

Wrist Arthrodesis Using K Wires

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Abstract

Background Wrist arthrodesis to provide a stable wrist can be done by multiple techniques for various indications. In this article, we aim to describe the technique and outcomes of wrist arthrodesis using K wires, which have the merits of being easier to practice, use minimal hardware and without any donor site morbidity, and provide a stable fixation.

Method Sixteen patients operated from May 2019 to March 2021 in the department of plastic surgery were included in the study. Surgery was done as a day care procedure under local anesthesia. Wrist and first CMC joint fixation was done using K wires, and splintage was given. Patients were subsequently followed up, and splintage was removed based on radiological evidence of bony fusion. Any complications if there were noted and managed.

Result All wrists were fused. The K wires were removed in about 44.5 days (6–7 weeks) and the splintage by 8 to 10 weeks (mean 8.8 weeks). Pin tract infections and subcutaneous pin migration were seen in 12.5% and 18.75% of our patients, respectively, which were conservatively managed.

Conclusion Wrist arthrodesis with dorsal plate fixation is a well-established technique with many advantages but as many complications as well. Fixation with wires is an alternative with lesser complications and comparable results.

Keywords

- ▶ arthrodesis
- ▶ implant
- ▶ K-wire
- ▶ wrist

Introduction

Wrist arthrodesis, also known as wrist fusion, is a surgical procedure to immobilize the wrist joint. First described in the early 1900s, the goal of wrist arthrodesis is to provide the patient with a stable wrist, while sacrificing wrist motion.¹ Various techniques of fixation have been described in the literature since its origin, ranging from intramedullary rods and Steinmann pins to internal fixation using plates and screws to external fixators as well.¹ Among these, dorsal plate fixation has become the preferred technique at most of the centers and successful results with dorsal plating with or without local bone graft have been

reported routinely.² While internal fixation techniques provide good union, they are also associated with complications. In this article, we aim to describe the technique and outcomes of wrist arthrodesis using K wires, which have the merits of being easier to practice, use minimal hardware, and without any donor site morbidity and provide a stable fixation.

Materials and Methods

This is a study of patients who had undergone wrist arthrodesis with fixation done using Kirschner wires. Patients included in the study were of brachial plexus injury, multiple

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nerve injuries, and a select case of post burn contracture. Patients who had fixation using other means were excluded from the study. Wrist and first CMC joint arthrodesis was performed to provide a stable wrist joint and a useful position of the thumb.

Technique

The surgery is performed as a day care procedure. After confirming the side, the patient is taken to the operative table and under all aseptic precautions, brachial plexus block is administered and the procedure is performed under tourniquet control. A curvilinear incision is made centered over the wrist joint, starting proximal to the joint and curving toward the first carpometacarpal joint (► **Fig. 1**). Radial and ulnar skin flaps are raised and extensor retinaculum is reached. Extensor retinaculum is incised between third and fourth compartments and joint capsule is reached. The joint capsule is incised and radial and ulnar flaps of the capsule are raised. Wrist is flexed to expose the articular surfaces of radius, scaphoid, lunate and trapezium (► **Fig. 2**). The articular surfaces of these bones are excised. Similarly, articular surfaces of the intercarpal joint and first carpometacarpal joint are excised (► **Figs. 3 and 4**). The excised bone fragments are used as bone graft and interposed between the radius and proximal carpal rows. Wrist is positioned in 15 to 20 degree extension and slight ulnar deviation and two 2.5 mm K-wires are passed through second and third metacarpals and carpals to the radius (► **Fig. 5**). The articular



Fig. 2 Exposed wrist joint.



Fig. 1 Incision marking.

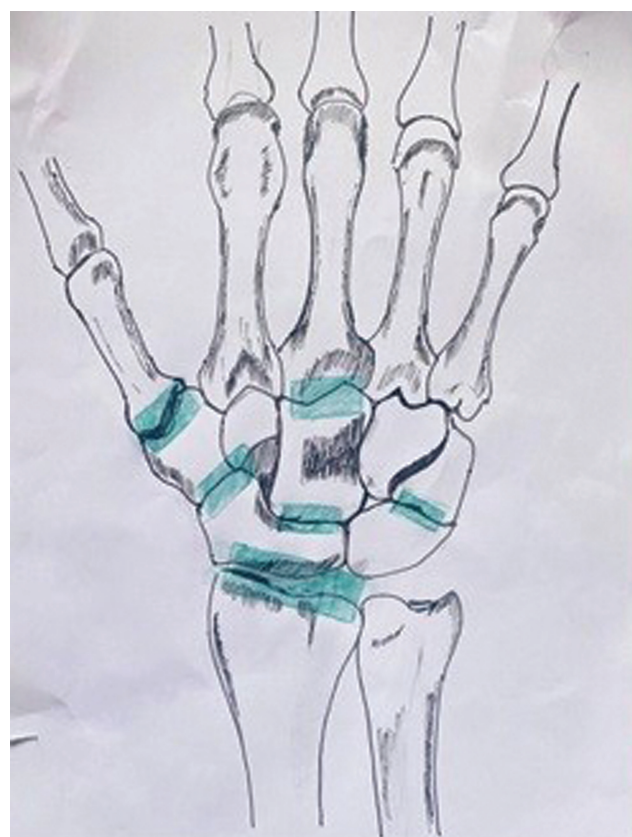


Fig. 3 Line diagram showing joints addressed.



