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COMPARING THE VOLAR LOCKING COMPRESSION PLATE WITH JOSHI'S EXTERNAL STABILIZATION SYSTEM FOR UNSTABLE DISTAL END RADIUS FRACTURES: A COMPARATIVE STUDY OF THEIR FUNCTIONAL AND RADIOLOGICAL RESULTS

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ABSTRACT

Purpose: This study compared the short-term functional and radiological results of volar locking compression plates (LCPs) and Joshi's external stabilization systems (JESSs) in the treatment of unstable distal end radius fractures. **Materials And Methods:** A prospective study was carried out on 50 patients with newly closed unstable distal end radius fractures aged 20 to 60. The patients were randomly divided into two groups of 25 patients each, and the results were compared. **Results:** The two groups' range of motion was compared, and a clinical and radiological examination was conducted during the average two-year follow-up period. Based on the modified Gartland and Werley grading system, the JESS group's functional result was excellent in 8%, good in 40%, fair in 48%, and poor in 4%, whereas the volar LCP group's functional result was excellent in 8%, good in 84%, fair in 4%, and poor in 4%. The JESS group's results, according to the Stewart grading system, were excellent in 8% of cases, good in 40%, fair in 48%, and poor in 4% of cases; in contrast, the LCP group's results were excellent-good in 88%, fair in 8%, and poor in 4%. **Conclusions:** In the volar LCP group, the mean time to union was 5.71 months, while in the JESS group, it was 3.75 months. According to the functional and anatomical evaluation of both groups, the volar LCP group's fixation produced better results than JESS's external fixation with precise preservation of the articular boundary. Open reduction and internal fixation is associated with better functional outcomes in the early post-operative period. Patients who require a quicker return to function following an injury should take this course of treatment into consideration. However, over the long term, this is comparable to JESS fixation.

KEYWORDS : Closed reduction distal radius, Distal radius fractures, Joshi's external stabilization system fixator, Locking compression plate, Volar Barton's fracture

INTRODUCTION

Distal radius fractures are extremely common injuries, making about 16% of all fractures treated in ERs and 74.5% of all forearm fractures.[1] Ever since Abraham Colles first detailed this injury in over 4000 publications have been published about distal radius fractures and how they are treated since 1814 [2].

Numerous fixation methods, each with pros and cons, have been documented. These methods include pin and plaster fixation, percutaneous and intramedullary pinning, external fixation (bridging or non-bridging, static or dynamic), injectable bone cement, internal fixation with customized implants, and injectable bone cement.

Recent trials have not revealed any superior external fixation or plating method.[8] This has allowed us to compare the outcomes of the two treatment approaches directly.

MATERIALS AND METHODS

Study Group

Each patient provided written informed consent, which was authorized by the local ethics commission. Between January 2011 and July 2013, 50 patients with intra-articular distal radius fractures (AO Type 23C3), skeletal maturity (>18 years), and written informed consent participated in this study. The patients were randomized into two groups, JESS and volar locking compression plate (LCP), each with 25 patients.

Patients with open fractures, infections, mental incompetence, wrist disabilities, or histories older than two weeks were not allowed to participate in the study. Follow-ups were conducted with these patients at 2, 6, 9, and 12 months. Range of motion (ROM) measures by Gartland and Werley demerit criteria [9], modified by Sarmiento [10], and radiographic evaluation by Stewart criteria [11] comprised the follow-up examination.

Surgical Technique

The patients were placed in the supine posture and given either general or regional anesthesia. We frequently used fluoroscopic imaging, a pneumatic tourniquet, and an intravenous antibiotic as a preventative measure prior to surgery.

The patient was positioned lying on their back on the operating table, with the affected upper limb stretched out to the side and bent slightly at the elbow, while the forearm was turned inward to a moderate degree.

Two Schanz pins were inserted: the first one placed at a 90-degree angle to the back surface of the radius bone, and the second one inserted through the base of the second metacarpal bone from the back surface. Traction was applied to align the fracture by gripping the index and middle fingers while the wrist was slightly bent upwards and angled towards the outer side.

