SCIENTIFIC ARTICLE

Distal Interphalangeal Joint Arthrodesis for Degenerative Osteoarthritis With Compression Screw: Results in 102 Digits

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Purpose To assess objective and subjective outcomes of distal interphalangeal joint arthrodesis with a headless compression screw for degenerative osteoarthritis.

Methods We retrospectively analyzed 102 cases of distal interphalangeal joint arthrodesis performed with headless compression screws on 59 patients. We included only primary cases of degenerative osteoarthritis with a minimum follow-up of 7 months. We identified appropriate bone coaptation and hardware positioning on postoperative radiographs in all digits. The mean follow-up period was 26 months (range, 7–67 mo).

Results In 89 of 102 cases, patients were fully satisfied; in 9 cases, they were satisfied. Four complications occurred: 2 cases of prominent hardware, 1 complex regional pain syndrome type 1, and 1 symptomatic bony callus on the fused joint. Secondary surgery was required in each of these 4 cases. No nonunion, malunion, nail dystrophy, pseudarthrosis, or infection occurred. All arthrodeses healed.

Conclusions Distal interphalangeal joint arthrodesis with headless compression screws was shown to be safe and effective in cases of degenerative osteoarthritis, with a low complication rate. *(J Hand Surg 2012;37A:1330–1334.*

Type of study/level of evidence Therapeutic IV.

Key words Arthrodesis, bone screw, hand, osteoarthritis, surgery.

DEFORMITY, PAIN, AND INSTABILITY at the distal interphalangeal (DIP) joint may result from degenerative, posttraumatic, or inflammatory arthritis.[1] Arthrodesis is commonly performed for symptomatic arthritis at the DIP joint.[1–5] A variety of arthrodesis techniques have been described.[1,2,5–8] Whereas favorable results have been reported, rates of nonunion and implant-related complications remain considerable.[2] We hypothesized that arthrodesis using a low-profile, headless compression screw would reduce these complications. The aim of this study was to assess the subjective and objective outcomes of DIP joint arthrodesis using SCRU 2 (Arex, Palaiseau, France) compression screws for degenerative arthritis.

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MATERIALS AND METHODS

From September 2004 to October 2009, the same surgical team performed DIP joint arthrodesis using SCRU 2 in 75 patients. For this review, we included only primary cases of symptomatic degenerative arthritis. We excluded 7 cases of posttraumatic arthritis, 2 cases of rheumatoid arthritis, and 2 revision cases.[1] Five patients were lost to follow-up. The study cohort was composed of 102 arthrodesis procedures performed in

FIGURE 1: Schematic drawing of SCRU 2. Head and tip are marked.

59 patients. The mean age of patients was 61 years (range, 43–80 y). There were 3 men. The right side was involved in 63 cases. The index finger was involved in 54 cases, the middle finger in 31, the ring finger in 13, and the little finger in 4.

SCRU 2 is a cannulated, compressive titanium screw threaded at both ends. It has a dual pitch thread that is the reverse orientation of a standard Herbert screw. Its core is cylindrical and cannulated to fit over a 1-mm (0.039-in) diameter K-wire. The tip is self-tapping. The head has an outer diameter (2.5 mm) smaller than the tip (3 mm), owing to the lower height of the thread. The leading thread has a larger pitch than the trailing thread, and it generates compression during insertion by a mechanism similar to the Herbert screw (Fig. 1). The length is 10, 15, 20, 25, 30, 35, 40, or 45 mm. A low-profile screw is also available; the head has a 2.3-mm outer diameter and the tip is 2.5 mm in diameter with the same length measurements.[9]

All patients underwent preoperative standard radiography; we evaluated pain preoperatively with a visual analog scale (VAS). Under local regional anesthesia and tourniquet, we made a dorsal incision over the DIP joint. We transected the extensor tendon to expose the joint and released the collateral ligaments. With the joint exposed in hyperflexion, we performed synovectomy and removed cysts and osteophytes using a rongeur. We resected the base of the distal phalanx and the head of the middle phalanx with a rongeur, creating 2 cancellous surfaces perpendicular to the major axes of both phalanges. Under fluoroscopic control, we introduced a 1-mm (0.039-in) K-wire in the base of the distal phalanx and drove it out of the fingertip. We then coapted the prepared bony surfaces at the DIP joint coapted in full extension and drove the K-wire proximally into the middle phalanx. The wire was centered within the medullary cavity of the middle phalanx, not too close to the nail, and we verified its position under fluoroscopic control. We performed a short incision at the Kirschner wire exit site and placed the cannulated screw from distal to proximal along the wire. We determined the length of the screw by the distance between the apex of the distal phalanx and the distal middle phalanx metaphysis. We used 1 of the 20-mm screws, 41 of the 25-mm screws, and 60 of the 30-mm screws. We used the low-profile screw in 9 cases. The low-profile screw achieved good bony purchase; in no cases did it have to be exchanged for a standard screw or other device. We removed the Kirschner wire, tested finger convergence to confirm correct rotation, and closed the skin. We verified positioning of the SCRU 2 and the joint using fluoroscopy at the end of the procedure, and postoperative x-rays were obtained the following day. We initiated mobilization of the PIP and metacarpophalangeal joints 5 days after surgery. A fabric compressive sleeve was applied continuously to the DIP joint for 4 to 8 weeks.

