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The Effectiveness of a Rehabilitation Program Based on Improving the Load Symmetry Index between the Upper Limbs in Reducing the Severity of Wrist Joint Pain in Wheelchair Fencing Players with Mobility Disabilities

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ABSTRACT

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Keywords:

- Wrist pain, wheelchair fencing, grip strength, load symmetry, people with mobility disabilities.

The research aims to identify the effectiveness of a rehabilitation program based on improving the load symmetry index between the upper extremities in reducing the severity of wrist joint pain in wheelchair fencing players with mobility disabilities. The researcher used the experimental method by designing one group (before-post) on a deliberate sample of (4) players. The intensity of pain was measured using the Digital Pain Scale (NRS), measure the grip force with a dynamometer, and then calculate the load symmetry index (%). The results showed a decrease in pain intensity and an improvement in the load symmetry index after the program, indicating its practical feasibility in rehabilitation and support for a safe return to training.

1- Introduction and the importance of research: Wheelchair

fencing is one of the sport activities of people with mobility disabilities that depends to a great extent on the upper limbs in implementing performance requirements, as the players hold the weapon, adjust its direction, and carry out stabbing and defense within high repetitions and at variable speeds, which increases the functional pressure on the joints of the upper limb. Studies indicate Injuries among wheelchair fencers are more predominantly upper limb injuries than others, which makes the issue of prevention and rehabilitation among the priorities of field and applied work in this category (Chung et al., 2012, p. 278).

The wrist joint is one of the joints prone to stress in this event because of its direct connection to the stability of the grip and the precise control of the movement of the weapon during attack and defense, as well as the change in the direction of movement under the pressure of competition may increase the likelihood of pain or injury if repeated loads are accompanied by a decrease in strength or neuromuscular control. In this regard, an Arab study dealt with the application of a rehabilitation program using physical therapy methods to rehabilitate wrist joint injuries in wheelchair fencing players. Studying the Feasibility of Rehabilitation Programs in Improving the Condition of the Wrist and Helping the Safe Return to Activity (Abdel Ghafoor, 2020, p. 246)

With the nature of activities that depend on the upper limb, lack of load regulation and gradual training and rehabilitation may increase the chances of pain and strain in the working joints (Zaher, 2004).

An Arab study of injured fencing players indicates that the application of targeted rehabilitation exercises can contribute to improving the functional efficiency of the wrist joint and reducing the pain associated with the injury, which supports the importance of adopting specialized rehabilitation programs for this category (Hussain & Ibrahim Al-Jubouri, 2025)

The importance of this study stems from the fact that it directs the rehabilitation program towards improving the symmetry of the load between the upper two extremities as a functional indicator that may be related to reducing the severity of wrist joint pain and supporting the restoration of skill performance in fencing players with mobility disabilities, in a way that serves the aspect of applied rehabilitation in the faculties of physical education and sports sciences.

2-Research problem:

Wheelchair fencing is characterized by the fact that the chair is fixed on a special frame, so that the distance and angles between the two fencers are adjusted and the chair is not allowed to move or change its position during the fight, which makes the production of attack and defense almost entirely based on the movement of the torso and upper limb instead of maneuvering with the feet as in regular fencing, (2019 IWAS , p. 36). In light of this feature, the requirements for grip, weapon orientation and impact force resistance are increased, especially with the high frequency of short and rapid movements, which increases the likelihood of functional fatigue and pain in the joints of the upper limb in this category.

Studies on wheelchair fencing indicate that upper limb injuries are more common than the rest of the body, and that players with poor torso control are more likely to be injured, with shoulder and elbow strains particularly prevalent (Chung et al., 2012, pp. 278–280). Studies on

wheelchair sports in general also indicate that shoulder injuries caused by overuse are recurring injuries, and that seated performance sports – including chair fencing – show higher injury rates, in part due to weakened kinetic chain due to trunk limitation/weakness and the resulting excessive upper limb compensation Fairbairn (Huxel Bliven, 2019, pp. 295–297).

At the level of training and training practice, it is observed that the swordsman relies more on the dominant party (the weapon party) to carry out most of the offensive initiative and retaliatory actions, while the non-controlling side is often used to support or stabilize according to the requirements of the rules and equipment (such as allowing the player to be tied to the chair, and some controls of equipping the chair during the competition) (IWF, 2022, p. 2). This pattern may lead to Functional differences between the two parties in the amount of load, endurance, and motor control, and with the continuation of these differences, it may lead to the appearance of pain in the wrist or shoulder, or the symptoms may recur when returning to training loads, especially if the rehabilitation improvement is directed at pain and strength in general without quantitative follow-up of the symmetry of work between the two parties.

Therefore, the problem can be identified in the following question:
Does a rehabilitation program that focuses on improving the symmetry of the upper limbs contribute to reducing the severity of wrist joint pain in wheelchair fencing players?

