occasion that an osteotomy is elected for difficult revisions, the use of an extended trochanteric osteotomy, which involved reattachment with wires or cable around the diaphysis, was popularized, which rarely resulted in breakage or failure of union.[3] There are cases, however, in which trochanteric reattachment must be done. If there has been a previous malunion or nonunion of the trochanter or if the proximal femur is replaced with a structural graft and a viable trochanteric fragment exists, reattachment of the trochanter is necessary to restore abductor function. The options are to use wire as originally described and to accept the relatively high failure rate in these difficult cases or attempt to improve trochanteric fixation devices. A number of potential areas for improvement include the characteristics of cable itself such as the bundle pattern of the filaments. Provisional fixation of the cable would allow for tightening and retightening in order to maximize the rigidity of fixation. Measuring tension in the cable prior to tightening would facilitate more consistent quality of fixation. Cable plates that allow for transversely oriented cables around the diaphysis can more effectively resist trochanteric migration or rotation.

Since 1997 we have used a trochanteric fixation system incorporating all of these features in patients with complex arthroplasties. We questioned whether this system would reduce the incidence of wire or cable breakage, dislocation, limp, use of assistive devices, and improve rates of union and abductor strength.

MATERIALS AND METHODS

We retrospectively reviewed 58 consecutive patients (Group I) in whom a complex hip arthroplasty was performed and trochanteric reattachment was attempted between 1991 and 1996 (Table 1). We obtained a minimum of 2-year followup. Twenty-seven patients had a previous trochanteric nonunion or malunion, in 20 cases the trochanter was reattached to a structural allograft (allograft prosthetic composite) and in 10 cases trochanteric osteotomy was done for a difficult revision usually associated with limited motion in a larger patient. The average patient age was 62 years and there were 31 women and 27 men. Wires were used in 33 patients and first-generation cables were used in the remaining 25 patients. A second-generation cable device was used in 42 patients (Group II) after 1997 (Table 1). There were 20 cases of trochanteric fixation to a structural graft, 19 cases of a previous malunion or nonunion and three cases of complex revisions in stiff hips and/or larger patients. The average age was 59 with 23 women and 19 men.

Before 1997, fixation was accomplished with a four-wire technique as described by Jensen and Harris,[10] a similar technique using cables, or with the Dall Miles Cable Grip System (Stryker Howmedica, East Rutherford, NJ). After 1997, a so-called second-generation cable system was used characterized by a 19 × 7 filament pattern (versus 7 × 7 in the Dall Miles system; Fig 1), a provisional fixation feature that allowed tightening and

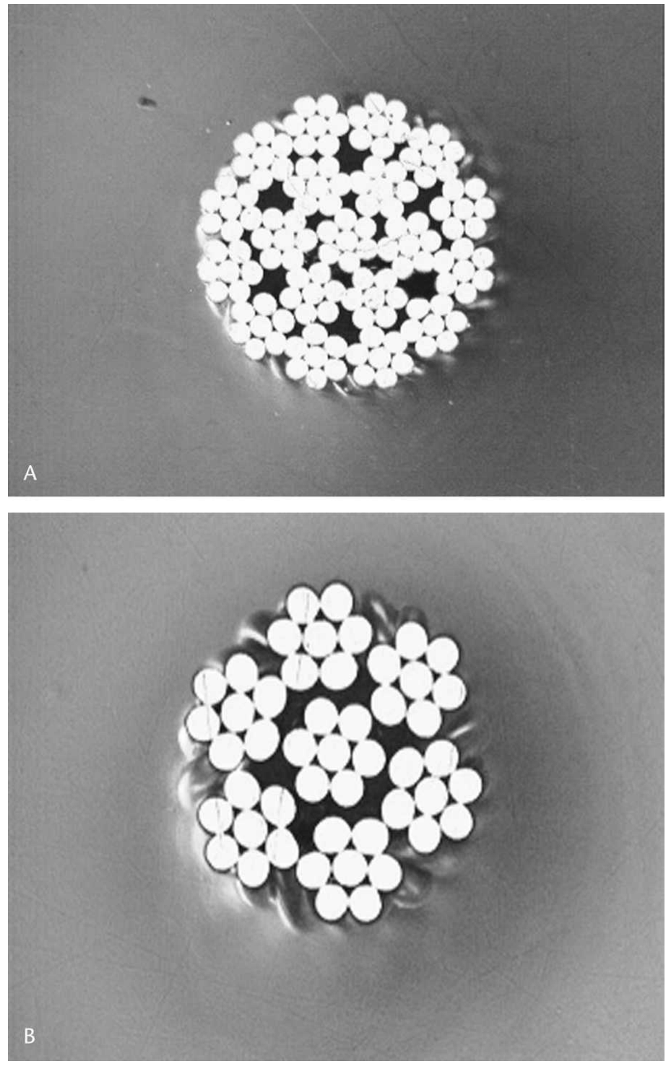

Fig 1A–B. A comparison of (A) a 19 × 7 with (B) a 7 × 7 bundle pattern is shown.