Fig. 4 Intraoperative image of articular surfaces.

surfaces of the first carpometacarpal (CMC) joint are also denuded. The thumb is placed in 20 degrees abduction and fixed using another K wire. Stable fixation is ensured and the wound is closed in layers starting from the joint capsule and extensor retinaculum and then the skin. Following dressing, splintage is given using POP slap maintaining wrist in fixation while fingers and MCP joints are free. Patient's first dressing is done on day 2 and subsequently on alternate days. The sutures are removed on the 10th day and the K wires are removed at 6 weeks. Splintage is continued for another 2 to 4 weeks depending on radiological evidence of bony fusion.

Results

Sixteen patients were operated from May 2019 to March 2021 in the department of plastic surgery (►Table 1). All patients attained bony union by the end of three months. There were three complications, one patient who had wound site hematoma and two who had pin tract infection with seropurulent discharge. None of the patients required a secondary procedure. One patient had a subcutaneous migration of K wires, which were, however, removed by giving stab incision under local anesthesia. All patients tolerated the procedure and splintage well. K wires were kept for a mean duration of 44.5 days (6–7 weeks) and were removed on OPD basis (►Fig. 6). X-Rays were done to confirm bony union (►Fig. 7) and subsequently the splintage was removed 8 to 10 weeks postoperatively (mean 8.8 weeks).



Fig. 5 Arthrodesis in 20 degree extension.

Discussion

Complete or total wrist arthrodesis is a well-established reconstructive surgical procedure that provides pain relief in post inflammatory, degenerative, and post-traumatic conditions and good wrist stability with satisfactory function.¹ It stabilizes the wrist and allows the hand to be kept in a useful position. Most authors recommend wrist arthrodesis, through a dorsal approach, between the radius and the third metacarpal, in a dorsiflexion position of 20 degrees as this position offers better finger function, preserving grip and pinch strength.³ When both hands are involved, the suggested fusion position is 5 to 10 degrees of flexion in the nondominant hand and slight extension in the dominant hand.³ A concomitant first carpometacarpal joint and interphalangeal joint was advised by Doi et al in cases of brachial plexus injuries. This brought the thumb in a more functional position.⁴ Wrist arthrodesis is done to provide maximal biomechanical advantage of tenodesis or transferred gracilis muscle by obtaining improved finger/thumb flexion through stable joints.⁵

First described by Ely² in 1910, wrist arthrodesis can be performed in a lot of ways. Earliest techniques relied only on the use of cancellous and cortico-cancellous bone graft stabilization, but they required long term immobilizations and were associated with high rate of pseudoarthrosis and significant donor site morbidity.² In 1965, Clayton described the insertion of a single 3/32-inch diameter Steinmann pin down the third metacarpal shaft into the medullary canal of

Table 1 Demographics of patients

S. No.	Age	Sex	Diagnosis	Time to K wire removal (days)	Splint duration (weeks)	Complications
1	30	M	BPI	42	8	None
2	33	M	BPI	42	8	Subcutaneous pin migration
3	31	M	PBC	48	10	None
4	18	F	MIXED NERVE INJURY	43	8	None
5	24	M	BPI	42	8	None
6	21	M	BPI	44	9	None
7	50	M	BPI	43	8	Pin tract infection
8	19	M	BPI	49	10	None
9	33	M	BPI	45	9	Subcutaneous pin migration
10	32	M	BPI	46	9	None
11	25	M	BPI	44	9	None
12	29	M	BPI	43	8	Hematoma
13	20	M	BPI	44	9	None
14	27	M	BPI	48	10	Pin tract infection
15	25	M	BPI	47	10	None
16	21	M	BPI	42	8	Subcutaneous pin migration

**Fig. 6** Post operative clinical images.

the radius for achieving wrist arthrodesis in patients with rheumatoid arthritis.⁶ There are several acceptable methods of pin or rod placement such as the single-Steinmann-pin technique of Millender and Nalebuff⁷ and the dual-rod technique of Feldon.⁸ In all these techniques, postoperatively, the wrist is immobilized in a short arm cast for 6 weeks and is discontinued based on radiographic confirmation of successful arthrodesis.

In 1972, Meuli⁹ performed a wrist arthrodesis with a dorsal plate applied from the second metacarpal to the

**Fig. 7** Xray image at 8 weeks postoperatively.

radius. Subsequently, with the advent of plate fixation, the internal fixation techniques in wrist arthrodesis shifted toward compression-plate fixation with a local or an iliac crest bone graft. Using a dorsal plate for wrist arthrodesis was advocated as a method of achieving immediate rigid fixation that obviated the need for postoperative cast immobilization and reduced the incidence of pseudarthrosis.² This, however, gave rise to complications such as extensor tendon adhesions, plate tenderness, implant exposure, and infection.

