

ORIGINAL RESEARCH

Comparing the Outcomes of Surgical and Non-Surgical Approaches in Management of Older Patients with Distal Radius Fracture; a Retrospective Cohort Study

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Abstract: **Introduction:** Distal radius fractures (DRFs) are the most common orthopedic injuries in emergency department. This study aimed to compare the outcomes of conservative and surgical managements of DRFs in the aged population. **Methods:** In this retrospective cohort study, ninety patients with unilateral DRFs were treated using either surgical or conservative (casting) approach and the management outcomes as well as complications were compared between the two groups at 3 and 6-month follow-ups. **Results:** A total of 90 patients over 70 years old were included (45 treated with cast immobilization, and 45 using the surgical method). The mean age ($p = 0.56$) and gender ($p = 0.85$) was similar in the two groups. Except for quality of life in both follow-up times, patients treated with surgical methods showed better outcomes in other aspects, including 3-month ($p = 0.042$) and 6-month ($p = 0.022$) mean Disability of the Arm Shoulder Hand (DASH) score, 3-month ($p = 0.013$) and 6-month ($p = 0.006$) mean range of motion (ROM), and 3-month ($p = 0.003$) and 6-month ($p = 0.033$) pain intensity based on Visual Analogue Scale (VAS). A total of 70 (77.77%) adverse events were registered (33 (36.6%) in the casting group and 37 (41.1%) in the surgical group; $p = 0.05$). The rate of mal-union ($p = 0.021$) and superficial radial nerve injury ($p = 0.026$) were significantly lower in the surgical group. **Conclusion:** The findings suggest that surgical approach for management of DRFs in elder cases has better clinical and functional outcomes than cast immobilization.

Keywords: Conservative treatment; radius fractures; casts, surgical; aged; disabled persons

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1. Introduction

Distal radius fractures (DRFs) are among the most common orthopedic injuries, with over 640,000 cases reported during 2001 in the US alone. This type of fracture accounts for up to 18% of all fractures in the elderly age group (1). Epidemiological studies point out that the highest incidences are found in children and the elderly people with the elderly group (over 65 years old) making up more than 50% of all DRF cases in the population (2). The age-adjusted incidence in large studies ranges from 73 to 202 per 100,000 in men and from 309 to 767 per 100,000 in women among adults over 50 years old

(2). An, peripheral low-energy fracture is a strong indication of osteoporosis (3). Patients with distal radius fracture have been found to carry twice the risk of a later hip fracture (4). In older adults, especially females, the fracture results from low-energy or moderate trauma, such as falling from a standing height. And some studies showed that there is an increased tendency to fall among patients over 65 years old (5). This indicates that greater fragility of the bone, resulting from osteoporosis and osteopenia, in combination with an increased tendency to fall are major risk factors for distal radius fractures, along with other risk factors such as prior forearm or vertebral fractures, loss of body height, cigarette smoking, and medical treatment for certain diseases (e.g. rheumatoid arthritis) (5, 6).

There are several surgical options for this kind of injury, and each option has its advantages and complications. The

