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The Efficacy of Exercise-Based Rehabilitation in Treating Ulnar Wrist Pain

Dr. Nadia Rahman[1*], Prof. Dr. M.A. Shakoor[2], Dr. Md. Imamur Rashid[1], Dr. Md. Nadim Kamal[1], Dr. Ziaur Rahman Chowdhury[1], Dr. Mohammad Golam Nobi[1], Dr. Abul Kalam Azad[1]

[1]Assistant Professor, Department of Physical Medicine and Rehabilitation, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
[2]Professor & Chairman, Department of Physical Medicine and Rehabilitation, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

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***Corresponding author:** Dr. Nadia Rahman
Assistant Professor, Department of Physical Medicine and Rehabilitation, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

Abstract **Original Research Article**

Background: Exercise-based rehabilitation effectively treats ulnar wrist pain, enhancing pain relief, grip strength, and mobility. Targeted exercises lead to significant pain reduction and functional recovery. ***Aim of the study:*** This study aimed to assess the efficacy of exercise-based rehabilitation in treating ulnar wrist pain. ***Methods:*** This cross-sectional study was conducted in the Department of Physical Medicine and Rehabilitation, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh from January 2023 to December 2023. This study includes 60 patients with ulnar wrist pain who were divided into two groups: Group A (30 patients) received rehabilitation therapy, and Group B (30 patients) received no therapy. ***Result:*** The mean age was 45.2 ± 10.5 years in Group A and 43.2 ± 9.7 years in Group B (P = 0.4466). Gender distribution was balanced, as were the mean pain durations (P = 0.7200). At baseline, Group A's mean VAS score was 7.8 ± 1.2 and Group B's was 7.6 ± 1.4 (P = 0.5548). After 12 weeks, Group A's pain score decreased significantly to 2.5 ± 0.7, while Group B's remained at 6.6 ± 1.2 (P < 0.0001). Group A's grip strength increased from 18.5 ± 3.5 kg to 33.0 ± 2.8 kg, compared to Group B's 20.5 ± 3.8 kg (P < 0.0001). Group A also showed greater wrist ROM and PRWE score improvements. ***Conclusion:*** This study concludes that exercise-based rehabilitation significantly reduces pain, enhances grip strength, and improves wrist range of motion in patients with ulnar wrist pain.

Keywords: Efficacy, Exercise-Based Rehabilitation, and Ulnar Wrist Pain.

I INTRODUCTION

Ulnar wrist pain, often resulting from injury or overuse, is a common and disabling musculoskeletal condition [1]. It primarily affects the ulnar side of the wrist, involving key structures like the ulnar nerve and the triangular fibrocartilage complex (TFCC), which are essential for wrist stability and function [2]. This condition is particularly prevalent among athletes, manual laborers, and individuals engaged in repetitive activities, such as tennis players, factory workers, and carpenters, due to the repeated stress on the wrist and forearm [3]. In these populations, the ulnar aspect of the wrist is frequently subjected to axial loading and rotational forces, leading to microtrauma and inflammation, which can progress to chronic pain and disability if untreated [4]. Managing this condition remains challenging, particularly in low-resource settings like Bangladesh, where access to specialized care is limited [5]. Traditional treatments for ulnar wrist pain usually include conservative methods such as rest, bracing, and non-steroidal anti-inflammatory drugs (NSAIDs) [1]. In more severe cases, surgical options like ulnar shortening osteotomy or TFCC repair are considered. However, these interventions do not always provide long-term relief and may come with complications such as nonunion, hardware issues, or persistent pain [6]. Furthermore, surgery is often expensive and inaccessible for many patients in low-resource regions like Bangladesh [7]. Even when surgery is performed, postoperative rehabilitation is critical to restoring wrist function, but such care is often unavailable in many parts of the country [5]. Consequently, many patients continue to suffer from pain and functional limitations long after their initial injury. Exercise-based rehabilitation has emerged as a promising alternative therapy that is both effective and accessible. This approach aims to improve pain and function through targeted exercises that strengthen the