Minimal fixation using K wires is an alternative to the plates and pins. This reduces the implant used and hence is a

simpler alternative. It is simple, requires lesser dissection and is cheaper for the patients, especially in a resource-strained setting. The tradeoff is that the pins are percutaneous, increasing the risk of pin tract infections and subcutaneous pin migration as seen in 12.5% and 18.75% of our patients, respectively. Burying the pins subcutaneously can be done to reduce the incidence of pin tract infections. It does not hamper the formation of bony ankylosis as seen by Brunelli et al, who achieved complete consolidation in all but one of 31 patients with paralytic hands.¹⁰

Wood et al¹¹ also performed wrist arthrodesis in 17 patients using dorsal radial bone graft with K wires and tension band wiring and achieved good union in all patients. The average time to removal of cast immobilization and bony union was 2.36 months. They emphasized that whatever means of internal fixation is selected, it should provide stability to the fusion site with a minimum of operative time, additional dissection, and retained hardware. Furthermore, because the desired position of wrist arthrodesis may vary from one wrist to the next, the ideal means of internal fixation should be applicable to a range of positions of the wrist in extension or slight flexion.

Another technique with K wires was described by Minami et al¹² in 20 patients using “bowed” crossed K wires, whereby they achieved complete arthrodesis in all patients. They removed the K wires at 9.3 weeks on average (range, 5–12 weeks) after operation and used cast immobilization for 10.9 weeks on average (range, 7–12 weeks). Bone union occurred at an average of 12 weeks (range, 8–14 weeks) in all their cases. In our experience, we have removed the wires in about 44.5 days (6-7 weeks) and the splintage by 8 to 10 weeks (mean 8.8 weeks).

In our experience, we observed that use of K wires for fixation is an easier, less time consuming, and technically simpler technique, which require lesser dissection and can be performed exclusively by plastic surgeons. It is also associated with shorter duration of surgery, lesser implant and lesser complications, and is hence more economical for the patient. The K wire and Steinmann pins are associated with lesser implant-related complications and their removal is also an easier and simpler procedure as compared to plate removal. Also, the addition of arthrodesis of the first carpometacarpal joint places the thumb in an abducted and more functional position and is an added advantage. Also less surgical exposure to the extensor tendon area minimizes scar adhesion. This technique does require splinting for a

longer duration of time ranging from 8 to 10 weeks as compared to 6 to 8 weeks with intramedullary rods and 4 to 6 weeks with dorsal plate fixation but the overall morbidity with the procedure is less.

Conclusion

Wrist arthrodesis with dorsal plate fixation is a well-established technique with many advantages but as many complications as well. Fixation with wires is an alternative with lesser complications and comparable results.

Conflict of Interest

None declared.

References

- Hayden RJ, Jebson PJ. Wrist arthrodesis. *Hand Clin* 2005;21(04):631–640
- Jebson PJ, Adams BD. Wrist arthrodesis: review of current techniques. *J Am Acad Orthop Surg* 2001;9(01):53–60
- Terzis JK, Barmptsioti A. Wrist fusion in posttraumatic brachial plexus palsy. *Plast Reconstr Surg* 2009;124(06):2027–2039
- Doi K, Muramatsu K, Hattori Y, et al. Restoration of prehension with the double free muscle technique following complete avulsion of the brachial plexus. Indications and long-term results. *J Bone Joint Surg Am* 2000;82(05):652–666
- Giuffre JL, Bishop AT, Spinner RJ, Kircher MF, Shin AY. Wrist, first carpometacarpal joint, and thumb interphalangeal joint arthrodesis in patients with brachial plexus injuries. *J Hand Surg Am* 2012;37(12):2557–63.e1
- Clayton ML. Surgical treatment at the wrist in rheumatoid arthritis : a review of thirty-seven patients. *J Bone Joint Surg Am* 1965;47:741–750
- Millender LH, Nalebuff EA. Arthrodesis of the rheumatoid wrist. An evaluation of sixty patients and a description of a different surgical technique. *J Bone Joint Surg Am* 1973;55(05):1026–1034
- Millender LH, Nalebuff EA, Feldon PG. Rheumatoid arthritis. In Green DP, ed. *Operative Hand Surgery*. New York: Churchill Livingstone; 1982;2:1161–1262
- Meuli HC. Reconstructive surgery of the wrist joint. *Hand* 1972;4(01):88–90
- Brunelli G, Vigasio A, Battiston B, Brunelli F, Guizzi P. L'arthrodèse du poignet dans les paralysies de la main (technique personnelle). [Arthrodesis of the wrist in cases of hand paralysis (personal technique)] *Ann Chir Main Memb Super* 1990;9(01):47–53, discussion 54
- Wood MB. Wrist arthrodesis using dorsal radial bone graft. *J Hand Surg Am* 1987;12(02):208–212
- Minami A, Kato H, Iwasaki N. Total wrist arthrodesis using bowed crossed K-wires. *J Hand Surg [Br]* 1999;24(04):410–415