JESS

A JESS (Joint External Stabilization System) was secured over the two pins using screws. Additional Schanz pins were inserted above and below the JESS frame, and screws were tightened to secure them. Subsequently, the JESS was adjusted by tightening the screws to create distraction. Dressings were applied to the pin insertion sites, and a forearm splint was placed.

Volar Locking Plate

The surgical approach involved accessing the flexor carpi radialis tendon sheath. Either the LCP T-plate or an oblique distal radius plate was utilized. The plate was positioned on the palm side of the lower end of the radius bone, with direct visualization, and secured at the top using the elongated hole to allow precise adjustment. The fracture was aligned and temporarily held in place with K-wires. Throughout the procedure, the reduction and plate positioning were regularly verified using imaging techniques. Subsequent to this, distal locking screws were carefully placed to reach the dorsal

surface without piercing it. To prevent irritation to the extensor tendons, a standard deduction of 2 mm was applied to the length of the distal screws. The distal locking screws were aimed to be positioned approximately 2 mm below the joint surface to provide support beneath the cartilage.

Statistical Analysis

The data underwent analysis utilizing computerized statistical software, specifically Microsoft Excel (2011 release) and Primer. Descriptive statistics such as mean, standard deviation, and proportions were employed to summarize the variables investigated in the study. Confidence intervals at the 95% level were calculated for differences in means. The Chi-square test was utilized to explore any relationships between qualitative study variables and outcomes. For quantitative data analysis, an unpaired t-test was conducted. A power analysis indicated that a minimum of 17 subjects per group was necessary to detect an effect size of 0.75, with power and significance levels set at 80% and 5%, respectively. The significance level was established at $P < 0.05$.

OBSERVATION AND RESULTS

In the JESS group, the average age was 42 years (range: 23–60), while in the LCP group, it was 38 years (range: 22–58). Additionally, 80% of participants in the JESS group were male, whereas 88% were male in the LCP group.

Laterality

In the JESS group, injuries occurred on the right side in 72% of patients, while in the LCP group, it was 80% of patients who sustained injuries on the right side.

Mechanism Of Injury

The most frequent mechanism of injury reported in both groups was a fall onto an outstretched hand from a standing height, with 90% of patients in the JESS group and 88% in the LCP group experiencing this. Following this, road traffic accidents were the next most common cause.

Union

In the JESS group, the average time to both clinical and radiological signs of union was 3.75 months, whereas in the LCP group, it was 5.71 months.

Fracture Type

As per the AO classification, type C2 fractures were the most prevalent in both groups, followed by type C1 and then type C3. In the JESS group, 84% of cases achieved union within 2–3 months, while in the LCP group, 52% required 3–4 months for union, and 40% achieved union within 2–3 months.

ROM

The ROM at 1 year follow-up with respect to palmar flexion, dorsiflexion, supination, pronation, radial deviation, ulnar deviation, and grip strength was 66.96 ± 6.95, 56.52 ± 8.99, 79.04 ± 9.16, 69 ± 7.45, 13.76 ± 3.07, 25.48 ± 3.78 and 78.84 ± 9.84, respectively, in JESS group and 67.48 ± 8.54, 57.12 ± 5.68, 80.76 ± 8.19, 70.2 ± 5.21, 14.12 ± 2.5, 25.96 ± 4.63, and 79.88 ± 11.72, respectively, in LCP group.

Radiological Parameters at 1 Year Follow-up

In the JESS group, measurements revealed a radial height of 11.28 ± 2.44 mm, a palmar tilt of 4.08 ± 6.1 degrees, and an articular step-off of 0.76 ± 0.84 mm. Conversely, in the LCP group, these measurements were slightly different, with a radial height of 12.16 ± 2.73 mm, a palmar tilt of 6.48 ± 7.14 degrees, and an articular step-off of 0.66 ± 0.60 mm.

