

Comparative results of radius distal AO type C1 fractures of elderly women by two different techniques

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Summary. *Backgrounds:* We evaluated clinical and radiographic outcomes of volar locking plates and close reduction with percutaneous pinning treatment approaches for elderly female patients with AO type C1 simple intra-articular distal radius fractures. *Patients and Methods:* We conducted retrospective studies of 72 elderly female patients with AO type C1 simple intra-articular DRFs treated with VLPs or CRPP, from 2012 to 2018. The patients were divided into two groups: There were 38 patients in VLP group and 34 patients in CRPP group. Periodic clinical and radiological evaluation was performed at 2nd, 4th, 6th, 8th weeks and in 6 and 12 months intervals for all patients. We recorded the patient-rated wrist evaluation scores, flexion, extension, supination and pronation degrees and radiographic outcome scores at the end of 6th and 12 months after surgery. *Results:* A total number of 72 patients were studied. 38 patients were treated with VLP and 34 patients were treated with CRPP. The mean age of the patients was 70,5 years. Comparing the PRWE scores, the VAS scores and the ROM degrees between the 2 groups yielded no significant difference at any time point between 6 months and 1 year. There were no differences in radiographic outcomes at the latest reported follow up between the two interventions and there was no significant difference in the complication between the 2 groups (VLP 6 and CRPP 6) complications. *Conclusions:* Complicated surgeries should be avoided because of specific problems in women aged 60 years or older. Our study show that VLP and CRPP techniques had little differences and similar clinical and radiographic results. (www.actabiomedica.it)

Key words: clinical outcomes, radiographic outcomes, elderly female patients, AO tip C1 intra-articular, distal radius fractures

Introduction

Distal radius fractures (DRFs) are approximately 17.5% of the fractures seen in the emergency department (1). The DRFs of young people occur with high-energy trauma, but most fractures in elderly women are caused by low energy injuries such as a simple fall on the ground (2). Because of the increased risk of osteoporosis, the rate of distal radius fractures in female a over 65 years is increasing (3). Although DRFs are a major public health problem because of its high prevalence, there is no uniform treatment. Several factors influence the choice of treatment such as patient

age, fracture pattern, displacement, fracture instability, resource availability and surgeon's preference (4). Treatment options for DRFs involves close reduction, external fixation and open reduction (5). In the osteoporotic fractures showed no significant difference in the results observed in patients who were operated or treated conservatively after one year (6). Volar locking plates (VLP) overloaded in simple fracture-type patients. Volar plating can cause many complications, such as flexor tendon injury, extensor compartment damage of the screw, and loss of wrist ROM due to deterioration of volar soft tissues (7). Close reduction of percutaneous pinning (CRPP) has many potential

uses, such as reduced operative time and soft tissue protection (8). However, CRPP can cause complications such as superficial pin circumference infection on the skin, deep infection in the pin path, and joint stiffness due to prolonged immobilization (9). The purpose of this study was to compare clinical and radiographic outcomes in a retrospective cohort of elderly female patients with AO type C1 simple intra articular DRFs treated with volar locking plates or close reduction percutaneous pinning

Patients and Methods

This was a retrospective and observational study. It is based on patient data who underwent surgical treatment of distal radius fractures from January 2012 to January 2018. This study included 72 elderly female patients between the age group of 60 to 83 years who were exposed to AO type C1 simple intra articular DRFs. Patient consent forms were signed. There were 38 patients in VLP group and 34 patients in CRPP. This patients were treated with VLP or CRPP. The inclusion criterias were the presence of AO type C1 simple intra articular DRFs, female patients over 60 years of age, patients with appropriate radiographs during injury and one year after surgery, one sided distal radius fracture and no previous deformity or fracture on the wrist. The exclusion criterias were AO type C2 or more complex and patients undergone surgery. Only plain radiography was used. Preoperative and postoperative MR and CT were not performed for metaphysial communiton. All patients were operated with peripheral anesthesia in the supine position while the hand was in full supine position. After the closed reduction under scopi for the CRPP process the fixation was achieved with at 1-2 K wire. In VLP group, operations were carried out with a classic volar approach. AO C1 fracture type was diagnosed by X-ray. Periodic clinical and radiological evaluation was performed at 2, 4, 6, 8 weeks, 6 and 12 months intervals for all patients. In all controls standard X ray was taken and both wrist flexion, extension, supination and pronation scores were measured and recorded. All patients were immobilized with cast during the post-operative 4 weeks. We started early therapy to improve