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American Academy of Orthopedic Surgeons is currently unable to recommend any specific treatment, whether conservative or surgical. In the latter case, they also do not suggest which surgical approach is best (7). Choice of treatment depends on many factors, such as the patient's age, lifestyle, associated medical conditions, compliance, functional demands, limb dominance, type of fracture, severity, and alignment of the fracture, condition of the soft tissue, and concomitant fractures (8, 9). In the last century, most distal radius fractures in adults were treated non-operatively (conservatively) by reducing the fracture when displaced and stabilization in a plaster cast or other external brace. The results of such treatment, particularly in older people with bones weakened by osteoporosis, are not consistently satisfactory (10). Treatment by closed reduction and cast immobilization can be carried out on a large scale, at low expense, and without admission; however, this often leads to poor radiological results and displacement, the rate of which can be as high as 40% (11). This has resulted in attempts to develop surgery strategies aimed at more accurate reduction and more reliable stabilization. Several surgical options for distal radius fractures have been described, such as percutaneous pinning and casting (closed reduction) (12) and external fixation (12, 13); Open Reduction Internal Fixation (ORIF) using the volar locking plate technique represents the most chosen option, ORIF with Herbert screw fixation and crif with k-wire (13, 14). Percutaneous pinning involves percutaneous (through the skin) insertion of pins, which may be threaded or wired (12). In external fixation, which is also a closed, minimally invasive method, metal pins or screws are driven into bone, generally via small skin incisions, after drilling them on either side of the fracture. These pins are then fixed externally with a plaster cast or an external fixator frame (12, 13). For both methods, fracture reduction is generally closed (15). Internal fixation, which is usually preceded by open reduction, involves open surgery, where the fractured bone is exposed to direct view. Given the invasive and technically demanding nature of open surgery, with the increased risks of infection and soft-tissue damage, internal fixation is usually reserved for more severe injuries. It is, however, an increasingly used method of surgery (16). Amongst these surgical methods, volar locking plate systems (VLPS) offer predictable outcomes, especially in osteoporotic patients, and their use is increasingly popular (17-20). There is also a paucity of evidence on the optimal treatment of distal radius fractures in the Iranian population.

This study aimed to compare the clinical and functional outcomes as well as quality of life of older patients with DRF between two treatment approaches of cast immobilization and surgery.

2. Methods

2.1. Study design and setting

A retrospective cohort study on 90 age- and gender-matched patients treated for DRF at two different referral Hospitals (Alzahra and Kashani) in Isfahan, Iran, was conducted between 2020 and 2021. Patients were either treated with surgical or conservative (casting) approaches due to different variables (i.e., associated medical conditions, type of fracture, severity and alignment of the fracture, surgical method, surgeon technique, and experience) and the management outcomes as well as complications were compared between groups at 3 and 6-month follow-ups. Ethical code IR.MUI.MED.REC.1399.1005 was obtained from Isfahan University of Medical Sciences. Consents were obtained from all patients. Researcher adhered to confidentiality of patients' data and ethical recommendations in the declaration of Helsinki.

2.2. Participants

Patients aged 70 years or older, with unilateral distal radius fracture, no history of upper limb surgery following trauma, no morbidity such as limb paralysis and preoperative deformity, and at least 6 months of follow-up after non-operative or operative treatment were included. Cases who had bilateral distal radius fractures, other associated injuries, or open fractures, and patients who did not give consent to participate in our study were excluded. All fractures were classified as B1 and B2 types based on orthopedic trauma association.

2.3. Procedure and interventions

All fractures underwent an initial closed reduction. All the Patients in both groups were radiologically examined three months and six months after the procedure to verify the stability of the reduction and the outcomes. The conservatively treated patients were immobilized with a long cast, and after four weeks, the arm portion of the cast was removed while the forearm part was kept for another 2-4 weeks. Then the cast was removed, and patients were advised for functional recovery of the wrist articulation. Patients in the surgical group were treated within one week from the traumatic event using different methods like open reduction internal fixation (ORIF), percutaneous pinning (PCP), and external fixation methods. After the surgery, a splint was applied to the forearm. The immobilization for patients treated with PCP and external fixation was kept for 4-6 weeks and for those in ORIF group, it was kept for two weeks, followed by rehabilitation. The rehabilitation consisted of physical therapy programs and functional training in self-care and home management.

2.4. Outcome assessment

All patients' clinical and functional outcomes were evaluated using three questionnaires at the 3- and 6-month follow-ups. Also, the range of motion (ROM) in injured and contralateral wrists were evaluated and compared between groups at the 3- and 6-month follow-ups. The Short Form 36 (SF36) was used to analyze the quality of life, the Disability of the Arm Shoulder Hand (DASH) was used to assess wrist function, and a Visual Analogue Scale (VAS) was used to evaluate the pain intensity.

