

C A S E R E P O R T

Open release of stiff wrist: a medium to long term case series and literature review

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Abstract. *Background and aim of the work:* The authors reported a personal case series of open release of stiff wrists performed after previous internal osteosynthesis of distal radius fractures. *Methods:* From a series of 16 patients operated by a single surgeon, 12 were evaluated at a mean 7.1 years follow-up (range 2.25 to 19 years), while 4 were lost at follow-up. The ROM in flexion-extension achieved at the final control was measured with a goniometer and compared to that recorded before surgery. The PRWHE questionnaire was administered at the last follow-up. *Results:* The mean flexion improved from 25.5° to 42.3° and the extension from 15.75° to 43°. The mean PRWHE value was 32.9. *Conclusions:* Although arthroscopic release is increasingly used in clinical practice for its minimal invasiveness and warranty of fast recovery, open arthrolysis in post-traumatic stiff wrists appears to be an effective procedure, adaptable to all types of stiffness, that lets get good long lasting functional results. (www.actabiomedica.it)

Key words: wrist open arthrolysis, wrist stiffness, wrist osteosynthesis

Introduction

Over the last two decades new techniques and surgical instrumentations have been developed and surgical treatment of distal radius fractures gained popularity becoming the treatment of choice for these common injuries. The aim of surgical treatment is to achieve a stable osteosynthesis allowing early mobilization and a faster recovery to daily life and working activities.

The functional range of motion (ROM) of the wrist has been object of several studies over the years. In 1985, Palmer was the first author who established this value reporting that about 35° in flexion-extension were necessary in order to perform the activities of daily living (ADL). (1)

He observed that extension (30°) was more important than flexion (5°), and that radial and ulnar deviation should be 10° and 15° respectively.

Afterwards, these values were increased by Nelson (28° flexion, 37° extension, 12° radial deviation, 27° ulnar deviation) and by Ryu (40° flexion, 40° extension, 10° radial deviation, 30° ulnar deviation). (2,3)

According to Saffar et al. wrist stiffness can be differentiated as intrinsic or extrinsic, even if in most cases both types (mixed) are present. (4)

Intrinsic stiffness includes all the cases in which exists an alteration of the joint morphology consequent to articular fracture, while extrinsic stiffness involves cases in which the joint is initially preserved.

Post traumatic and post-operative stiffness of the wrist may have a significant impact on the daily and working life. Despite this, only few studies published in the literature were focused on the treatment of wrist stiffness. (5-13)

Nevertheless in these studies stiffness from different origin were included (arisen after prolonged

immobilization in distal radius fractures, secondary to many types of intervention such proximal row carpectomy, excision of dorsal cysts and different types of osteosynthesis after wrist fractures, or burns), treated mostly by means of arthroscopy or plastic surgery techniques as appropriate, and were not selectively focused on homogeneous groups of patients that presented stiffness derived from internal osteosynthesis of distal radius fractures.

The aim of our retrospective study is the evaluation of functional recovery and residual disability in a clinical series of patients operated on in our Institution with open wrist arthrolysis for joint stiffness (intrinsic and/or extrinsic) secondary to surgical treatment of articular distal radius fractures.

We also reviewed the literature about this topic analyzing our results and those previously reported in clinical studies.

Materials and Methods

From 1996 to 2014 we treated 16 consecutive patients affected by post traumatic stiffness who previously underwent to osteosynthesis for articular distal radius fractures in our Department. Among them, 13 were males and 3 were females. The mean age at the time of the surgical procedure was 44.4 years (range 28 to 69 years). The mean interval from the first intervention (open reduction and internal fixation with volar plate of distal radius fracture and open surgical release) was 2.3 years (range 10 months to 4 years). According to Fernandez classification the fractures were initially classified in: 2 type II, 5 type III, 3 type IV, 2 type V. (14) The stiffness was classified as intrinsic in 5 cases and mixed in 11 cases. The indication for surgery was a subjective limitation in daily and working activities with a severe reduction of the ROM according to stiffness values proposed by Ryu (less than 40° in flexion and extension). (3)

Surgical Technique

Before the intervention all the patients were evaluated with x-Ray and CT-scan in order to detect the eventual mobilization of internal devices and signs of arthritis.