digit motion, even while the hand was mobilized in a cast. When radiological improvement was seen, the plaster was removed. Particular attention was given to the stability of the cast in terms of early movement in the CRPP group. While the K-wires were removed at a mean of 2 months, the plate screws were not removed. To protect against pin-tract infection, dressing were maked with povidone iodine. We recorded the patient rated wrist evaluation (PRWE) scores (10), flexion, extension, supination, and pronation degress and radiographic outcome scores at 6 and 12 months after surgery. Ethics approval was not obtained as the research was a retrospective and observational study.

The clinical analysis on pain was performed using a visual analog scale (VAS) from 0 to 10 for subjective evaluation. SPSS24.0 statistical software was used to analyze the measured data. Chi-square test and Fisher's exact test used to compare categorical data. Data results was carried out by the paired t-test and $P < 0.05$ was considered statistically significant.

Results

We were studied 72 female patients in our study. 38 patients were treated with VLP (group 1) and 34 patients were treated with CRPP (group 2). The average age of the patients was 70,5 years ($P = 0.950$) (in group I was $70,4 \pm 6,6$ years and in group II was $70,7 \pm 7,17$ years). Compared to the PRWE scores of the two groups, there was no significant difference between 6 months and 1 year at any time point ($p = 0.23$ and $p = 0.80$), but when comparing the PWRE scores between group of CRPP 6 months and 1 year we found significant difference ($p = 0.02$). Compared to the VAS scores of the two groups, there was no significant difference between 6 months and 1 year at any time point ($p = 0.14$ and $p = 0.95$), but when comparing the VAS scores between group of CRPP 6 months and 1 year we found significant difference ($p = 0.00$) (Table 1). Range of motion were assessed at 6 and 12 months. Compared to the ROM degrees of the two groups, there was no significant difference between 6 months and 1 year at any time point.. The CRPP group showed improved flexion ($p = 0.02$), extension ($p = 0.05$), supination ($p = 0.01$) and pronation ($p = 0.04$) at 6 months

Table 1. Comparison of patient-rated wrist evaluation (PRWE) scores, flexion, extension, supination, pronation and VAS scores in patients who underwent closed reduction and percutaneous pinning (CRPP) or open reduction and internal fixation with volar locking plates (VLP) between 6 months and 1 year

| | VLP | CRPP | P Value |
|------------------|-----------|----------|---------|
| 6 months | | | |
| Pain score | 7.3±1.4 | 8±1 | 0.146 |
| Extension (deg) | 59±4.4 | 54±7.3 | 0.45 |
| Flexion (deg) | 60.2±7.8 | 56.5±8.8 | 0.196 |
| Supination (deg) | 59.2±5.6 | 52.8±8.3 | 0.11 |
| Pronation (deg) | 63.7±5.5 | 57.5±7.3 | 0.19 |
| PWRE –P | 30.5±5.6 | 31.7±5 | 0.271 |
| PWRE –SF | 39.1±7.5 | 41±4.1 | 0.616 |
| PWRE –UF | 25.9±5.5 | 28.1±4.1 | 0.196 |
| PWRE –F | 32.5±6.4 | 34.9±3.5 | 0.300 |
| PWRE | 63.3±11 | 66.6±8 | 0.232 |
| 1 year | | | |
| Pain score | 5.7±1.8 | 5.8±1.6 | 0.950 |
| Extension (deg) | 60.5±5.3 | 61.5±6.5 | 0.573 |
| Flexion (deg) | 64.5±7.2 | 64.6±8.6 | 0.900 |
| Supination (deg) | 62.7±5.7 | 61.5±6.5 | 0.802 |
| Pronation (deg) | 67±5.4 | 65.3±6.7 | 0.573 |
| PWRE –P | 26.5±5.1 | 27.1±4.3 | 0.397 |
| PWRE –SF | 36.3±7.6 | 36.3±4.4 | 0.851 |
| PWRE –UF | 22.4±5.2 | 23.1±3.8 | 0.661 |
| PWRE –F | 29.8±6.2 | 29.7±3.8 | 0.594 |
| PWRE | 56.3±10.9 | 57.1±8.2 | 0.802 |