muscles around the wrist and forearm, enhance range of motion, and alleviate pain via controlled movements [8]. Research suggests that exercise-based rehabilitation can be as effective as more invasive treatments, such as surgery combined with orthotics, in improving pain and function in patients with ulnar wrist pain [9]. Moreover, home-based exercise programs have proven highly effective in improving wrist strength and function, even in patients recovering from more significant injuries, such as distal radius fractures [10]. These findings suggest that exercise-based rehabilitation offers a low-cost, viable alternative to traditional treatments, particularly in settings where access to specialized care is limited. Unlike surgical interventions or advanced physiotherapy techniques, it can be implemented in various settings, including patients' homes, with minimal equipment and supervision [10]. This makes it especially suitable for the healthcare landscape in Bangladesh, where many patients lack regular access to physical therapists or rehabilitation centers [11]. Furthermore, exercise-based rehabilitation has been shown to be highly effective in improving long-term outcomes for patients with chronic musculoskeletal conditions, including ulnar wrist pain [12]. By encouraging patients to take an active role in their recovery, this approach not only enhances physical outcomes but also fosters greater engagement and self-efficacy in treatment [9]. Despite its numerous benefits, exercise-based rehabilitation is not without challenges. Compliance with home exercise programs can be inconsistent, particularly in populations with low health literacy or limited access to resources [13]. Additionally, while exercise-based rehabilitation has been effective in reducing pain and improving function, it may not suffice for all patients, especially those with severe or complex injuries [14]. In such cases, a combination of exercise-based rehabilitation with other therapeutic modalities may be necessary to achieve the best outcomes [13]. The need for effective, accessible treatments for ulnar wrist pain is particularly acute in low-resource settings like Bangladesh, where traditional treatment options are often inaccessible or ineffective. This current study is aimed to assess the efficacy of exercise-based rehabilitation in treating ulnar wrist pain.

II OBJECTIVE

To assess the efficacy of exercise-based rehabilitation in treating ulnar wrist pain.

III METHODOLOGY & MATERIALS

This cross-sectional study was conducted in the Department of Physical Medicine and Rehabilitation, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh, during the period from January 2023 to December 2023. A total of 60 patients with ulnar wrist pain were included in this study. These patients were divided into 2 groups - Group A (30 patients): Patients who received rehabilitation therapy and Group B (30 patients): Patients who received no therapy. Patients were eligible for inclusion if they were aged more than 30 years, had a diagnosis of ulnar wrist pain, and had not undergone any prior surgical intervention for this condition, and to provide informed consent. Exclusion criteria included previous wrist surgeries, or chronic diseases that could impact the study. Patients unable to comply with the rehabilitation protocol were also excluded. Consent of the patients and guardians was taken before collecting data. Interventions include-

Group A (Rehabilitation Group): Patients in this group underwent a supervised, structured exercise-based rehabilitation program for 12 weeks. The program included:

- **Strengthening exercises** for the wrist and forearm muscles (focused on improving ulnar deviation, wrist flexion, and extension).
- **Stretching exercises** to improve range of motion (ROM) in the wrist.
- **Therapeutic modalities** such as heat therapy to relieve pain and reduce inflammation.
- **Home exercise program**: Patients were instructed to perform specific exercises at home for 20 minutes per day, 5 days per week.
- **Weekly monitoring sessions**: Patients visited the clinic once a week for a supervised rehabilitation session and progress evaluation was done.

Group B (Control Group): Patients in this group received no therapeutic interventions but were monitored at the same time intervals as Group A. They were asked to maintain their usual activities without any specific exercise programs or therapies.