All the interventions were performed by the same surgeon (N.D.R.).

The surgical approach depended on the type and localization of the stiffness. As a general rule, a radio-carpal capsulotomy was performed, either dorsal and volar if necessary, by means of a blunt subperiosteal dissection, preserving the peristiloideal and ulno-carpal regions and proceeding to the removal of all intra-articular fibrous tissue. Sometimes the removal of bone spurs was necessary, as well as tangential resection of the radial rim and radial stiloideotomy, in order to restore an adequate curvature and reduce the radio-carpal conflict. In case of radial shortening with relative ulnar prominence, a resection of the distal portion of the ulnar head (Wafer procedure) was performed.

After surgery, all the patients started a specific early rehabilitation protocol. This included active and passive exercises program aimed to restore a functional joint mobility. Analgesic drugs were prescribed, and regular clinical check were done during this phase in rehabilitation outpatient clinic. The length of rehabilitation program ranged was 12 weeks.

Postoperative Controls

During the follow-up clinical evaluation was performed by two independent surgeons in the same day. In case of disagree, a conjoined evaluation was performed in the same day. The ROM in flexion-extension was evaluated by means of a goniometer and compared with the same measurements taken just before surgery.

The Italian version of the patient-rated wrist/hand evaluation (PRWHE) questionnaire was administered. The patient-rated wrist evaluation (PRWE) questionnaire is a 15-item questionnaire designed to measure wrist pain and disability in activities of daily living. (15) The Italian version of the PRWHE has equivalent evaluation capacities to the original English version and is a reliable functional outcome measurement instrument for wrist and hand disorders. (16)

Results

4 patients were lost to follow-up. They lived elsewhere and it was not possible to trace them by telephone and mail. 12 patients were able to complete clinical investigation for this study. The mean duration of follow-up was 7.1 years (range 2.25 to 19 years).

Among the 12 patients examined in this research, the preoperative mean flexion was 25° (range 6 to 40) and the mean extension was 15.75 (range -30 to 45).

At the final control we reported a mean flexion of 42.3° (range 20 to 70) and a mean extension of 43° (range 0 to 64). The mean PRWHE score at the final FU was 32.9 (range 3 to 63.5). The demographics of patients and results of treatment of every patient of our clinical series were reported in table 1 and 2. No complications were observed in the early post-operative period and later. No recurrence of stiffness

occurred, and the results preserved over the time. 8 patients returned to their previous work activities, 2 patients changed job but still remained manual workers, 1 heavy worker patient lost his job and 1 retired.

Discussion

Wrist stiffness can be a severe complication after surgical treatment of distal radius fractures. Conventionally, stiffness can be differentiated as intrinsic,

Table 1. Case series

Patients	Age / Sex	Fernandez classification	Intrinsic	Mixed	Follow-up years
1	40	II	x		6
2	28	III	x		2.25
3	53	III		x	6
4	57	V		x	6
5	30	IV		x	7
6	40	IV		x	19
7	52	III		x	6
8	30	IV		x	6
9	36	II	x		9
10	44	II		x	6
11	69	V		x	6
12	48	III		x	6

Table 2. Results

Patients	ROM°				PRWHE	Job	
	Pre		Post			Pre	Post
	Flex	Ext	Flex	Ext			
1	20	40	32	64	60	computer technician	
2	40	-30	42	20	37.5	factory worker	unemployed
3	6	-6	45	0	3	farmer	
4	40	45	54	52	20.5	employee	
5	30	15	60	30	17	boiler technician	warehouse worker
6	40	30	30	60	63.5	factory worker	gardener
7	15	20	45	50	21	business man	
8	15	15	20	50	39.5	unemployed	
9	30	20	45	50	23	employee	
10	10	5	25	35	53	chef	
11	40	10	70	60	18.5	employee	retired
12	20	25	40	45	38.5	housewife	

extrinsic and mixed types. Intrinsic stiffness includes all the cases in which exists an alteration of the joint morphology consequent to articular fractures. Ligament lacerations or avulsions can be associated in high energy trauma. Intra-articular hematoma can lead to fibrous scar tissue formation, and prolonged immobilization can induce retraction of joint capsule and ligaments components. Moreover, inflammatory arthropathies, infections, congenital malformations, and other pathological conditions can favor the onset of joint stiffness. Extrinsic stiffness includes cases in which the joint is initially preserved. It can be consequence of malunited extra-articular fractures, ischemic muscular contractures, muscular and tendinous loss of substance, tendon adhesions, peripheral nerve injuries, spastic contractures, and skin injuries due to burns or scars. Moreover, complex regional pain syndrome may occur limiting the movement and inducing a miostatic contracture with late modifications of muscle length and fibrosis. (4)