compared with flexion, extension, supination and pronation at 1 year (Table 2). Radial inclination, radial tilt and radial height grades did not change after fracture healing. Therefore, only the first year results of both groups were evaluated. Both groups had intra-articular (AO type C1) radius distal fracture types and were similar degrees of initial fracture displacement. When comparing VLP to CRPP postoperative images taken at 1 year, there was no significant difference between

two groups in radial inclination ($p = 0.975$), radial tilt ($p = 0.661$) and radial height ($p = 0.346$) (Table 3). There was no significant difference in the complication between the 2 groups (VLP group 6 (%15) and CRPP group 6 (%17) complications. There were 12 complications in the whole study. In VLP group 2 patient had mild median nerve compression recovered with conservative treatment, two patients had a delayed union and were successfully treated with immobilization for

Table 2. Comparison of patient-rated wrist evaluation (PRWE) scores, flexion, extension, supination, pronation and VAS scores between 6 months to 1 year the VLP group and 6 months to 1 year the CRPP group

| | | | | | | | | | | |
|---------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| 6 months-1year VLP | Flexion | Extension | Supination | Pronation | PWRE-P | PWRE-SF | PWRE-UF | PWRE-F | PWRE | VAS |
| P scores | ,091 ^a | ,402 ^a | ,130 ^a | ,103 ^a | ,027 ^a | ,223 ^a | ,096 ^a | ,212 ^a | ,091 ^a | ,009 ^a |
| 6 months-1year CRPP | Flexion | Extension | Supination | Pronation | PWRE-P | PWRE-SF | PWRE-UF | PWRE-F | PWRE | VAS |
| P scores | ,002 ^a | ,005 ^a | ,001 ^a | ,004 ^a | ,009 ^a | ,009 ^a | ,001 ^a | ,001 ^a | ,002 ^a | ,000 ^a |

Table 3. Comparison of radial inclination, radial tilt and radial height between VLP group and CRPP group

| | VLP | CRPP | P Value |
|--------------------------|-----------|-----------|---------|
| Radial tilt (deg) | 6.7 ± 1.2 | 6.8±1.3 | 0,661 |
| Radial inclination (deg) | 16,2±2 | 16,2 ±1,9 | 0,975 |
| Radial length (mm) | 7,3±1,4 | 6,9 ±1,4 | 0,346 |

8 weeks, 2 patient had a malunion (a loss of reduction). In the CRPP group, 2 patient had a superficial infection which recovered with oral antibiotics, 4 patients had a malunion (late loss of reduction). There was no loss of reduction from immediate postoperative to early postoperative period for whole groups.

Discussion

Elderly females have many health problems. The most important health problem of elderly female patients that differ from older male is menopause and its related health problems, such as sarcopenia (loss of muscle mass and muscle function) and osteoporosis. The incidence of distal radius fractures is high among the elderly population and can outcome potentially poorly functional result and dysfunction in elderly female (11). Nellans et al. Reported a functional decline in wrist in more than 50% of women with wrist fractures (12). Previous studies have shown that the malalignment in elderly patients with distal radial fractures is not correlate with functional outcome (13). Generally known that extra-articular simple distal radius

fractures are treated with close reduction and percutaneous K-wire fixation and intra-articular comminuted distal radius fractures are treated with open reduction and volar or dorsal locking plates. But volar locking plates overloaded in simple fracture type patients. Our study showed that there was no significant difference with compared VLP and CRPP techniques, at 1year. Aggressive surgery should be avoided when treating elderly patients because of these health problems specific to elderly females.

Studies propose that differences between fixation types may be short term and that long-term results are similar. Bisaccia et al. presented the results of treatment of unstable and intraarticular DRFs by internal fixation with external fixation. They shows that both methods provide similar clinical and radiographic results (14). Wei et al. (15) presented the results of treatment of unstable DRFs by internal fixation with external fixation. They found that results of motion and radiographic alignment for each group were excellent in 6 months and 1 year. Similarly, Egol et al. (16) presented the results of treatment of unstable DRFs by VLP with external fixation. The improvement in the range of motion in the VLP group due to early movement was seen over time with the external fixation group. Mc Fayden et al. (17) compared results for unstable extra articular fractures treated with VLP or percutaneous pin fixation. They did not determine whether had long-term differences since they completed their follow-up in 6 months. Leung et al. (18) showed that plate fixation results at 24 months were significantly better than percutaneous pinning in intraarticular fractures. Kreder et al. (19) found that CRPP had a better functional result than VLP. In our

patient cohort, we found no significant difference between 2 groups in terms of VAS scores, PWRE scores and range of wrist ROMs to be at 6 months and 1 year. We think early movement is very important here. The early movement was started in plate group with rigid fixation smoothly in a short period of time. The same situation was achieved by providing plaster support in K wire group. Therefore, we think that the results are not different.

