



Evaluating the Impact of Physical Therapy on Wrist Fracture Patients Treated with Volar Locking Plates

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Abstract

Introduction: Distal radius fractures are among the most frequent musculoskeletal injuries, accounting for over 17% of fractures treated in emergency care centers. The primary objective is to promote healing and restore the pre-injury level of functionality. Treatment generally involves two phases: initial care and definitive surgery, where volar locking plates are used to stabilize fractures, presenting a low risk of complications. Personalized rehabilitation plans are crucial in this context. **Objective:** This retrospective study aims to investigate the influence of physical therapy on patients who underwent surgery involving a volar locking plate after sustaining wrist fractures. **Materials and Methods:** The research covers 63 patients who underwent surgery for distal radius fractures. Following initial care at the Emergency Center of the Clinical Center of Vojvodina, patients received rehabilitation treatment either at the clinic for rehabilitation in the clinical center of Vojvodina or as an outpatient service at the Health Center in Novi Sad. Data were collected included patient socio-demographic characteristics such as age, gender and so on, clinical parameters encompassing diagnosis and treatment method, and the use of the PRWE (Patient Rated Wrist Evaluation) score. **Results:** The average patient age was 50.87 ± 14.96 years. Left wrist fractures were more common. Falling was identified as the leading cause of wrist fractures. The average PRWE score in the sample was 18.97, indicative of mild difficulties. Among the patients, 51 (81%) received physical therapy for an average of 10.17 days. Most patients (87%) successfully returned to their jobs, while some opted for career changes (5%) or retirement (8%). **Conclusion:** The treatment of distal radius fractures utilizing volar locking plates combined with appropriate physical therapy represents an effective approach, resulting in comprehensive functional recovery in daily life activities and professional pursuits.

Subject Areas

Orthopaedic Surgery, Trauma Surgery

Keywords

Distal Radius Fracture, Volar Locking Plate, PRWE Score

1. Introduction

Volar locking plates (VLP) serve as mechanical fracture bridges, effectively acting as a load-bearing implant with a notably low risk of complications [1] [2]. The precise subchondral placement of distal screws is of paramount importance to provide essential support to the joint surface and prevent the loss of reduction. Experimental biomechanical evidence supports the application of VLP in cases involving dorsal multifragmentary distal radius fractures [3]. Volar locking plates are meticulously designed with screws that lock at a fixed angle (buttress plate). However, this fixed orientation of the locked screws renders the plate less forgiving in minor application errors, potentially posing a risk of screw penetration into the joint. Specific fragments, particularly dorsal ones, may pose challenges when securing with screws, necessitating the use of additional metal constructs to ensure the stabilization of all fracture fragments [4]. The Patient Rated Wrist Evaluation (PRWE) score is a valuable tool used to assess a patient subjective experience and functional ability following a wrist injury and/or surgery [5]. It quantifies patient self-reported pain and disability, providing essential insights into the effectiveness of treatment and the progress of the patient's recovery journey. Typically, the PRWE score encompasses questions related to pain, swelling, wrist strength, range of motion, and the ability to perform daily activities. Widely employed, it plays a crucial role in evaluating and monitoring the outcomes of medical interventions and rehabilitation programs related to wrist injuries.

The purpose of this article was as follows: assessing the frequency of wrist fractures based on gender and age, examining the prevalence of wrist fractures concerning the injured side, identifying the primary causes of wrist fractures and understanding the occurrence of comorbidities among operated patients, which may include conditions such as diabetes, hypo/hyperthyroidism and smoking. Additionally, the study aims to determine the percentage of patients who underwent physical therapy, along with the duration of their physical therapy sessions. It will also calculate the average postoperative PRWE score, providing valuable insights into the post-surgical wrist functionality. Finally, the research will analyze the percentage of patients who successfully returned to their respective workplaces following treatment.

Statistical analysis was performed on the data using IBM Statistical Package for the Social Sciences version 25. Descriptive statistics methods were used, comprising frequencies, percentages, variability range (minimum and maximum val-

ues), measures of central tendency (mean), and data variability represented by the standard deviation (SD). The t-test for independent samples identified potential differences between two independent populations within the sample, focusing on gender disparities and the effect of physical therapy on PRWE scores. The Chi-square test assessed potential differences between subgroups in the total sample, specifically concerning return-to-work patterns stratified by gender and physical therapy application. Statistical significance was determined at probability levels ranging from $p \leq 0.05$ to $p < 0.001$.

