Arthrodesis of small joints of the hand using cerclage and a single K wire

Sean B Rice BA(Hons) MSc, Achilleas Thoma MD FRCSC FACS
Department of Surgery, Division of Plastic and Reconstructive Surgery, St Joseph's Hospital, McMaster University, Hamilton, Ontario

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Arthrodesis for small joints of the hand is a well established technique for the treatment of joint instability, deformity and pain. A technique for compression arthrodesis in small joints of the hand utilizing both Kirschner wire and cerclage is reviewed. The results of a retrospective series of 44 small joint arthrodesis in 33 patients are presented. Indications for arthrodesis were trauma (28.3%), rheumatoid arthritis (30.5%), osteoarthritis (14.7%) and traumatic arthritis (26.5%). Patient age ranged from 18 to 73 years, and 38% were male. Joint fusion as determined by radiography occurred in 41 of 44 cases, representing a 93% success rate, comparable with that cited in the literature. Complications included nonunion in three cases and infection in two cases, leading to eventual amputation. The present technique represents a simple, fast and effective method for small joint arthrodesis of the hand.

Key Words: *Arthrodesis, Hand, Joints, Surgery*

Arthrodèse des petites articulations de la main à l'aide de cerclage et de broche K simple

RÉSUMÉ : L'arthrodèse des petites articulations de la main est une technique répandue pour le traitement de l'instabilité articulaire, de la déformation et de la douleur. Une technique d'arthrodèse par compression des petites articulations de la main au moyen de la broche de Kirschner et du cerclage est passée en revue. Les résultats d'études rétrospectives de 44 arthrodèses des petites articulations chez 33 patients sont présentés ici. Les indications de l'arthrodèse ont été le traumatisme (28,3 %), la polyarthrite rhumatoïde (30,5 %), l'arthrose (14,7 %) et l'arthrite traumatique (26,5 %). L'âge des patients variait de 18 à 73 ans et 38 % étaient des hommes. La fusion articulaire déterminée par radiographie a été observée dans 41 cas sur 44, représentant un taux de succès de 93 % comparable à ce qui est cité dans la littérature. Les complications ont été la non-union dans trois cas, l'infection dans deux cas, entraînant l'amputation. La technique actuelle représente une méthode simple, rapide et efficace pour l'arthrodèse des petites articulations de la main.

Arthrodesis for small joints of the hand is a well established technique for an array of disorders from pain to instability. The goals of arthrodesis are to position the joint in the most functional angle and to achieve solid bony union in the shortest possible time, while maintaining maximal associated joint motion (1). To attain these goals a wide variety of techniques have been advocated: Herbert screw (2,3), lag screw (1), external fixation (4), tension band (5,6), sliding bone graft (7) and plate fixation (8). We present the results of a retrospective analysis of the senior author's experience using the technique of cerclage and a single Kirschner wire (K wire) for arthrodesis of small joints of the hand.

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Correspondence and reprints: Dr A Thoma, 200 James Street South, Suite #208, Hamilton, Ontario L8P 3A9. Telephone 905-523-0019, fax 905-523-0229, e-mail athoma@fhs.mcmaster.ca

PATIENTS AND METHODS

Charts were retrospectively reviewed for all small joint arthrodesis procedures of the hand performed by the senior author between 1985 and 1995. Forty-four small joint arthrodesis procedures were performed on 33 patients

TABLE 1
Outline of joints for arthrodesis

	Finger		Thumb	
Diagnosis	**PIP**	**DIP**	**MCP**	**IP**
Trauma	4	6	2	1
Rheumatoid arthritis	5	3	1	5
Osteoarthritis	0	7	0	0
Traumatic arthritis	0	5	4	1

DIP Distal interphalangeal joint; IP Interphalangeal joint; MCP Metacarpal-phalangeal joint; PIP Proximal interphalangeal joint

TABLE 2
Outline of patient demographics

Diagnosis	% patients	Age (years)	Sex (male:female)
Trauma	28.3	35.1 (18-71)	7:2
Rheumatoid arthritis	30.5	60.6 (52-70)	3:8
Osteoarthritis	14.7	64.75 (63-66)	0:4
Traumatic arthritis	26.5	47.1 (35-73)	7:2

(Table 1). Indications for operative fixation were trauma (28.3%), rheumatoid arthritis (30.5%), osteoarthritis (14.7%) and traumatic arthritis (26.5%). Patient age ranged from 18 to 73 years, and 62% were female (Table 2). Time to joint fusion was determined from reviewing radiologists' notes.