In both Group A (Rehabilitation Group) and Group B (Control Group), patients were allowed to use non-steroidal anti-inflammatory drugs (NSAIDs), such as aceclofenac 100mg twice daily after meal for 10 days to manage pain and inflammation associated with ulnar wrist pain. The study measured both primary and secondary outcomes at baseline, 6 weeks, and 12 weeks post-intervention. The primary outcome measures included pain, assessed using the Visual Analog Scale (VAS), wrist function evaluated via the Patient-Rated Wrist Evaluation (PRWE), and grip strength, measured using the JAMAR hand dynamometer. Secondary outcome measures consisted of range of motion (ROM), assessed using a goniometer to measure ulnar deviation, radial deviation, wrist flexion, and extension, along with quality of life, evaluated using the Short Form (SF-36) questionnaire. After the collection of data, the data were entered into a computer, and statistical analysis of the results was obtained by using Windows-based computer software devised with Statistical Packages for Social Sciences version 22. A p-value of less than 0.05 was considered statistically significant.

IV RESULT

Table I presents the baseline characteristics of the study groups. The mean age of participants in Group A was 45.2 ± 10.5 years, while in Group B, it was 43.2 ± 9.7 years, with no statistically significant difference between the groups (P = 0.4466). Regarding gender distribution, Group A had 56.7% male (17 individuals) and 43.3% female (13 individuals), while Group B comprised 60% male (18 individuals) and 40% female (12 individuals), showing no significant difference (P = 0.7971). The mean duration of pain reported by participants was similar in both groups, with Group A reporting an average of 5.4 ± 2.1 months and Group B reporting 5.6 ± 2.2 months, yielding a non-significant P-value of 0.7200. In terms of the affected hand, the right hand was predominantly affected in both groups, with 83.3% in Group A and 86.7% in Group B, while the left hand was affected in 16.7% of Group A and 13.3% of Group B, with no significant difference (P = 0.7146). Occupational distribution indicated that a majority of participants in both groups were engaged in manual labor, with 66.7% in Group A and 63.3% in Group B, while 33.3% in Group A and 36.7% in Group B were involved in non-manual jobs. This distribution was also statistically non-significant (P = 0.7843). Overall, the baseline characteristics were well-balanced between the two groups, indicating that there were no significant differences in age, gender, duration of pain, affected hand, or occupation, suggesting that the groups were comparable before the intervention. Table-II presents the pain intensity scores, measured using the Visual Analog Scale (VAS), for both groups. At baseline, the mean VAS score was 7.8 ± 1.2 for Group A and 7.6 ± 1.4 for Group B, indicating similar levels of pain in both groups, with no statistically significant difference (P = 0.5548). However, after 6 weeks of treatment, a significant reduction in pain was observed in Group A, with a mean VAS score of 5.6 ± 1.0, compared to 6.9 ± 1.3 in Group B (P = 0.0001), indicating a notable improvement in the rehabilitation group. This trend continued after 12 weeks, where Group A showed a substantial decrease in pain intensity to 2.5 ± 0.7, while Group B's pain level remained relatively high at 6.6 ± 1.2, with a highly significant difference between the groups (P < 0.0001). Table-III outlines the changes in grip strength, measured in kilograms, for both groups. At baseline, the mean grip strength was similar between the groups, with 18.5 ± 3.5 kg in Group A and 18.0 ± 3.3 kg in Group B, showing no statistically significant difference (P = 0.5713). After 6 weeks of treatment, Group A exhibited a substantial improvement in grip strength, increasing to 24.2 ± 3.2 kg, while Group B showed a much smaller increase to 19.5 ± 3.0 kg. The difference between the groups at this stage was highly significant (P < 0.0001). This trend continued through to the end of the 12-week study period, where Group A's grip strength further increased to 33.0 ± 2.8 kg, compared to Group B's grip strength of 20.5 ± 3.8 kg, maintaining a highly significant difference (P < 0.0001).

