

Clinical evolution of workers with Fernández III distal radius fracture. Surgical and non-surgical non-complicated treatment

Evolución clínica de trabajadores con fractura de radio distal Fernández III. Tratamiento no complicado quirúrgico y no quirúrgico

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Abstract

Background: This fracture is a very frequent emergency. Surgical and non-surgical management are still controversial, such as functional impact. **Objective:** To compare clinical evolution of Fernandez III distal radius fractures, managed with surgically vs no surgical treatment, in a specialized hospital. **Method:** Comparative, observational, longitudinal study, released on workers with unilateral Fernandez III closed distal radius fractures, both sex, with evolution less than 5 days. Those patients with pathologies getting difficult in bone consolidation, and with several fractures were excluded. Those with incomplete information, complicated, and whom paste were modified after 5 days, and with bad reduction or stabilization fracture according to AO were eliminated. Mayo Functional Wrist Scale (EFMM) was applied at 3 and 6 months. Student-t test was applied. **Results:** 159 patients recruited, 34% females, 66% males. Medium age 40 years old. Surgical treatment 42.5% (plate 8.7%, external fixation 29%, external fixation and nails 8.7%). Non-surgical treatment 33%. Significant differences ($p \leq 0.05$): EFMM at 3 and 6 months; pain, grasp at 3 months; mobility at 6 months; total laboral inability days. **Conclusions:** Surgical treatment shows better functional results, especially pain and grasp at 3 months, mobility at 6 months, and faster returning to work.

Keywords: Fracture. Distal radius. Fernandez III. Treatment. Laboral inability.

Resumen

Antecedentes: Las fracturas de radio distal Fernández III (FRDF III) son una urgencia muy frecuente. Las indicaciones quirúrgicas y no quirúrgicas persisten controversiales, así como el impacto funcional. **Objetivo:** Comparar la evolución clínica de los trabajadores con FRDF III, con manejo quirúrgico frente a no quirúrgico, no complicados, en un hospital especializado. **Método:** Estudio comparativo, observacional y longitudinal en trabajadores con FRDF III unilateral cerrada, de ambos sexos, con evolución menor de 5 días. Se excluyeron pacientes con comorbilidad afectante de consolidación ósea y polifracturados. Se eliminaron aquellos con información incompleta, con complicaciones, con aparato de yeso modificado 5 días después de su colocación, con mala reducción-estabilización acorde a la AO. Se aplicó la Escala Funcional de Mayo para Muñeca (EFMM) a los 3 y 6 meses del tratamiento. Se utilizó la prueba t de Student. **Resultados:** 159 pacientes, 34% mujeres, 66% hombres. Edad promedio 40.18 años. Manejo quirúrgico 42,5% (placa 8.7%, fijador 29%, fijador + clavillo 8.7%); no quirúrgico 33%.

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Diferencias significativas ($p \leq 0.05$): EFMM 3 y 6 meses; a 3 meses: dolor, prensión; a 6 meses: movilidad; y días totales de incapacidad. Conclusiones: El tratamiento quirúrgico muestra mejores resultados funcionales, destacando el dolor y la prensión a 3 meses, y la movilidad a 6 meses, con reincorporación laboral en menos tiempo.

Palabras clave: Fractura. Radio distal. Fernández III. Tratamiento. Incapacidad laboral.

Introduction

Distal radius fracture is one of the most common fractures reported in international literature¹⁻⁴, and especially among the working population². Up to 640,000 cases are reported annually in the United States of America, with this type of fracture being the sixth most common. It predominates at ages from 40 to 60 years; in the pediatric and juvenile population the male gender prevails, and in the adult population, the female gender, and by 50 years of age, the female/male ratio becomes equal⁴⁻⁶.

There are multiple classifications, which is why two or more procedures can be found for treatment^{1,2,4}.

Regarding the fracture mechanism, the following biomechanical forms are considered^{3,7-9}.

- Axial load mechanism, on the radius distal articular aspect, load of indirect characteristics.
- Associated with hand on hyperextension, at between 40 and 90 degrees.

This translates into tension forces on the volar aspect and compression forces on the dorsal aspect.

The radiological projections useful for diagnosis are anteroposterior, lateral and oblique. Additional investigations, such as computed tomography and magnetic resonance imaging, show no difference for diagnosing these fractures^{1,10-12}.