2.4.1 Short Form 36 (SF36)

The SF-36 is a general quality of life instrument that measures eight health-related concepts: physical functioning (PF-10 items), role limitations due to physical problems (RP-4 items), bodily pain (BP-2 items), general health perceptions (GH-5 items), vitality (VT-4 items), social functioning (SF-2 items), role limitations due to emotional problems (RE-3 items), and perceived mental health (MH-5 items). In addition, a single item that provides an indication of perceived change in general health status over a one-year period (health transition) is also included in the SF-36 .(21)

2.4.2. Disability of the Arm, Shoulder, and Hand Score (DASH)

To assess the patient's functional status during the preceding week, the validated Persian version of the Disability of the Arm, Shoulder, and Hand Score (DASH), was used. The questionnaire is designed to evaluate the degree of difficulty in performing several physical activities because of an arm, shoulder or hand problem (21 items), the severity of each of the symptoms of pain, activity-related pain, tingling, weakness and stiffness (5 items), as well as the effects of the condition on social activities, work, and self-image (4 items). The DASH also contains two optional four-item modules concerning the ability to work (work module) and to practice sports or play musical instruments (sports/performing arts module) .(22)

2.4.3. Visual Analogue Scale (VAS)

The pain Visual Analogue Scale (VAS) is a single-item scale, a unidimensional measure of pain intensity. For pain intensity, the scale is most commonly anchored by "no pain" (score of 0) and "pain as bad as it could be" or "unbearable pain" (score of 10). The VAS is widely used due to its simplicity and adaptability to a broad range of populations and settings and is broadly accepted as a generic pain measure.

2.4.4. Range of motion

For range of motion, we measured the amount of wrist flexion and extension as well as radial and ulnar deviation in both fractured and other wrists at 3-month and 6-month follow-ups. The maximum motion of a normal wrist required for daily activities is 60 degrees of extension, 54 degrees of flexion, 40 degrees of ulnar deviation, and 16 degrees of ra-

dial deviation, a total of 170 degrees.

2.5. Statistical analysis

Continuous and categorical variables were reported as mean \pm standard deviation (SD) and frequency (percentage), respectively. Continuous variables were compared between groups using independent samples t-test and categorical variables were compared using chi-squared or Fisher exact tests. All statistical analyses were performed using SPSS version 26 (IBM SPSS Statistics for Windows, version XX (IBM Corp., Armonk, N.Y., USA)

3. Results

3.1. Baseline characteristics

A total of 90 patients over 70 years old were included in this study. 45 patients were treated with cast immobilization, and 45 cases were treated using surgical methods. The patients' mean age at the time of trauma was 77.84 ± 5.90 (range: 70-93) years for the surgical group and 77.47 ± 5.4 (range: 70-90) years for the conservative group ($p = 0.56$). The two groups were predominated by women (60% vs. 68%; $p = 0.85$) and had a similar situation regarding mean DASH (84.10 vs. 83.7; $p = 0.83$), mean pain intensity (7.30 vs. 7.50; $p = 0.89$), and mean range of motion (68.60 vs. 70.20; $p = 0.78$) at the time of admission.

3.2. Outcomes

All patients were evaluated in the 3- and 6-month follow-ups. Table 1 compares the studied outcomes as well as complications between the groups 3 and 6 months after intervention. Except for quality of life in both follow-up times, patients treated with surgical methods showed better outcomes in other aspects, including 3-month ($p = 0.042$) and 6-month ($p = 0.022$) mean DASH, 3-month ($p = 0.013$) and 6-month ($p = 0.006$) mean ROM, and 3-month ($p = 0.003$) and 6-month ($p = 0.033$) pain intensity based on VAS.