Table-IV presents the changes in wrist range of motion (ROM) for both groups. For wrist flexion, Group A had a baseline mean ROM of 40.2 ± 6.1 degrees, while Group B's mean was 41.2 ± 4.5 degrees, with no significant difference (P = 0.4728). After 12 weeks, Group A showed a significant improvement in flexion to 55.0 ± 4.8 degrees, compared to 42.6 ± 4.3 degrees in Group B (P < 0.0001). In terms of wrist extension, the baseline measurements were 43.7 ± 5.2 degrees for Group A and 45.4 ± 3.7 degrees for Group B, also without a significant difference (P = 0.1500). By the end of the study, Group A's extension improved significantly to 55.5 ± 3.6 degrees, while Group B's extension remained relatively unchanged at 46.0 ± 3.9 degrees, with a statistically significant difference (P < 0.0001). For radial deviation, Group A started with a mean ROM of 12.8 ± 2.5 degrees and Group B with 12.6 ± 2.3 degrees, showing no significant difference at baseline (P = 0.7483). After 12 weeks, Group A's radial deviation increased to 18.5 ± 3.0 degrees, whereas Group B's remained almost the same at 13.2 ± 2.6 degrees, yielding a highly significant difference (P < 0.0001). Lastly, the baseline ulnar deviation was 25.4 ± 3.1 degrees for Group A and 24.8 ± 3.4 degrees for Group B, with no significant difference (P = 0.4779). At the 12-week follow-up, Group A showed a marked improvement to 33.2 ± 3.4 degrees, while Group B's ulnar deviation increased slightly to 26.0 ± 3.7 degrees, resulting in a highly significant difference (P < 0.0001). Table-V presents the Patient-Rated Wrist Evaluation (PRWE) scores for both groups. At baseline, the mean PRWE scores were similar between the two groups, with 61.2 ± 6.5 for Group A and 61.8 ± 5.8 for Group B, indicating no significant difference (P = 0.7074). After 6 weeks of treatment, a substantial reduction in PRWE scores was observed in Group A, decreasing to 43.6 ± 5.7, while Group B showed minimal change, with a score of 60.7 ± 5.5. This difference between the groups was highly significant (P < 0.0001). At the end of the 12-week period, Group A's PRWE scores further improved to 25.3 ± 4.1, indicating a significant enhancement in wrist function and pain relief. In contrast, Group B's scores remained relatively high at 59.1 ± 4.7, with the difference between the two groups continuing to be statistically significant (P < 0.0001).

Table-I: Baseline characteristics of the study people (N=60)

Characteristics	Group A (n=30)	Group B (n=30)	P-value
Age (years)			
Mean ± SD	45.2 ± 10.5	43.2 ± 9.7	0.4466
Gender			
Male	17 (56.7%)	18 (60%)	0.7971
Female	13 (43.3%)	12 (40%)	
Duration of Pain (months)			
Mean ± SD	5.4 ± 2.1	5.6 ± 2.2	0.7200
Affected hand			
Right	25 (83.3%)	26 (86.7%)	0.7146
Left	5 (26.7%)	4 (13.3%)	
Occupation			
Manual	20 (66.7%)	19 (63.3%)	0.7843
Non-manual	10 (33.3%)	11 (36.7%)	

Statistical analysis was done by Chi-square test
p value < 0.05 indicates significant

Table-II: Pain intensity (VAS) Before and After Treatment among the study people (N=60)

VAS Score	Group A (n=30) (Mean ± SD)	Group B (n=30) (Mean ± SD)	P-value
Baseline	7.8 ± 1.2	7.6 ± 1.4	0.5548
After 6 weeks	5.6 ± 1.0	6.9 ± 1.3	0.0001
After 12 weeks	2.5 ± 0.7	6.6 ± 1.2	< 0.0001

Statistical analysis was done by Chi-square test
p value < 0.05 indicates significant

Table-III: Grip Strength (kg) Over the Course of Treatment among the study people (N=60)

Grip Strength (Kg)	Group A (n=30) (Mean ± SD)	Group B (n=30) (Mean ± SD)	P-value
Baseline	18.5 ± 3.5	18.0 ± 3.3	0.5713
After 6 weeks	24.2 ± 3.2	19.5 ± 3.0	< 0.0001
After 12 weeks	33.0 ± 2.8	20.5 ± 3.8	< 0.0001

Statistical analysis was done by Chi-square test
p value < 0.05 indicates significant