Our clinical series included 12 patients treated for wrist stiffness secondary to surgical treatment for distal radius fractures. No patient reported previous illness in clinical history favoring intrinsic stiffness. The clinical series was limited as for the total number of patients but homogenous as for initial diagnosis, methods of surgical treatment and rehabilitation program.

The results observed in our clinical investigation were favorable, with a significant increase of the ROM. Almost all the patients returned to their previous activities with no recurrence of stiffness.

Open release seemed to be a reliable technique allowing a complete removal of intra-articular fibrous tissue and adhesions, and a complete extra-articular release.

In the literature we found few studies focused on the treatment of post-traumatic wrist stiffness. Some of them were referred to arthroscopic techniques (7-9) and only one to open arthrolysis. (5).

The largest series of arthroscopic release after distal radius fractures was reported by Mathoulin, with 53 cases included in a personal series of over 1000 arthroscopies. Stiffness developed either after conservative and surgical treatment. With a mean 36-months follow-up the Author reported at the functional score 46 excellent and good results, 6 fair, and 1 poor because

of the onset of a complex regional pain syndrome (CRPS). The mean flexion obtained was 60° (range 45 to 90°) and the extension was 65° (range 55 to 85°) (9)

In another series of 47 arthroscopies reported by Luchetti, 36 were performed to treat wrist stiffness after distal radius fractures. These data were difficult to interpret because the Author did not specify how many patients originally underwent to internal osteosynthesis. Nonetheless, after a mean follow-up of 58 months ROM, strength and Mayo Wrist Score were significantly improved in the majority of the patients, with complete pain relief. (8)

In 2017 Kamal published a personal case series of 11 patients operated on with open arthrolysis for wrist stiffness after volar plating for distal radius fractures. After an open volar approach, tenolysis, volar capsulotomy and hardware removal were performed in all the patients. At a mean time of follow-up of 4.5 years, the ROM was significantly augmented in flexion-extension and pronation-supination in all cases. The mean DASH score improved by 36.2 points. Only the VAS did not significantly change at the final follow-up. (5)

These favorable data have been confirmed by our findings that showed an improved ROM and functional outcome at a mean follow-up of 7.1 years.

No studies reported in the literature compared arthroscopic and open wrist arthrolysis. Arthroscopic studies highlighted the advantages of minimal invasivity and versatility, but this technique can be applied only when intrinsic factors cause wrist stiffness. On the contrary, arthroscopy could be insufficient when extrinsic or mixed type of wrist stiffness must be approached. In this case a wide release of soft tissues surrounding wrist joint is often required with an open procedure.

Our study has several limitations. The number of patients involved in the study is small and prevented to obtain statistically significant results. An effective comparison with other series found in the literature was not possible because no studies investigating the same specific topic.

We did not have an arthroscopic control group in order to compare the results. The follow-up period differs greatly from one patient to another and this could be an important bias for obtaining comparable data. For this reason, we could not consider in all the

patients the influence of arthritic changes on daily life and work activities, that might occur in long-term follow-up.

Conclusions

Open arthrolysis of stiff wrist appears to be an effective procedure, with positive results which are maintained over time. Arthroscopy is certainly less invasive, allowing to approach and treat all the intra-articular causes of wrist stiffness in minimally traumatic manner. Nonetheless, the open surgery preserves its value, because in case of major complexity both articular and extra-articular structures of the wrist can be approached.

Even if our case series is limited and burdened by multiple bias, we think that our results supported the use of open arthrolysis in wrist stiffness after surgical treatment of distal radius fractures.

Further studies with larger clinical series and comparing open and arthroscopic procedures could be useful to plan the optimal treatment of these disabling traumatic sequelae.

Conflict of Interest: Each author declares that she or he has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

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