3.3. Complications

A total of 70 (77.77%) adverse events were registered (33 (36.6%) in the casting group and 37 (41.1%) in the surgical group; $p = 0.05$). In both casting and surgical groups, the most prevalent observed complication was mal-union (25 (27.7%) vs. 10 (11.1%); $p = 0.021$, respectively), followed by Need for reoperation (9 (10%) vs. 8 (8.8%); $p = 0.321$, respectively). The rate of mal-union ($p = 0.021$) and superficial radial nerve injury ($p = 0.026$) were significantly lower in surgical group.



Table 1: Comparing the studied outcomes and complications between the 2 groups 3 and 6 months after intervention

| Outcome | Surgery Group n = 45 | Casting Group n = 45 | P-value |
|--|----------------------|----------------------|---------|
| Disability of the Arm Shoulder Hand (DASH) | | | |
| 3 months | 63.02 ± 9.57 | 68.29 ± 14.52 | 0.042 |
| 6 months | 53.80 ± 9.01 | 60.04 ± 15.58 | 0.022 |
| SF-36 | | | |
| 3 months | 64.20 ± 12.74 | 62.84 ± 10.31 | 0.135 |
| 6 months | 76.87 ± 12.52 | 70.64 ± 10.92 | 0.295 |
| Pain intensity based on Visual Analogue Scale (VAS) | | | |
| 3 months | 3.02 ± 0.98 | 3.60 ± 1.07 | 0.009 |
| 6 months | 1.98 ± 0.86 | 2.38 ± 0.88 | 0.033 |
| Range of motion (ROM) | | | |
| 3 months | 129.56 ± 13.00 | 121.89 ± 15.49 | 0.013 |
| 6 months | 146.00 ± 13.67 | 138.11 ± 13.11 | 0.006 |
| Complications | | | |
| Mal-union | 10 (11.1) | 25 (27.7) | 0.021 |
| Surgical site infection | 5 (5.5) | 0 (0.0) | 0.05 |
| Superficial radial nerve injury | 6 (6.6) | 0 (0.0) | 0.026 |
| Un-union | 4 (4.4) | 3 (3.3) | 0.214 |
| Need for reoperation | 8 (8.8) | 9 (10) | 0.321 |
| Total | 33 (36.6) | 37 (41.1) | 0.05 |

Data are reported as mean ± standard deviation or frequency (%). At the time of admission, the difference between groups regarding the DASH, ROM, and pain intensity was not significant.

4. Discussion

Our data showed significant difference between outcomes of DRF management in patients who underwent conservative and casting treatments. Clinical outcomes in surgical group were better than casting group. We found a significant difference in complications between two groups: mal-union and superficial radial nerve injury were significantly lower in surgical group. We considered that a distal radius fracture would affect the whole upper extremity, resulting in a temporary or long-term physical performance impairment (13). This concept applies especially to the elderly population, who are more sensitive to a health-related reduction in quality of life and mobility skills (14). Patients who suffer a DRF usually experience long-term functional impairments that restrict daily activities (2).

Distal radius fractures are very common injuries among the elderly, and most DRFs that occur in elderly persons are a source of morbidity and loss of quality of life (23). Even though DRFs are among the most common injuries treated by orthopedic trauma and hand surgeons, the treatment options are vast and the best choice for each case remains debatable variable and remain debatable (6). Prevention of this fracture is possible by treating osteoporosis with diet and drugs, including vitamin D, calcium, and bisphosphonate medications. Several studies have investigated the functional and radiological outcomes in osteoporotic DRF-affected patients; some authors have highlighted that osteoporosis has a negative effect on clinical outcomes in DRFs after surgery

and suggested that the cause may be the complications related to the low bone mass density of the distal radius, including loss of fixation and late displacement (24).