Table-IV: Wrist Range of Motion (Degrees) Before and After Treatment among the study people (N=60)

Range of Motion (Degree)	Group A (n=30) (Mean ± SD)	Group B (n=30) (Mean ± SD)	P-value
Flexion			
Baseline	40.2 ± 6.1	41.2 ± 4.5	0.4728
After 12 weeks	55.0 ± 4.8	42.6 ± 4.3	< 0.0001
Extension			
Baseline	43.7 ± 5.2	45.4 ± 3.7	0.1500
After 12 weeks	55.5 ± 3.6	46.0 ± 3.9	< 0.0001
Radial Deviation			
Baseline	12.8 ± 2.5	12.6 ± 2.3	0.7483
After 12 weeks	18.5 ± 3.0	13.2 ± 2.6	< 0.0001
Ulnar Deviation			
Baseline	25.4 ± 3.1	24.8 ± 3.4	0.4779
After 12 weeks	33.2 ± 3.4	26.0 ± 3.7	< 0.0001

Statistical analysis was done by Chi-square test
p value < 0.05 indicates significant

Table-V: Patient-Rated Wrist Evaluation (PRWE) Scores Before and After Treatment among the study people (N=60)

PRWE Score	Group A (n=30) (Mean ± SD)	Group B (n=30) (Mean ± SD)	P-value
Baseline	61.2 ± 6.5	61.8 ± 5.8	0.7074
After 6 weeks	43.6 ± 5.7	60.7 ± 5.5	< 0.0001
After 12 weeks	25.3 ± 4.1	59.1 ± 4.7	< 0.0001

Statistical analysis was done by Chi-square test
p value < 0.05 indicates significant

V DISCUSSION

This current study was conducted in the Department of Physical Medicine and Rehabilitation, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh from January 2023 to December 2023 to assess the efficacy of exercise-based rehabilitation in treating ulnar wrist pain. A total of 60 patients with ulnar wrist pain were included in this study. The mean age of participants in Group A was 45.2 ± 10.5 years, and in Group B, it was 43.2 ± 9.7 years, with no statistically significant difference (P = 0.4466). This similarity in age distribution suggests that age-related factors were unlikely to influence the differential outcomes observed between the two groups. This finding aligns with existing literature, such as the study by Meyer and Tilly [15], which emphasized the importance of reporting patient age in rehabilitation trials to ensure comparability and reliability of the results. Gender distribution was also similar between the groups, with Group A consisting of 56.7% male and 43.3% female, while Group B had 60% male and 40% female participants, showing no significant difference (P = 0.7971). The balanced gender ratio between the two groups helps rule out gender as a confounding factor in the study outcomes. This finding is consistent with Sarrafzadegan *et al.*, [16], who noted that gender differences should be accounted for in rehabilitation studies, as they can influence the response to physical therapy interventions due to variations in muscle strength and pain thresholds. Both groups reported similar durations of pain, with Group A averaging 5.4 ± 2.1 months and Group B averaging 5.6 ± 2.2 months (P = 0.7200). The close alignment in pain duration suggests that the chronicity of the condition was comparable between groups, which is critical as pain duration can significantly affect rehabilitation outcomes. Mehta *et al.*, [17] highlighted that baseline pain intensity and duration are key predictors of chronic pain progression, underscoring the importance of ensuring these variables are balanced when comparing rehabilitation interventions. Regarding the affected hand, the majority of participants in both groups had right-hand involvement, with 83.3% in Group A and 86.7% in Group B, showing no significant difference (P = 0.7146). This finding correlates with Bellamy *et al.*, [18], who noted that manual dexterity and functional impairments tend to be more pronounced in the dominant hand, further highlighting the need for targeted rehabilitation strategies. The occupational distribution revealed that the majority of participants in both groups were engaged in manual labor, with 66.7% in Group A and 63.3% in Group B, while 33.3% in Group A and 36.7% in Group B were involved in non-manual jobs (P = 0.7843). The study by Marom *et al.*, [19] emphasized that manual workers are at a higher risk of experiencing prolonged disability and functional impairments after hand injuries, which aligns with the high percentage of manual laborers in this study's population. The current study demonstrated a significant reduction in pain intensity, as measured by the Visual Analog Scale (VAS), in the rehabilitation group compared to the control group. Specifically, the VAS scores in Group A (rehabilitation group) decreased from 7.8 ± 1.2 at baseline to 2.5 ± 0.7 after 12 weeks, whereas Group B (control group) showed only a minimal reduction from 7.6 ± 1.4 to 6.6 ± 1.2 (P < 0.0001). This finding aligns with the study by Gutiérrez-Espinoza *et al.*, [20], which reported that supervised physical therapy led to a significant reduction in PRWE pain scores, suggesting that structured rehabilitation enhances pain management in wrist conditions. Similarly, the findings resonate with the results from Krischak *et al.*, [10], who demonstrated that a home exercise program significantly lowered pain levels in patients with wrist fractures. In terms of grip strength, Group A exhibited a substantial improvement, increasing from 18.5 ± 3.5 kg at baseline to 33.0 ± 2.8 kg after 12 weeks, while Group B's grip strength only improved slightly from 18.0 ± 3.3 kg to 20.5 ± 3.8 kg (P < 0.0001). This significant difference underscores the impact of rehabilitation therapy on enhancing muscle strength. These findings are in line with those reported by Pang *et al.*, [21], who found that community-based upper-extremity exercises significantly improved grip strength in participants with chronic conditions, demonstrating the efficacy of structured rehabilitation in increasing muscle performance. Furthermore, the study by Blanquero *et al.*, [22] highlighted that feedback-guided exercises led to a faster improvement in grip strength compared to traditional paper-based exercise programs. The rehabilitation group also showed significant improvements in wrist ROM for flexion, extension, radial deviation, and ulnar deviation compared to the control group. For example, wrist flexion in Group A increased from 40.2 ± 6.1 degrees at baseline to 55.0 ± 4.8 degrees after 12 weeks, while the control group only improved slightly from 41.2 ± 4.5 degrees to 42.6 ± 4.3 degrees (P < 0.0001). Likewise, Hsieh *et al.*, [23] found that using digital devices for wrist rehabilitation significantly improved ROM, further