Fernandez classification is based on the mechanism of injury rather than just on radiographic data, and evaluates bone and soft tissue (ligament) involvement, which modifies the prognosis³. It comprises five groups (Fig. 1).

General objectives of treatment focus on restoring articular congruency, as well as distal radius metaphysis-diaphysis axes. Therefore, the characteristics of the fracture path, instability of the line, associated lesions and patient functionality must be known^{4,7,11,13-15}.

In ligamentotaxis, traction and contraction are transmitted to the extrinsic ligaments of the radio-carpal and radio-ulnar joint and allow the fragments to be mobilized in order to be fixed later. The closed reduction technique is widely described in different reports; it includes pain management, reduction maneuvers, cast immobilization and radiographic control^{8,16,17}.

The purpose of our study was to analyze clinical evolution and work disability of working patients with Fernandez III distal radius fracture, managed without complications at the Traumatology and Orthopedics Hospital of Puebla (HTOP – *Hospital de Traumatología y Ortopedia de Puebla*), of the Mexican Institute of Social Security (IMSS – *Instituto Mexicano del Seguro Social*), for 6 months, using the Modified Mayo Wrist Score (MMWS).

Method

This work was approved by the Local Committee of Research and Health Research Ethics No. 2105 of the IMSS with registration code R-2017-2105-29. A comparative, observational, longitudinal study was carried out at IMSS HTOP. Patients with Fernández III fractures who signed the informed consent document, of both genders, workers, with a maximum evolution of 5 days from the fracture to the date of care, with unilateral, closed fracture, and management without complications were included. Patients with chronic degenerative diseases that affect bone consolidation (decompensated diabetes, chronic kidney disease, hypothyroidism, osteoporosis, osteopenia, rheumatoid arthritis) and polytraumatized patients were excluded. Patients who requested to be withdrawn from the study, those who did not complete the required information and those with vascular injury, peripheral nerve injury, infection, reoperation, etc., were eliminated, as well as patients in whom the plaster cast was modified 5 days of after its placement, and those in whom reduction and stabilization would have been poor according to the criteria established by the AO.

All patients were evaluated one month after treatment, when it was possible to refer them to the rehabilitation protocol for mobilization to be started in those who had proper consolidation (average consolidation of any fracture is 30 days), with the purpose to rescue ranges of motion, reduce inflammation and subsequently strength recovery. They had a follow-up appointment at 2 months to verify and reinforce compliance with the rehabilitation program.

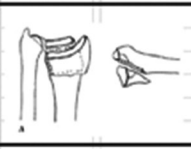
I		Bending fracture •Two forces are transmitted, one radial axial and another compressive given by the hand in extension (scaphoid-ulnar complex impaction). •The bone suffers tensile forces on dorsal aspect and palmar (volar) aspect and compressive force on dorsal aspect. •Spongy bone collapses at distal metaphyseal portion. •Colles and Smith •Extra-articular component.
II		Shearing fracture of the joint surface •Barton-type fractures. •Volar injury. •Carpal volar dislocation. •Preserved radiocarpal ligaments. •Unstable fracture line.
III		Compression of the joint surface •Major compression axial forces. •Extension to distal radius. •Spongy bone resorption. •Semi-lunar compression on postero-medial aspect. •Carpal ligaments, subchondral bone lesion. •Associated scaphoid-ulnar luxation.
IV		Avulsion fracture •Ligamentous attachments. •Associated carpal dislocations. •Wrist high-energy rotational component. •Soft tissue injury.
V		Combined fractures •High energy. •Mixed component, compression, bending, rotational and shearing. •Soft tissue injury.

Figure 1. Fernandez classification. (Created with information and images from Fernandez D, Jupiter J. *Fractures of the distal radius*. New York: Springer; 1996).

Information was recorded from medical charts and directly from patient examination and X-rays. Patients were evaluated with the MMWS (which evaluates pain, work status, range of mobility, grip or prehension strength) three and six months after treatment^{18,19}.

Student's t-test was used to compare functionality, with a p-value ≤ 0.05 being regarded as significant.