Some investigators performing similar studies have stated that there is no significant difference in patient's overall outcomes between two groups. Testa et al. evaluated 91 patients aged 65 years and older with DRFs, treated in two groups (cast immobilization versus ORIF), 1, 3, 6, and 12 months after intervention using similar methods to our study, and they found no significant clinical difference between the casting and the surgical group (25). Arora et al. in a similar study, came to the same conclusion and found no significant difference between 2 treatment methods of DRF (26). Ju et al. in a meta-analysis of eight studies similar to ours in 2015 compared surgical treatment (440 patient) and cast immobilization (449 patients) and found no significant differences in DASH score, VAS pain score, grip strength, wrist extension, pronation, supination, or ulnar deviation between the groups. However, they found that the non-surgical group had significantly greater wrist flexion, radial deviation, ulnar variance, and less radial inclination than the surgical group. And they concluded that surgical and non-surgical methods produce similar results in treatment of DRFs in the elderly, and minor objective functional differences did not impact subjective function outcome and quality of life. (27)

However, the results of our study were similar to the trends observed in some other studies (9, 12, 28), where surgically treated patients tended to achieve better upper extremity function, experience lower pain intensity and greater range

of motion after treatment, and usually need fewer physical therapy sessions in comparison to casting group to achieve a rather similar function. Hung et al. in a study in 2016 concluded that surgical methods resulted in better functional outcomes for DRFs in Chinese older adults aged 61 to 80 years(29) . After 3-month and 6-month follow-ups, our data showed a significant clinical difference between the casting and the surgical groups, with a better outcome using different surgical methods. This study found a significant improvement in outcomes in the DASH, pain score, and range of motion (flexion, extension, and radial deviation) using surgical methods. However, there seemed to be no significant difference between the SF-36 scores of the two groups. This data may suggest that despite the absence of a significant difference in the quality of life between the two groups, the functional outcomes in the mid-term are better in surgically treated patients. Thus, the surgical methods are a more admissible option in treating DRFs.

We found a difference in the incidence of complications: 23.3% in the surgical group and 33.3% in the conservative group. Mal-union (38.8% in total) had the highest incidence among registered adverse events in both groups, and approximately 1 out of 3 patients, regardless of the fixation method, were diagnosed with mal-union in follow-ups. Regardless of the fixation method, surgical management may result in complications. Since the incidence of complications in the surgical group has been lower, it can be concluded that functional outcomes have been better in this group. On the subject of difference between the results of our study and similar investigations done by other authors, we found that in those studies (25-27) they registered more incidence of adverse events in the surgically treated patients in follow-ups (35-45 %) and this may result in worse functional outcome, resulting in the insignificant difference between 2 groups; and as we discussed before, there are many variables that affect both the choice of treatment and outcomes of the chosen treatment, such as the patient's age, lifestyle, associated medical conditions, compliance, functional demands, limb dominance, type of fracture, severity, alignment of the fracture, condition of the soft tissue, and concomitant fractures. Bruce et al. in their study in 2016 point out the absence of a consensus strategy for the treatment of distal radius fractures and the implications of variance in treatment on cost and quality of care, and indicate the need for established, evidence-based guidelines or further clinical trials to assist in the management of this common fracture(30) . The result of our investigation suggests that surgical methods are a more admissible option for the treatment of DRFs; however, further prospective randomized controlled studies with larger numbers will be required to evaluate the potential long-term benefits of surgical treatment. This study prospectively investigated the outcome of DRFs in Iranian elderly patients,

and the results followed the trend observed in the general elderly population in other parts of the world (9, 12, 28, 29).

5. Limitations

Selection bias due to lack of randomization and heterogeneous fracture configuration within the group might have limited our results' power. Also, we did not divide fractures into subgroups and we did not separately evaluate the devices used in surgery.

6. Conclusion

Our findings suggest that using surgical methods in treatment of DRFs in the elderly seems to be a more admissible option than cast immobilization. The affected limb's functional outcomes and range of motion were better after surgical treatment compared to cast immobilization treatment.

7. Declarations

7.1. Acknowledgments

None.

7.2. Authors' contributions

M.Gh designed the study, wrote the proposal and initial draft. S.H analyzed the data, gathered data, entered them into SPSS, and edited the manuscript. M.T introduced the idea, supervised the study, and revised the final draft.

7.3. Funding and supports

None.

7.4. Conflict of interest

None.

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