2. Research and Results

The research was conducted on 63 ($N = 63$) patients of both genders, with male patients constituting 38% ($N = 24$) of the total sample, while female patients comprised 62% ($N = 39$) of the total. All patients attended follow-up appointments. The average patient age was $M \pm SD = 50.87 \pm 14.96$ years. At the time of injury, males had an average age of $M \pm SD = 44.33 \pm 13.17$ years, ranging from 21 to 67 years, while females had an average age of $M \pm SD = 54.87 \pm 14.71$ years, ranging from 18 to 81 years. Regarding the side of the fracture, 39.7% ($N = 25$) of patients had a fracture of the right wrist, 54% ($N = 34$) of the left, and both wrists were affected in 6.3% ($N = 4$) of cases. Among males, 41.7% ($N = 10$) had right wrist fractures, 54.2% ($N = 13$) had left wrist fractures, and 4.1% ($N = 1$) had both. Among females, 38.5% ($N = 15$) had right wrist fractures, 53.8% ($N = 21$) had left wrist fractures, and 7.7% ($N = 3$) had both. The most common cause of wrist fracture included falls, accounting for 79.4% ($N = 50$) of cases, followed by other forms of injuries (traffic accidents and sport injuries) at 11.1% ($N = 7$) of cases. When considering comorbidities, 5% ($N = 3$) of patients had diabetes, hyper/hypothyroidism had 8% ($N = 5$) and smoking was observed in 10% ($N = 6$) of patients. Among the patients, 81.0% ($N = 51$) received physical therapy. The number of days attending physical therapy ranged from a minimum of 0 days for patients who did not attend to a maximum of 21 days. For patients who had physical therapy, the number of days ranged from a minimum of 5 days to a maximum of 21 days, with an average of $M \pm SD = 12.57 \pm 4.49$ days. PRWE scores revealed that 42.9% ($N = 27$) of patients experienced minimal difficulties, 34.9% ($N = 22$) had mild difficulties, 19% ($N = 12$) had significant difficulties and 3.2% ($N = 2$) had severe difficulties. The average PRWE score for the entire sample was $M \pm SD = 18.97 \pm 18.94$. To assess the impact of physical therapy on PRWE scores, differences were tested between patients who received physical therapy and those who did not. The results of an independent samples t-test $t(61) = -3.528$; $p = 0.001$ showed a statistically significant difference in the average scores on the PRWE total score between patients who received rehabilitation ($M \pm SD = 15.22 \pm 15.96$) and patients without rehabilitation ($M \pm SD = 34.92 \pm 22.82$). Patients who received rehabilitation achieved a statistically significantly better average score compared to patients who did not receive rehabilitation (Table 1).

Table 1. Differences in average PRWE scores between patients with and without applied physical therapy.

	PRWE score	M	N	SD	MIN	MAX	T-test	DF	p
Physical therapy	Yes	15.22	51	15.96	0.00	76.00			
	No	34.92	12	22.82	0.00	95.00	-3.528	61	0.001
	Total Sample	18.97	63	18.94	0.00	95.00			

Note: M = mean; N = total number of participants in the sample; SD = standard deviation; Range of variability (Min = minimum value of the variable; Max = maximum value of the variable); T-test = conducted analysis for independent samples; DF = degrees of freedom; p-value = level of statistical significance ($p < 0.01$ to $p \leq 0.05$).

Table 2. Distribution of patients with and without rehabilitation according to the parameter "return to work".

	Total sample (N = 58)	Patients after rehabilitation	Patients without rehabilitation	Total	χ^2	DF	p
Return to work	f	48	7	55			
	Yes % ^a	87.3%	12.7%	100.0%			
	% ^b	98.0%	77.8%	94.8%			
	No f	1	2	3	5.893	1	0.112
	% ^a	33.3%	66.7%	100.0%			
	% ^b	2.0%	22.2%	5.2%			
Total f	49	9	58				
%	84.5%	15.5%	100.0%				

Note: f = Frequency; %^a = Percentage within the examined parameters; %^b = Percentage within the patients with/without rehabilitation parameter; χ^2 = Chi-square test; DF = Degrees of freedom; p-value = Level of statistical significance ($p < 0.01$ to $p \leq 0.05$).