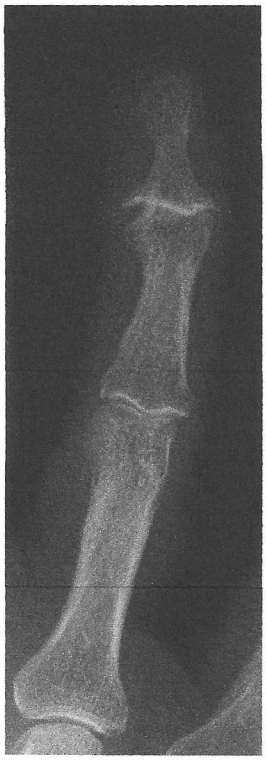

FIGURE 2: Preoperative x-ray showing advanced degenerative osteoarthritis of the DIP joint of the ring finger.

All patients received x-ray evaluation at 3 to 6 weeks after surgery. In June 2010, the authors reviewed and evaluated all patients. We performed radiographs, recorded the VAS, and asked patients whether they were not satisfied, satisfied, or fully satisfied. Nonunion was defined as no evidence of bone fusion at more than 6 months after surgery.

RESULTS

The mean follow-up period was 26 months (range, 7–67 mo). Postoperative x-rays at 3 to 6 weeks showed that implant position and joint alignment remained sta-

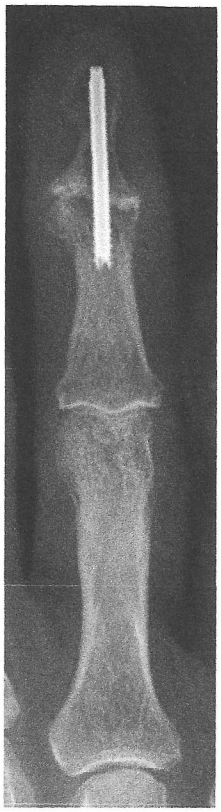

FIGURE 3: Postoperative (3 wk) x-ray of the same finger as in Figure 2 showing the screw correctly placed and good bone coaptation.

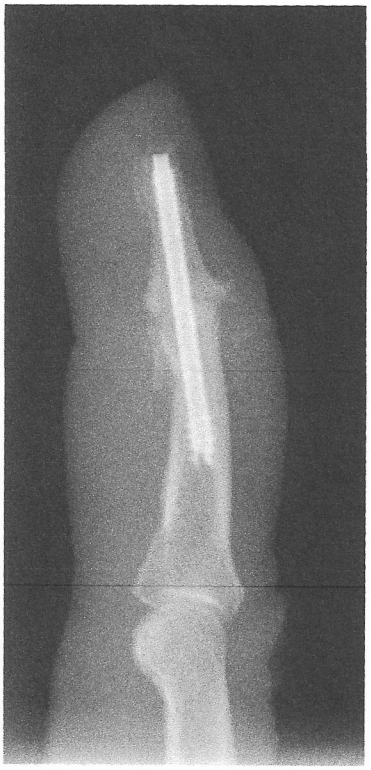

FIGURE 4: Postoperative (3 wk) x-ray of another case showing good bone coaptation. There is no dorsal cortical violation or nailbed violation. The hardware is correctly aligned but extends slightly proximal to the metaphysis of the middle phalanx.

ble in all cases. Figures 2 through 4 show a representative example.