supporting the role of interactive and structured exercise programs in promoting wrist flexibility. The significant decrease in PRWE scores observed in Group A, from 61.2 ± 6.5 at baseline to 25.3 ± 4.1 after 12 weeks, highlights the effectiveness of the rehabilitation program in improving wrist function and overall quality of life. In contrast, Group B's PRWE scores remained relatively high at 59.1 ± 4.7, indicating minimal functional recovery. This improvement is in line with findings from Meijer *et al.*, [24], who demonstrated that serious game-based rehabilitation led to enhanced PRWE scores compared to traditional care, suggesting that innovative and engaging rehabilitation methods are effective in improving wrist function. Furthermore, the use of photobiomodulation therapy in combination with home exercises, as reported by Sæbø *et al.*, [25], also resulted in significant reductions in PRWE scores, further validating the importance of combining various therapeutic modalities to optimize recovery outcomes. Given the ease of implementation and the potential for widespread applicability, exercise-based rehabilitation offers a promising solution, particularly in low-resource settings where access to advanced medical care is limited.

Limitations of the study

In our study, we had a small sample size. The study population was selected from one center in Dhaka city, so may not represent wider population. The study was conducted at a short period of time.

VI CONCLUSION AND RECOMMENDATIONS

This study concludes that exercise-based rehabilitation significantly reduces pain, enhances grip strength, and improves wrist range of motion in patients with ulnar wrist pain compared to a control group. The findings suggest that such rehabilitation programs are an effective, accessible, and sustainable treatment option, particularly in low-resource settings. Future studies should explore the long-term effects of exercise-based rehabilitation for ulnar wrist pain, including larger, diverse populations. Additionally, integrating patient education on compliance with home-based exercises could enhance outcomes.

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