3- Research Objectives

- 1- Identify the effect of the proposed rehabilitation program in reducing the severity of wrist joint pain in wheelchair fencing players.
- 2- Identify the effect of the proposed rehabilitation program on improving the symmetry of the load between the upper limbs in wheelchair fencing players.

4- Research hypotheses

- 1- There are statistically significant differences between the pre- and post-measurements in the severity of wrist joint pain and in favor of telemetry.
- 2- There are statistically significant differences between the pre- and post-measurements in the similarity of the load between the two upper limbs and in favor of the telemetry

5- Research Areas

5.1 The Human Field: Chair Fencing Players with Mobility Disabilities with Wrist Joint Pain

5.2 Spatial Field: Ashnona Club for the Handicapped

5-3 Temporal Domain: The research procedures were carried out during the period from (1/9/2025) to (30/11/2025).

6. Research Procedures:

6-1 Research Methodology:

The researcher adopted the experimental method to suit the nature and objectives of the research, using a single group design with pre- and post-measurement, in order to identify the effect of the proposed rehabilitation program on the variables under study (severity of wrist joint pain, load symmetry between the upper extremities, etc.).

6-2 Research Population and Sample

The research population was represented by players with mobility disabilities (wheelchair fencing players) in (Ashnouna Club for the Disabled) in Diyala Governorate , where the research sample was deliberately selected from fencing players who have wrist pain/injury, as the number of (4) injured fencing players was selected, and the case was diagnosed by the treating physician and specialized in physical therapy and rehabilitation.

6.3 Exploratory Experiment

The reconnaissance experiment was conducted on (30/8/2025) on a number of wheelchair fencing players from outside the research sample, with the aim of ascertaining the validity of the tools used, the clarity of the measurement procedures, and the possibility of applying the proposed rehabilitation program within the limits of pain. The experiment also aimed to determine the appropriate time to perform the exercises and avoid potential difficulties before starting the actual application to the research sample.

6.4 Tools and data collection tools

The researcher adopted the following tools and means of data collection:

- 1- Personal data registration form (age, height, weight, duration of practice, weapon limb)
- 2- Digital Pain Intensity Scale (NRS) from (0-10) to estimate the severity of wrist joint pain.
- 3- A grip force measurement device (Dynamometer) to measure the grip force of both the dominant and non-controlling parties.
- 4- A special form for recording grip strength attempts and calculating the load symmetry index (%) according to the equation: $(\text{smallest value} \div \text{largest value}) \times 100$.
- 5- Utility tools according to availability (stopwatch to adjust rest periods, measuring tape, scale, etc.).

6.5 Tests and Measurements

The tests were conducted in two stages:

- 1- Pre-measurement before the start of the implementation of the qualifying program.
- 2- Telemetry after the completion of the qualifying program.

Measurements were carried out in the same conditions as far as possible in terms of location, timing, instruments and the support team to ensure the accuracy of the comparison between the two measurements.

The severity of wrist joint pain was measured using the Digital Pain Scale (NRS) from (0–10). The grip strength for both the dominant and non-controlling limbs was measured with three attempts and the best value was adopted, then according to the load symmetry index (%) according to the equation: (smallest value ÷ largest value) × 100.

6.6 Statistical Treatments

The data were statistically processed using:

1. The arithmetic mean.
2. Standard deviation.
- 3- Wilcoxon test of correlated samples to compare the pre- and post-measurements for its suitability for the research sample.
- 4- Percentage change (improvement rate).
- 5- Adopting a significance level of (0.05) to judge the significance of the differences.

7. Presentation and discussion of the results:

7.1 Presentation of Results:

Table (1) Differences between the pre- and post-measurements of the research variables

Percentage of improvement %	Significance level (p)	Wilcoxon Value (W)	Al-Badadi (Q±A)	Al-Qibli (Q±A)	Unit of Measurement	Variable	t
33.3	0.125	10	4.00±0.82	6.00 ±0.82	Degree	Pain intensity	1
11.3	0.125	10	83.50 ± 3.42	75.00 ± 4.76	%	Pregnancy symmetry	2

7.2 Discussion of the Results:

Table (1) of the severity of wrist joint pain shows a decrease after the implementation of the rehabilitation program, as the mean decreased from (6.00) to (4.00) degrees, with an improvement rate of (33.3%). This trend is considered acceptable from a practical point of view, because the references specialized in interpreting changes in the digital pain scale indicate that a reduction of about two points or about (30%) is a clinically important change in many cases of chronic pain (Dworkin et al., 2008; et al., 2001). The researcher attributes this improvement to the nature of the program based on gradual pregnancy and adherence to therapeutic exercises directed to the wrist within the limits of pain, the gradual intensity and size of exercises within the limits of pain

is one of the basic principles in rehabilitation programs and the safe return to activity (Al-Sultani, 2013). Regular rehabilitation exercises help to restore joint function and reduce accompanying symptoms, which is consistent with the findings of published Iraqi research on the rehabilitation of the wrist of wheelchair fencing players, as the improvement after application was attributed to the effect of physiotherapy methods and rehabilitation exercises used (Abdel Ghafoor, 2020).