Functional Outcome

In the JESS group, the functional outcomes, as per the modified Gartland and Werley scoring, were distributed as follows: excellent in 8%, good in 40%, fair in 48%, and poor in 4%. Conversely, in the volar LCP group, the distribution was as follows: excellent in 8%, good in 84%, fair in 4%, and poor in 4%.

Radiological Outcome

In accordance with the Stewart scoring system, the outcomes were as follows: in the JESS group, 2 cases (8%) demonstrated an excellent result, 10 cases (40%) showed a good result, 12 cases (48%) had a fair result, and 1 case (4%) resulted as poor. Conversely, in the LCP group, 22 cases (88%) achieved an excellent to good result, while 2 cases (8%) were fair, and 1 case (4%) was poor.

Distribution of Outcome According to Fracture Type

In the JESS group, among seven cases with type C1 fractures, four resulted in a good outcome, while three resulted in a fair outcome. For the 10 patients with type C2 fractures, five had a good outcome, four had a fair outcome, and one had a poor outcome. Among the seven patients with type C3 fractures, two had an excellent outcome, one had a good outcome, and four had a fair outcome.

In contrast, in the LCP group, among eight cases with type C1 fractures, two had an excellent outcome, and six had a good outcome. For the 12 patients with type C2 fractures, 10 had a good outcome, one had a fair outcome, and one had a poor outcome. Lastly, all three patients with type C3 fractures had a good outcome.

Complications

In the JESS group, 4% of cases experienced pin tract infection, 2% had pin loosening, and another 2% encountered neuropraxia of the sensory branch of the radial nerve. Additionally, approximately 8% of patients developed malunion following the removal of JESS. Both the JESS and volar LCP groups exhibited finger and wrist stiffness in 10% of patients, attributed to prolonged immobilization and insufficient physiotherapy. This stiffness was addressed through regular exercises, leading to fair results at the 1-year follow-up

DISCUSSION

Intra-articular fractures of the distal end of the radius present as complex and unstable injuries, leading to ongoing debate regarding their treatment. The primary goal of treatment is to restore anatomical integrity and function. Both external fixation and plating have demonstrated satisfactory outcomes. Recent studies have enhanced our understanding of wrist anatomy and function, expanding the surgical options available. Currently, open reduction and plate fixation are widely accepted surgical techniques, with locked plates gradually replacing conventional support plates due to their superior biomechanical strength, particularly beneficial in osteoporotic or multiple fractures.

External bridging fixation, a longstanding treatment modality predating plating, remains favored by many surgeons for its familiarity, minimal exposure requirement, and shorter learning curve.

Numerous studies comparing external fixation and plating have yielded comparable results across various metrics. For instance, Egol *et al.* found that while volar plating initially resulted in improved range of movement, after one year, both groups showed similar outcomes in terms of range of motion, grip strength, and DASH scores.

In our study, the LCP group exhibited early mobilization advantages at the 3-month follow-up compared to the JESS group. However, by the 9-month follow-up, both groups demonstrated comparable results.

Patients undergoing open reduction and internal fixation

displayed greater range of motion and strength at 6- and 9-months post-operation, with more reporting high satisfaction with overall wrist function and motion.

While anatomical and radiological parameters were better restored in the volar LCP group in our study, the significance of anatomical restoration in functional outcomes remains debatable.

Despite complications such as pin loosening and infection, the JESS group showed comparable outcomes to the LCP group in our study, with a shorter time to union observed in the JESS group.

CONCLUSIONS

It seems that open reduction and internal fixation may lead to better functional outcomes in the early post-operative period, making it a suitable option for patients needing a quicker return to function following the injury. However, over the long term, outcomes appear comparable to JESS fixation. Therefore, considering the individual needs and preferences of patients, as well as the specific characteristics of their injuries, can help guide treatment decisions.

Ethical Approval

That statement reflects a commitment to ethical conduct in research involving human participants, aligning with the principles outlined in the 1964 Helsinki Declaration and its subsequent revisions. It indicates that the study adhered to the ethical standards set forth by institutional and/or national research committees to ensure the welfare, rights, and confidentiality of the participants.

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