Results

A total of 115 patients with non-surgical management were admitted, out of whom 39 (34%) were eliminated according to the selection criteria: one due to the presence of compartment syndrome and 38 due to edema that resolved with re-manipulation of initial cast, with up to 25 patients being recorded with fracture collapse, who required surgical management with fixators. As for surgical management, 86 patients were recruited and 3 (3.5%) were eliminated: one due to injury to the radial artery during plate insertion, who required repair by reconstructive surgery, and two more patients who presented with regional painful syndrome, with the position of the wrist on immobilization therefore being modified.

Finally, 159 patients were included in the study: out of them, 83 (52%) underwent surgical management.

The majority (66%) were males. Age ranged from 19 to 64 years, with an average of 41 years (Table 1). The most common surgical treatment was closed reduction and placement of fixators. The non-surgical treatment group included 76 patients managed with brachioradial cast immobilization, 38.7% with reduction and casting and 14.8% without reduction prior to casting (Table 1).

Both groups were evaluated with MMWS three and six months after treatment. Functional outcomes at 3 months are shown in figure 2. Better functionality is observed, markedly in favor of surgical treatment, both on total score and on each one of MMWS domains, although statistical significance was only reached on the "Pain", "Grip" and "Total score" domains.

At 6 months (Fig. 3), the results favored surgical management again, with a marked increase in the "Does not work" and "Unemployed" sections on MMWS "Employment status" domain, at the expense of patients with non-surgical management, and most of those who were surgically treated were observed to return to work. At this data cutoff, most non-operated patients reported regular or poor functionality (total MMWS result); in contrast, those who underwent surgery reported fair, good, or excellent functionality. The best results with surgery are also noticeable on

Table 1. Group outcomes, number of patients, gender, age, type of treatment and disability days

		Results					
		Surgical group		Non-surgical group		Total	
Number of patients	Females	25	12.8%	29	20.4%	54	34%
	Males	58	29.7%	47	33.1%	105	66%
	Total	83	52.2%	76	47.8%	159	100%
Age (years)	Minimum	19		21		19	
	Maximum	64		62		64	
	Average	40.18		42.5		41.2	
	SD	11.637		12.016		17.541	
		Surgical group		Non-surgical group			
Treatment	Fixator 57	29.2%		Reduction + cast 55	38.7%		
	Fixator + pin 9	4.6%		Cast-reduction 21	14.8%		
	Locked plate 17	8.7%		Modifiers	9.9%		
				Pain 14	3.5%		
				Edema 5	3.8%		
				Not modified 54			
Disability days	Minimum	43		56			
	Maximum	244		198			
	Average	93		119			
	SD	46.253		33.661			

Student's t-test: 4.152; p = 0.001

SD: standard deviation.