As shown in Table (1) of the Load Symmetry Index between the two upper limbs (%), it showed an improvement from (75.00%) to (83.50%) and (11.3%), which indicates a reduction in the functional imbalance between the dominant and non-controlling limbs after the program. This can be explained by the fact that directing part of the exercise to increase the contribution of the non-controlling limb and reduce over-reliance on the weapon tip helps to distribute the effort better during performance from a stationary sitting position. This aspect is even more important for chair fencing players because upper limb injuries are the most common in them, an epidemiological study of fencers has shown that upper limb injuries were predominant in wheelchair fencers with a higher association of injury when impaired torso control Chung et al. (Chung et al., 2012). Wheelchair sports research also suggests that poor "base of support" (torso/central control) may lead to excessive upper limb compensation and increase the chances of overuse injuries, so improving central stability is an important part of rehabilitation and prevention (Fairbairn et al., 2019)

Regarding statistical significance, the lack of significance ($\alpha = 0.05$) in the Wilcoxon test with a very small sample (4 players) is to be expected, because the statistical ability is limited in the few samples, even with practical improvement. Therefore, it is more appropriate to interpret the results by combining the direction of change and its magnitude with the rates of improvement, noting that the generalization of the results later requires larger samples or repeating the measurement over longer follow-up intervals, which is a common logic in sample qualification research Special (Dworkin et al., 2008).

8- Conclusions and Recommendations

8.1 Conclusions:

1- The proposed rehabilitation program showed a reduction in the severity of wrist joint pain in wheelchair fencing players with mobility disabilities after its implementation.

The proposed rehabilitation program showed an improvement in the load symmetry index between the upper limbs after its implementation, indicating a reduction in the imbalance between the dominant and non-dominant limbs.

The results indicate that directing the rehabilitation towards reducing over-dependence on the dominant limb while gradually carrying the pregnancy within the limits of pain helps to support functional improvement and reduce symptoms in this group.

8.2 Recommendations: 1- Approval of the proposed rehabilitation program within the rehabilitation programs for wheelchair fencing players suffering from wrist joint pain, taking into account the gradation in intensity and size.

2- The need to follow up on the load symmetry index between the upper extremities, in addition to measuring the intensity of pain when evaluating the progress of rehabilitation and before fully returning to training.

3- Emphasize adherence to pain limits during exercise and stop or reduce exercise when symptoms increase abnormally.

4- Conducting subsequent studies on larger samples and different classifications of fencing players with mobility disabilities, with the addition of other functional variables when possible.

9. References

9-1 Arabic Sources:

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Appendices

Appendix 1: Summary of the Rehabilitation Program for Wrist Joint Rehabilitation and Improvement of Pregnancy Symmetry

Program Duration: (8) Weeks

Number of Units: (3) Units per Week Unit

Time: (30-45) Approximately (depending on the player's response)

Overall objective: To reduce the severity of wrist joint pain and to improve the index of load symmetry between the upper extremities.

Principles of applying the program:

1- Gradual in the intensity and size of the exercises from easy to difficult.

2- Adherence to pain limits: Allows for possible mild pain, and reduces pregnancy when symptoms increase.

3. Taking into account individual differences, disability status, and classification, if any.
- 4- Fixing the rest periods between the sets (30-60 seconds) according to the player's endurance.

Program Stages:

- Phase I (Week 1–2): Wrist Preparation + Range of Motion + Mild Fixed Contractions
- Phase II (Week 3–5): Gradual strengthening of the wrist and grip + light muscular endurance
- Phase III (weeks 6–8): Functional strengthening + pregnancy-like exercises + higher endurance

Appendix (2): Qualifying Module Content Form

First: Warm-up (5-7 minutes)

- 1- General movement of the upper limb (shoulder, elbow, wrist)
- 2- Movement of the wrist (flexion/extension/lateral deviation) within the limits of pain

Second: Main Part (20–30 minutes)

- a) Wrist range exercises (2–3 sets × 8–12 repetitions)
- b) Wrist and grip static strength exercises (2–3 sets × 6–10 seconds stabilization)
- c) Gradual resistance exercises using an elastomer/grip ball (2–3 sets × 8–12 repetitions)
- d) Load symmetry exercises (focusing on the non-dominant limb) while maintaining the same time/repetition for both extremities

Third: Relaxation (3-5 minutes)

- 1- Light stretching of the forearm and wrist muscles
- 2- Breathing and relaxation