TABLE 1. Comparison of Patients Treated Using Wire or Early Generation Cable (Group I) with Patients Treated Using More Recent Cable Plate Device (Group II)

Characteristic	Group I (n = 58)	Group II (n = 42)	p Value
Age (years)	62	59	NS
Gender	31 women/27 men	23 women/19 men	NS
Preoperative Hip Score	31	34	NS
Postoperative Hip Score	72	81	< 0.2
Breakage	24 of 58 (41%)	8 of 42 (19%)	< 0.025
Nonunion	21 of 58% (36%)	7 of 42 (14.6%)	< 0.05
Dislocation	10 of 58 (17.2%)	2 of 42 (4.8%)	< 0.2
Limp More Than Mild	32 of 58 (55%)	16 of 42 (21%)	< 0.1
Requires Assistive Device	36 of 58 (62%)	19 of 42 (45%)	< 0.1
Side Lying Abduction versus Gravity	36 of 58 (57%)	33 of 42 (79%)	< 0.1

NS = Not significant

retightening, and a cable tightener capable of measuring cable tension. All cables were retightened at least once to minimize the risk of loss of tension in the first cable when subsequent cables were tightened. The newer systems also had the option of a plate extension to allow for transversely oriented cables around the diaphysis below the laser trochanter to better resist trochanteric rotation or migration. All patients had two or more transversely oriented cables used at or below the level of the lesser trochanter in addition to at least one cable obliquely oriented toward the tip of the trochanter.

Patients were reviewed clinically and radiographically. Clinical data included patient age, gender, diagnosis, preoperative Harris hip score, and ambulatory status.[7] At a minimum followup of 2 years, restoration of abductor function was judged on a clinical and radiographic basis. If solid trochanteric union was present or if migration less than 10 mm was present and the patient was able to abduct against gravity in the side-lying position actively, abductor function was considered restored. If migration greater than 10 mm was present, the patient was classified as having a nonunion. Radiographs also were reviewed for presence of wire or cable breakage, fretting, fragmentation, and association osteolysis (Figs 2, 3). Clinical data at most recent followup included Harris hip score, ambulatory status including use of assistive walking devices, presence of limp classified as more than mild, and ability to abduct against gravity actively (side-lying abduction). The early trochanteric fixation group (Group I) (wire or first generation cable) was compared with the second-generation group (Group II) clinically and radiographically. Clinical and radiographic measurements were made by two observers that were not members of the surgical team.

Continuous data such as hip score were compared using a student's t test whereas discrete data such as presence of trochanteric union were compared using chi square and Fisher's exact tests. A value of $p < 0.05$ was considered significant.

RESULTS

There was no difference between the two groups in age, gender, preoperative or postoperative hip score or dislocation rate.

Group II tended to have a lower incidence of limp rated more than mild (21% versus 55%) use of assistive device for walking (45% versus 62%), and a higher incidence of the ability to resist gravity with side-lying abduction (79% versus 57%). Although these differences indicated a trend ($p < 0.1$), they were not significant with the numbers available. Group II did have a lower incidence of wire or cable breakage ($p < 0.025$) and trochanteric nonunion ($p < 0.05$) (Table 1).