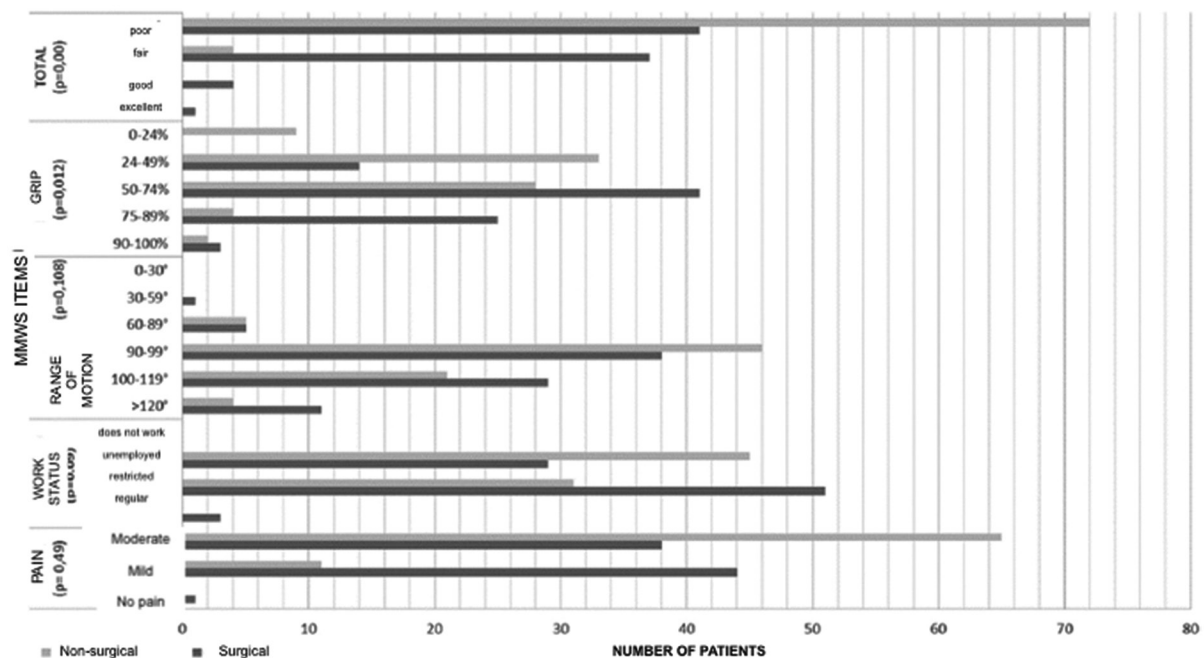


Figure 2. Comparison of the Modified Mayo Wrist Scale (MMWS) at 3 months between surgical and non-surgical groups.

the "Pain" domain. However, the p-value was only significant on the "Range of motion" domain, which is clinically highly relevant.

In addition, average number of days of disability shows a difference of 16 days less for the surgical group in comparison with the non-surgical group (Table 1).

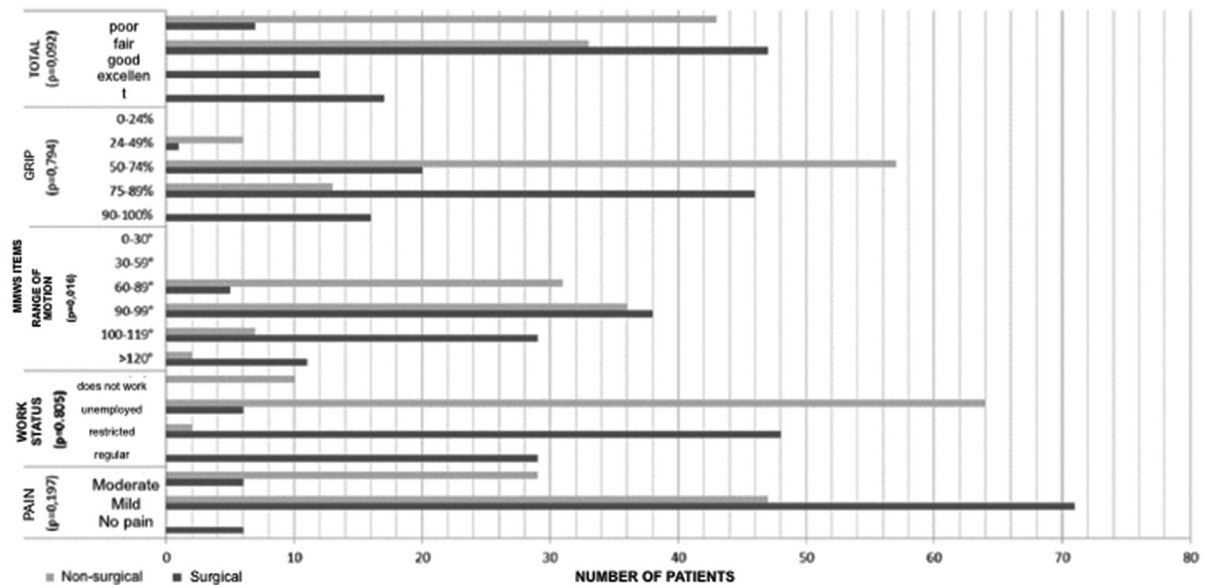


Figure 3. Comparison of the Modified May Wrist Scale (MMWS) at 6 months between the surgical and non-surgical groups.

Discussion

Distal radius fracture is one of the most widely studied, with multiple classifications, each one according to radiographic, anatomical or injury mechanism parameters. The AO classification¹¹, although of recent popularization, is purely descriptive with regard to fracture line location and does not consider biomechanics or kinematics of the injury, which make bone and capsule-ligament damages associated with the fracture more understandable. Therefore, the most relevant, widespread and used classification is the Fernandez classification (Fig. 1), which evaluates the mechanism of injury and fracture anatomical findings. Type I or II fractures usually receive non-surgical treatment, and type IV and V fractures are definitely of surgical treatment³. Type III fractures exhibit a large variability in the therapeutic behavior to be followed, which generates diverse functional results in the compromised wrist.