OPERATIVE TECHNIQUE

The more proximal joints were exposed through a dorsal longitudinal incision, while exposure of the distal joint was through a dorsal Y-shaped incision, with particular attention paid to avoiding injury to the nail matrix. The extensor tendon as well as the capsule were incised in the midline over the metacarpal-phalangeal and proximal interphalangeal joint (PIP) joints, while in the distal interphalangeal (DIP) and interphalangeal (IP) joints, the extensor tendons were transected perpendicular to their orientation to expose the joint. Osteotomy was performed on the joint surface with an oscillating saw at a desired angle of about 30° flexion for PIP joints and 0° flexion for the IP and DIP joints. Using a K wire driver, two holes were made transversely on either side of the osteotomies. A 24 gauge wire was passed through the loop. A 0.035 gauge K wire was then passed in a retrograde fashion either obliquely across the more proximal joints or longitudinally across the DIP and IP joints. The cerclage wire was then partially tightened. Next, the K wire was countersunk across the joint. At this point, the cerclage interosseous wire was tightened to its limit. The K wire was then cut short and allowed to migrate under the skin to avoid later pin tract irritation and/or infection (Figure 1). The joint capsule, followed by the extensor tendon, was then re-approximated. Postoperatively, the hand was protected in a plaster splint for four weeks. The K wire was removed under local anesthesia at six weeks.

Figure 1) *Radiographic depiction of the surgical technique*

RESULTS

Results are presented in Table 3. Joint fusion occurred in 41 of 44 cases, representing a 93% success rate. Joint fusion, as determined by independent radiologists, occurred at 11.4 weeks on average (range seven to 30 weeks). Time to healing was significantly skewed by the osteoarthritic subgroup, and, in particular, one patient who underwent multiple joint arthrodeses. Failures in the trauma group consisted of one nonunion and one infection leading to an eventual amputation. Both of these were mangled hand injuries requiring either skin grafting or flaps. The patient in the rheumatoid arthritis subgroup was elderly with multiple concurrent medical problems including renal dialysis for the past four years. One patient with osteoarthritis developed a painless fibrous union

TABLE 3
Results for joint arthrodesis

Diagnosis	Union (weeks)	Non-union	Infection	Amputation
Trauma	10.1	1	1	1
Rheumatoid arthritis	11.9	1	0	0
Osteoarthritis	17.1	1	0	0
Traumatic arthritis	9.7	0	1	1

TABLE 4
Cost comparison for cerclage and Kirschner wire (K wire) with AO plate fixation

AO plate (Synthes)	K wire and cerclage
Plate five-hole $36.10	Size 12 K wire $3.04
Plate four-hole $34.20	Cerclage wire $3.70
Plate screws $7.45 (each)	
Total: $73.35	**Total:** $6.74

and was reluctant to have further corrective surgery. Within the traumatic arthritis group, a patient with scleroderma developed skin ulcerations secondary to K wire irritation, which lead to osteomyelitis and eventual amputation.

DISCUSSION

There are a wide variety of techniques in the literature for arthrodesis of small joints of the hand, with fusion rates ranging from 80% to 100% (1-11). Most of these studies have concentrated on one causative factor such as osteoarthritis. In the current review, we examined the effectiveness of a technique utilizing both K wire and cerclage across a range of conditions contributing to joint destruction. Nonunion occurred in three of 44 cases, and infection leading to eventual amputation occurred in a further two cases. This represents a 93% success rate, comparable with that quoted in the current literature. Time to bony fusion as determined radiographically in the present study was slightly longer than averages currently cited. However, because ours was a retrospective study, the time between surgical fixation and return for radiographic analysis could not be controlled. Therefore, the average time to bony union of 11.4 weeks is not an exact figure.

Following surgical fixation, the hand was immobilized for four weeks, with K wire removal at the six-week follow-up. Those advocating external fixation (4,8) argue that only the joint in question is immobilized, thus preventing associated joint stiffness. However, in the current review associated joint stiffness did not pose a problem. Techniques similar to the one described have used two K wires to provide rotational stability (9,11). This is a theoretically sound principle, yet we did not find rotation to be a problem with this method.

Removal of the hardware due to skin irritation is a common problem with most internal fixation techniques. In a previous study using cerclage, up to 70% of cerclage wires had to be removed due to skin irritation (9). In the present study, the cerclage wire had to be removed in only two cases. We found that burying the end of the exposed cerclage wire into bone significantly reduced skin irritation and avoided interference with the extensor tendon mechanism.

In a biomechanical comparison of arthrodesis techniques, Stokel et al (12) found that tension band and cerclage wire techniques offered the strongest fixation results. With numerous techniques available for arthrodesis, and each having a similar success rate, a cost comparison among various surgical procedures is in order. A cost comparison for hardware between the operative techniques of AO plate fixation (Synthes) and cerclage plus K wire is outlined in Table 4. There is an almost 11-fold increase in cost for plate fixation versus K wire plus cerclage.

The surgical technique using a single K wire and cerclage described in this study provides a simple, reliable and cost-effective technique for small joint arthrodesis of the hand.

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