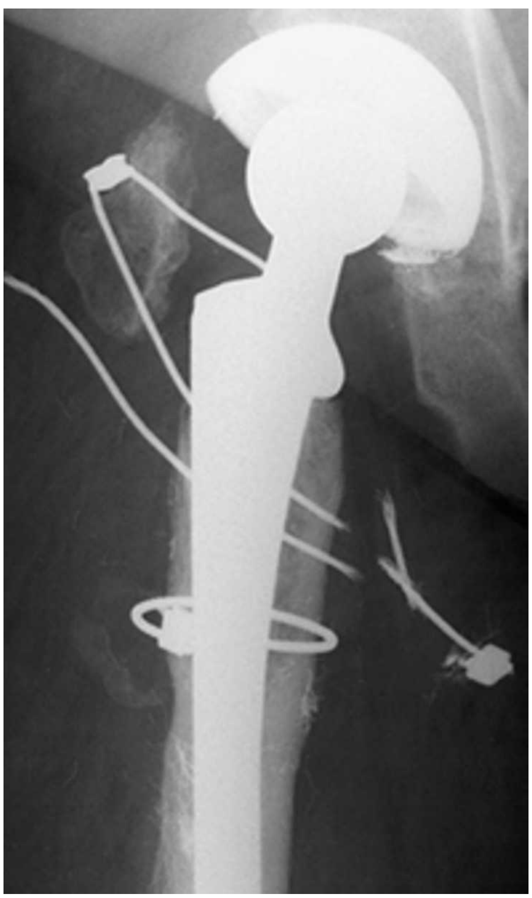

Fig 2. An AP radiograph after revision THA shows cable breakage and trochanteric migration that resulted in marked limp, weakness, and the patient's use of a cane to assist with walking.

Fig 3. An AP radiograph shows cable breakage associated with fretting and metal debris.

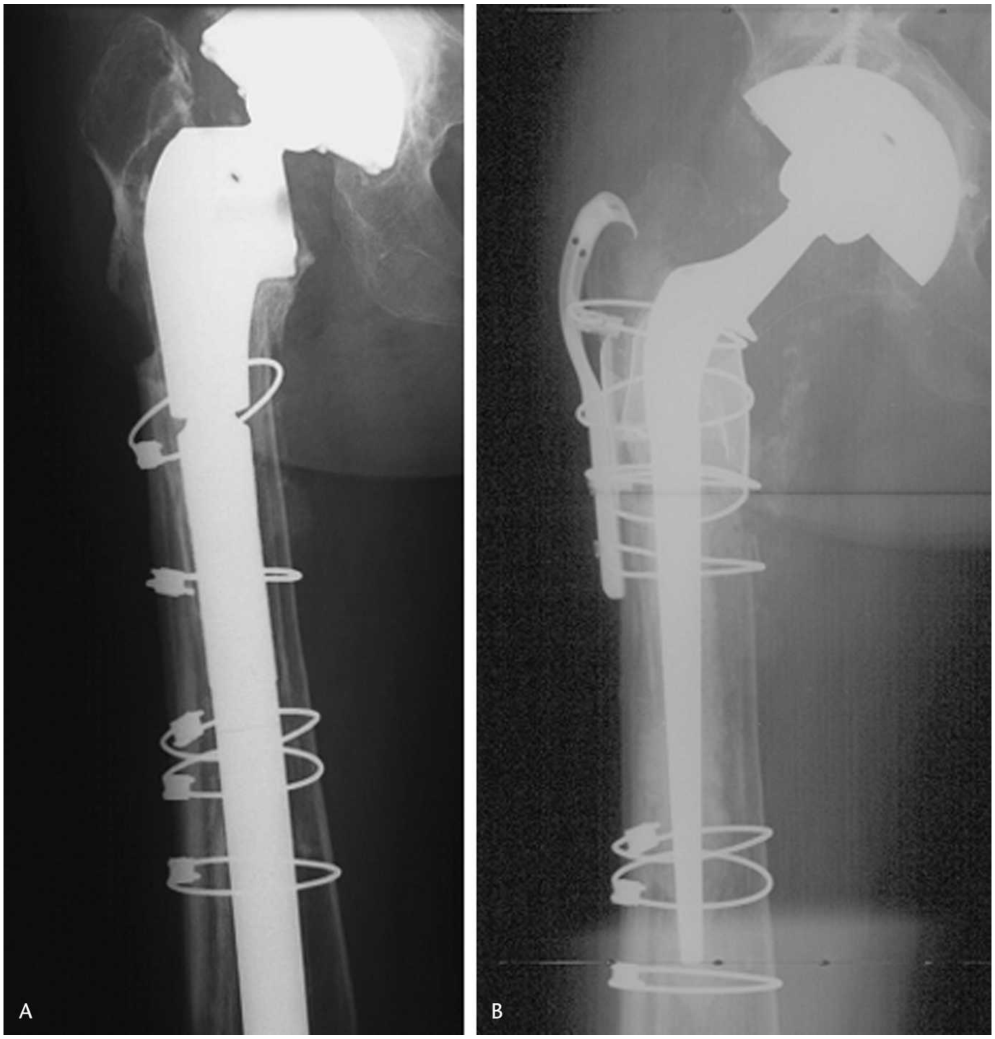

Fig 4A–B. (A) A radiograph shows trochanteric nonunion associated with loose cementless components. (B) The large trochanteric fragment was advanced and reattached successfully using a cable plate, restoring abductor function.