The incidence of complications in the presented population was consistent with reports on the subject in international literature: up to 30-50% for conservative management and less than 10% for surgical treatment^{4,6,14}.

There is no perfect scale for assessing wrist functionality. MMWS is based on four domains, each weighing 25%: pain (on a Likert scale: no pain, mild/occasional, moderate, severe pain) and grip (the latter

comparing the grip of the affected wrist with the contralateral wrist), both with certain degree of subjectivity; and work status and ranges of mobility (measured with a goniometer). This scale was preferred because it is wrist-specific, less subjective than others (such as Disability Arm-Shoulder-Hand [DASH] and Patient-Rated Wrist Evaluation [PRWE]) and because its highest scores essentially require normal movement and function. In addition, it allows a more detailed and significant analysis with regard its domains and total score²⁰⁻²².

In this study, evolution assessment at 3 months showed a difference on MMWS scores in favor of surgical treatment, both in total score and when the domains were separated; however, statistical significance was only achieved in the "Pain" and "Grip" domains and in total score. There are previous reports with similar results²³. It is important to note that the best score in individual domains and total MMWS do have clinical relevance, in contrast to statistical significance.

The surgical group exhibits less pain and better grip with regard to the non-surgical group, but the main contribution of the present work is that early wrist mobilization generated a positive impact on early re-incorporation of patients to daily activities, which translated into fewer disability days in the surgical group (Table 1). This is consistent with MMWS total score results at 3 months, and at 6 months in the

“Ability” and “Pain” domains and in total score. These results reaffirm what was found in other studies¹⁶.

As for functionality, according to the international literature, the differences between management modalities in favor of surgery are maintained for up to 6 months, but appear to decrease or even disappear after that period²⁴. There is evidence that, after 6 months, functional evolution shows a plateau regardless of the treatment modality²⁰. The present study concurs, since the functional scale at 6 months shows no significant difference.

Other studies comparing particular surgical procedures show variable results^{16,25-27}, such as when contrasting volar plate implantation in older adults in comparison with cast immobilization²⁵, without representative differences in ranges of motion and grip being found. The population of this study, although young, showed similarities regarding mobility at 6 months of treatment, but better grip with surgical management. Another report compares Kirschner's pins percutaneous implantation and non-surgical management¹⁶, with no differences being found between both treatments, probably due to the absence of a better implant, such as a plaque or some type of fixator.

Early mobilization appears to improve functionality, both in the present study and in other reports²⁶ that do not record differences in pain, but they do with regard to the fact that prolonged immobilization for more than 6 weeks in the non-surgically managed group caused a negative impact on functionality, which is consistent with our study.

Curtin and Hernández-Boussard²⁷ report a group of patients in whom pain was the main cause of additional medical appointments, associated with the treatment performed (8% had been operated with plate, 11% with external fixators and 14% with closed reduction); in the present work, pain showed a significant difference between groups at 3 and 6 months. In both data cutoffs, the fact that most surgical patients report mild or no pain at all, while all those on conservative treatment report pain, at least mild, stands out.

In international literature, studies are mostly in patients aged 60 years or older^{1,7,10}; our work comprises not only this age group, but also young working population.

On the other hand, the existence of multiple functional scales precludes the consensus around a test that helps to homogenize the results with regard to wrist-specific functionality^{20,22}.

The present work provides epidemiological information about this type of fractures in the working population, in addition to establishing the results in terms of return to work in favor of surgical management and the advantages of early mobilization. With this, it attempts to help clarify the panorama with regard to therapeutic options and their impact on the functionality of patients with Fernandez classification type III distal radius fracture.

Conclusions

The present study suggests that, in Fernandez grade III distal radius fractures, surgical treatment offers better functional outcomes at 3 months, especially with regard to pain and grip, and at 6 months, with regard to mobility, in comparison with non-surgical treatment. Similarly, the population who undergoes surgical treatment returns to their work activities in fewer days than the population managed with plaster cast.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments have been performed on humans or animals for this research.

Confidentiality of data. The authors declare that they have followed the protocols of the work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained informed consent from the patients and/or subjects referred to in the article. This document is in the possession of the corresponding author.

Conflicts of interest

The authors declare that there is no conflicts of interests.

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