The preoperative VAS averaged 6.2, compared with the postoperative average of 1.1. We noted no nonunion, malunion, nail dystrophy, hardware malpositioning, dorsal cortical violation, pseudarthrosis, or infection on physical examination or at x-ray follow-up. Union was achieved in all digits. We observed no quadriga effect or impairment of motion in the adjacent digits. In 89 of 102 cases, patients were fully satisfied; in 9 cases they were satisfied, and in 4 cases they were not satisfied. Four complications occurred in these 4 cases: 2 of distally prominent hardware, 1 of unresponsive complex regional pain syndrome type 1, and 1 of painful bony callus of the fused DIP joint. Each of these cases required secondary surgery with screw removal. Satisfactory pain relief was achieved at latest follow-up, 6 to 12 months after the secondary surgery. No other patient required screw removal.

DISCUSSION

Distal interphalangeal joint arthrodesis has been reported to have high failure and complication rates, although there is a lack of large and homogeneous series in the literature. Stern and Fulton[6] compared Kirschner wire, cerclage wire, and Herbert screw procedures in 181 cases and found overall 20% major complications (nonunion, malunion, or infection) and 16% minor complications (skin necrosis, cold intolerance, PIP joint stiffness, paresthesias, superficial wound infection, or prominent hardware). In the same series, a correlation was found between infections and the use of Kirschner wires. Nonunion occurred in 12% of cases overall. Successful union appeared to depend on the amount and condition of bone stock. For posttraumatic cases, they reported 22% nonunion.[6] Another study reported a 38% rate of nonunion for posttraumatic arthritis.[10]

Compression has been a key point in the evolution of hardware for arthrodesis, improvement of union rates, time to union, and time to return to work.[2,11] Several studies have reported the results of compression screw techniques, ranging from 0% to 15% nonunion and from 14% to 44% overall complications (Table 1).[2,4,6,12,13] The oblique placement of an AO lag screw has been reported to result in nonunion in 4% of cases

TABLE 1. Distal Interphalangeal Joint Arthroplasty by Compression Screws: Comparison With Several Studies

First Author, Year of Publication	Technique or Device	Digits (n)	Mean Follow-up (mo)	Union Rate (%)	Overall Complications (%)
Stern, 1992	Herbert screw	27	72	89	19 (major) and 44 (minor)
El Hadidi, 2003	Herbert screw	15	48	93	33
Lamas Gómez, 2003	Herbert screw	20	25	95	15
Brutus, 2006	Mini-Acutrak screw	27	7	85	37
Olivier, 2008	Compact screw	28	24	100	14
Current series	Arex SCRU 2 screw	102	26	100	4

at 8 weeks' mean follow-up.[14] We found a low complication rate in our series, although direct comparisons of this series with the referenced reports must be interpreted with some caution, because we excluded posttraumatic, rheumatoid, and revision cases in our study. This exclusion was done to provide a more uniform population, but at the cost of limiting generalizability and potentially biasing results compared with less selective series.

Indeed, compression screws have improved biomechanical strength compared with tension-band wires.[5] These characteristics provide bone coaptation and stability even before osseous fusion.[9]

The small-diameter distal part of SCRU 2 seems to fit better into the distal phalanx than a Herbert screw, minimizing the risks of nail dystrophy or skin necrosis, which were reported in 11% of cases treated with the mini-Acutrak screw[2] and 15% after Herbert screw placement.[6]

A learning curve is associated with this technique. In a previous series of patients (12 patients and 19 surgeries) operated on in our institution, 1 case of infection and 7 cases of hardware malpositioning required removal of the screw.[9] We decided to exclude these cases from the present series because different surgeons with different levels of experience had been involved. However, those results showed that the wire should be carefully placed, centered within the medullary cavity of the middle phalanx, not too close to the nail and well aligned with the digit axis.

The use of SCRU 2 requires the DIP joint to be fused in a neutral position to ensure intramedullary placement of the screw. The extended position is typically cosmetically acceptable but may interfere with grip, particularly in the ulnar digits.[7,8] Fluoroscopy is mandatory to ensure appropriate monitoring of the procedure. The screw should not extend proximal to the distal metaphysis of the middle phalanx, because in degenerative osteoarthritis implant arthroplasty of the PIP joint may be required subsequently.[8] In our view, this hardware is not suitable for use in the thumb because the screw should extend to the distal diaphysis of the proximal phalanx, but the intramedullary cavity of the proximal phalanx is too wide to ensure proximal stability of the screw.

The objectives of DIP joint arthrodesis are pain relief, early fusion, stability, functional restoration, and aesthetic appearance.[10] Nonunion and malunion are generally identified with the presence of a radiolucent line on radiographs. We believe that after a minimum 6-month follow-up, satisfactory retrospective evaluation can be performed. Our procedure seems to be safe and effective in cases of degenerative osteoarthritis and has a low complication rate.

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