DISCUSSION

The major limitation of the present study is that it is not randomized but rather a longitudinal comparison. Nevertheless it is among the larger series examining the use of cable devices in complex hip procedures rather than primary or routine revision cases.

The use of trochanteric grip cable system to reattach the greater trochanter was described by Dall and Miles in 1983,[4] primarily for use in primary THA. A multifilament cable system was developed in an attempt to improve performance over traditional monofilament wire. They were able to reduce their incidence of trochanteric detachment to 1.5% and that of cable breakage to 3.1% in a series of 321 hips[4] when used in primary cases. These were used, however in routine primary THA. Using this system in revision surgeries, McCarthy et al[13] reported a nonunion rate of 9% and a breakage rate of 10%. Factors associated with successful healing included the use of vitallium (versus stainless steel cables), the use of trochanteric slide osteotomy, cable placement through a dill hole in the lesser trochanter rather than intramedullary placement of the cable, and bone-to-bone apposition at the osteotomy site. Other authors were unable to achieve results as good. Koyama et al[12] used the cable grip system in 62 revision THA surgeries and reported a nonunion rate of 30.6 % and cable fragmentation in 29%. Similar results were reported by Ritter et al[14] in 40 hips with cable breakage in 32.5% and nonunion in 37.5%.

Authors of subsequent reports indicated that complications other than nonunion and cable breakage could be attributed to the use of multifilament cable. Silverton et

Fig 5A–C. (A) A radiograph shows a failed cementless THA with massive proximal femoral bone loss and trochanteric avulsion. (B) An intraoperative radiograph shows a cable plate securing the trochanter to the structural graft and stabilizing the graft–host bone junction. (C) A corresponding postoperative radiograph.

al[15] reported a nonunion rate of 25% of 98 revision surgeries. Fraying and fragmentation of the cable were present in 15 of the 17 patients in which nonunion occurred (88%). Of equal concern was the fact that fraying and fragmentation occurred in 35% of patients in whom a radiographic union was achieved, and bone destruction around the cable was seen in 10% of cases.[15] This raised the concern for potential problems related to free-floating metallic debris that was identified radiographically. Subsequent authors presented evidence that the metal debris associated with cables did, in fact, have deleterious effects. Hop et al[9] reported a series of over 700 primary THAs with 10-year followup and compared the patients in whom trochanteric fixation was performed with wire with those in whom cable reattachment was used. At minimum 10-year followup the cable group had more wear, osteolysis, and radiographic evidence of acetabular loosening.[9] Based on these concerns, the use of cable around the hip joint became much less popular. In addition trochanteric osteotomy in the traditional form rarely has been used as an operative approach for hip replacement in recent years. There are cases however, in which reattachment of the greater trochanter must be done. These include patients in whom hip arthroplasty must be done in the presence of a previous trochanteric malunion or nonunion (Fig 4) and patients in whom a trochanteric fragment is reattached to a proximal femoral structural graft (Fig 5). The use of wires or early generation cables has been associated with a relatively high failure rate in this setting. Blackley et al[1] reported trochanteric migration in 22% of cases in which the trochanter was attached to a structural graft utilizing wires. Haddad et al[6] reported a nonunion rate of 43% when early generation cables were utilized to attach the trochanter to structural graft. There is need, therefore, for improved trochanteric fixation devices at least in these challenging scenarios.

Later-generation cable fixation devices have design features that theoretically could improve the clinical performance compared with earlier designs. By incorporating a cable plate below the lesser trochanter, transversely oriented cables can be placed around the diaphysis, which more effectively resist trochanteric rotation or migration. The ability to measure the tension in the cable and tighten and retighten the cables allows for more consistent rigid fixation. Finally, there is some evidence that the filament pattern of the cable may have higher strength and less potential for breakage or fretting.

We found a system incorporating these characteristics did result in improved clinical performance in the current series compared with early generation cable or traditional wire fixation. The results suggest the trochanteric cable plate with the features described is associated with more effective restoration of abductor function with a lower complication rate compared with trochanteric attachment with wire or earlier-generation cable devices.

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