In older female patients, there is a risk of loss of reduction due to low bone quality. Huard et al. (20) compared the results of treatment of a distal radius fracture of 38 patients with a volar non-locking plate or K-wires in patients over 70 years of age. Voigt and Lill (21) compared the results of a VLP or CRPP for the treatment of distal radial fracture in 89 elderly patients. In both studies, loss of reduction was found to be frequently. Four patient had a malunion (a loss of reduction) in the CRPP group and 2 patient had a malunion in the VLPs group in our study. However, there was no loss of reduction in the early period.

VLP has some advantages, such as direct imaging of fractures, stable fixation, subchondral support, re-correcting of the articular surface and early motion. Volar plating can cause many complications, such as flexor tendon injury, carpal tunnel syndrome, extensor compartment damage of the screw, and loss of wrist ROM due to deterioration of volar soft tissues (7). Medici et al. presented that routine release of the transverse carpal ligament at the time of fracture fixation may decrease the incidence of postoperative carpal tunnel. There is no such routine practice in our clinic (21). Close reduction of percutaneous pinning has many potential uses, such as reduced operative time and soft tissue protection (8). CRPP has some complications such as pin path infections, joint stiffness, superficial radial nerve damage and complex regional pain syndrome. Bisaccia et al. showed that medication with sodium hypochlorite 0,05% decrease the percentage of pin-tract infection and mobilization with respect to povidone-iodine. In our clinic, we made dressing with povidone iodine to protect against pin tract infection (22). In present study, especially superficial skin infections were more common in fixation with K wire, but the other complications were not different in both applications.

Patients are more interested in wrist functional activities than clinical outcomes. Clinical outcome evaluation after DRF is based on objective measures such as radiographic parameters, wrist ROM and VAS. For assessing healing outcome of a distal radius fracture, Graham (23) suggested the evaluation criteria based on three radiographic measurements, including radial height (averagely should be 11 to 12 mm), radial inclination (averagely should be around 23°), and radial tilt (averagely should be around 11°). Today, Graham's criteria have become one of the most widely practiced guidelines for treatment of patients with distal radius fractures. These radiographic parameters did not necessarily correlate with subjective functional outcomes. Because there is a weak correlation between radiographic and functional outcomes in elderly female patients (6). In our study, no significant difference was found between the groups for radial inclination, radial height and radial elevation images taken at 6 months and 1 year.

Our results were evaluated according to PRWE scores (10). PRWE scoring is more sensitive than other measures in distal radius fractures (24). In the VLPs group, ROM and pain scores are better than the CRPP group at the beginning. The difference in PRWE scores in CRPP group tended to decrease over time. It is possible that the lower PWRE scores and VAS scores in CRPP group may be due to delayed onset of wrist ROM exercises. Elderly women have osteoporosis, malnutrition, impaired muscle function, anemia, poor wound healing, delayed recovery in surgery, and a high risk of mortality. Surgical planning is based on the patient, the type of fracture and the experience of the surgeon. CRPP technique should be the first method that comes to mind because of the risk of minimal blood loss, short duration of surgery and minimal wound infection in elderly female patients.

There were some limitations in our study. The sample size of 72 patients remains small, although there is a large distal radius fracture fixation to date in the orthopedic literature. Our study was a retrospective study and since both patients were elderly female, there was a limitation in collecting data and reaching patients. We excluded a number of patients because some of them died. Different radiographic shots and human error can lead to different outcomes between

groups. The follow-up period in this study is one limited. Moreover, the incidence of posttraumatic arthritis would not have been detected at the short-term follow ups in the studies included in present study. Seeing the onset of posttraumatic arthritis to affect wrist functions is possible in long-term follow-up. Also early movement and rehabilitation are the most important tools that will lead to success.

Conclusions

Even though both method were found to be safe to maintain fracture healing and to protect against complications in simple intraarticular radius distal fractures in elderly patients. It is appropriate to choose more simple surgical method in elderly women with osteoporosis and additional diseases.

Conflict of interest: Each author declares that he or she 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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