Regarding the parameter of returning to work, 87.0% (N = 55) of patients returned to their previous jobs, 5% (N = 3) did not and 8% (N = 5) retired. Statistical analysis using the chi-square test ($\chi^2 = 5.893$; DF = 1; $p = 0.112$) showed no significant differences in the distribution of patients with and without physical therapy regarding their return to work. Although the total number of patients varied in each category (with and without physical therapy), the majority in both categories had successfully returned to work (**Table 2**).

3. Discussion

Injuries to the distal part of the radius are among the most common musculoskeletal injuries. They account for over 17% of all fractures treated in emergency departments [6]. The exceptional functional status of this region and its frequent trauma make this segment particularly significant. According to the 2022 census of the Republic of Serbia, the average population age is 43.8 years, while the av-

average age of patients in our sample is similar to $M \pm SD = 50.87 \pm 14.96$ years, placing our sample within the working-age population [7]. In younger individuals, fractures are often a result of high-intensity force, whereas in older individuals, they are typically associated with low-energy trauma, which aligns with the data in our sample. Additionally, distal radius fractures occur 2.5 times more frequently in women than in men, with osteoporosis being a dominant risk factor [6]. In our study, this ratio stands at 1.6. A study conducted in Turkey between 2011 and 2013 by Ermutlu *et al.* found a higher frequency of distal radius fractures in the left hand [8]. A similar situation is observed in our sample, where fractures of the right wrist are present in 39.7% ($N = 25$), while fractures of the left wrist are present in 54% ($N = 34$) of patients. Studies in Washington show that about 80% of wrist injuries occur due to falls on an outstretched hand [9]. In our sample, a significant 79.4% ($N = 50$) of injuries also resulted from falls. Traffic accidents are the second most common accounting for 6.3% ($N = 4$) in our sample. The PRWE score is a commonly used measure that has been extensively examined and analyzed in the existing literature. The effectiveness of the PRWE questionnaire has been demonstrated in participants six months after the fixation [10], which aligns with the follow-up duration observed in our study. Our average PRWE score of 18.97 is lower than the results of Duprat *et al.* who reported scores of 22.97 and 20.56 [11]. In a randomized controlled trial with a three-year follow-up conducted by Sudow *et al.*, the mean PRWE score of 7 was significantly better [12]. In similar studies, Dennison *et al.* reported PRWE scores of 5.4 and 5.1 in their two early and late rehabilitation protocols [13]. It's important to note that, in their study, they excluded people with diabetes and metabolic conditions, despite them having concomitant ulnar-sided fractures. Consequently, the increased PRWE score in our study can be attributed to our more permissive exclusion criteria and our limited experience with the utilization of VLP for distal radius fractures. Patel *et al.* reported that 28 out of 30 patients (93%) returned to work [14]. In a study by Watson *et al.* involving 133 patients, they found that 90% of them resumed their work within 26 weeks [15]. In our sample, 87% ($N = 55$) of patients returned to work, which closely corresponds to the findings of the aforementioned previous studies. According to the latest data published by the International Diabetes Federation, 1 in 10 people suffer from diabetes [16]. In our sample, 5% ($N = 3$) of the total 63 ($N = 63$) patients have diabetes. This finding contradicts our results, which can be explained by the precise selection of patients for operative treatment. The American Association of Clinical Endocrinologists estimates that in the United States, approximately 13 million people, or 4.8% of the population, have undiagnosed thyroid dysfunction [17]. The National Health and Nutrition Examination Survey examined 13,344 randomly selected individuals, finding that 4.6% of the population had hypothyroidism, while 1.6% had hyperthyroidism [18]. Our results, with 8% having thyroid dysfunction, are in line with the findings of the survey. Serving as the seventh state with the highest number of smokers, Serbia is ranked among the top 10 countries with a smoking prevalence of 40.6% among

its population [19]. In our sample, only 10% (N = 6) of participants were cigarette smokers, which is significantly lower than the average number of smokers in the Republic of Serbia. It should be noted that we intentionally selected non-smoking patients to reduce potential postoperative complications.

In conclusion, we noted a greater incidence of wrist fractures in women, and both sexes showed an increased susceptibility to left wrist injuries. The most common cause of wrist fractures was falls. Functional abilities after the application of physical therapy proved to be satisfactory. Work-related activities for patients who underwent operative treatment for distal radius fractures were minimally restricted, as the majority were able to return to their previous tasks, even though no statistical significance was observed. We demonstrated a statistically significant difference in average PRWE scores between patients who underwent physical therapy and those who did not, with patients receiving physical therapy achieving significantly better average PRWE scores.

Conflicts of Interest

The author declares no conflicts of interest.

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