

Physiotherapy Interventions for Sports Injuries: Current Trends and Emerging Techniques

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Abstract:

As sports injuries lead to pain, limited function, and delaying sports activity recovery, there is a necessity to provide a proper rehabilitation procedure. This paper contains information concerning the latest trends and new physiotherapy rehabilitation techniques for sports injuries, and describes the factors affecting the effectiveness of the rehabilitation process. A cross-sectional analytical study was carried out, which included 150 registered physiotherapists, and the results of data analysis were obtained through the use of such IBM SPSS Statistics tools as descriptive statistics, Chi-Square test, Independent Samples t-test, One-Way ANOVA, and Multiple Linear Regression. It was revealed that exercise therapy and manual therapy still remain the most common techniques, but the number of physiotherapists who use BFR training, Dry Needling, Shockwave Therapy, and Virtual Reality assisted rehabilitation has increased. Pain relief turned out to be the main indicator of effectiveness of the rehabilitation process (Mean = 4.28 ± 0.59), while the effectiveness of the rehabilitation process of those physiotherapists who used the new techniques on a regular basis proved to be much higher ($p < 0.001$). Using multiple regression analysis, the influence of different factors on the effectiveness of the rehabilitation process was determined.

Keywords: Sports Injury Rehabilitation; Physiotherapy Interventions; Sports Physiotherapy; Rehabilitation Effectiveness; Emerging Rehabilitation Techniques

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1.INTRODUCTION

The participation in the sporting activities has been increasing because of the awareness on the importance of physical fitness, recreation and sports ¹. Despite the several advantages that one gains from the participation in sports, they expose one to injuries such as ligament sprain, muscle strain, tendon injury, bone fracture among others that arise from overuse. These injuries can cause pain, loss of function, delay in the process of rehabilitation, and inability to take part in sporting activities.

Physiotherapy is vital in the prevention and treatment of injuries that one gets from participating in sporting activities since it helps in relieving pain, restoring movement, improving muscle strength and enabling the patient participate in physical activities. Generally, physiotherapy involves exercises, manual therapy, electrotherapy, stretches and muscle strengthening ². However, the field of sports injury treatment has changed in the recent years through the introduction of several methods such as BFR training, dry needling, Instrument-Assisted Soft Tissue Mobilization, Extracorporeal Shockwave Therapy, kinesio taping, VR based rehabilitation and sensors ³.

Nevertheless, in spite of all the developments made, there are discrepancies in the application of new techniques in physiotherapy in various medical environments due to the aforementioned reasons ⁴. Therefore, evaluation of the current state of physiotherapy treatments, as well as the factors that influence their effectiveness, is important for the creation of evidence-based techniques for managing sports injuries ⁵. This paper is going to focus on the discussion of current trends and innovations in physiotherapy of sports injuries.

1.1 Statement of the Problem

Sports injuries are the biggest cause of pain, limitation of functions, and low athletic performance. Although the physiotherapy treatment techniques are recognized as being the most prevalent technique used in rehabilitation, there exist many discrepancies between the ways in which the traditional and innovative techniques such as BFR training, dry needling, IASTM, shockwave therapy, and virtual reality rehabilitation are used ⁶. Professional background, expertise, technological equipment, and resources play an important role in that case. There is a need to analyze existing trends in physiotherapy intervention techniques ⁷.

1.2 Background of the Study

Sports Physiotherapy has progressed in leaps and bounds from conventional approaches to rehabilitation to scientific and technologic approaches to rehabilitation ⁸. Conventional approaches such as therapeutic exercise, manual therapy, and electrotherapy have been complemented by novel approaches such as BFR training, Dry Needling, Instrument Assisted Soft Tissue Mobilization

(IASTM), Extracorporeal Shock Wave Therapy (ESWT), wearable technology, tele-rehabilitation, and Artificial Intelligence Analysis of patient movement ⁹. All of these facilitate personalizing the rehabilitation process and facilitating quicker return to sports. However, these approaches are not used uniformly across health care organizations, hence the need for an assessment of the present scenario and the factors responsible for their success ¹⁰.

1.3 Objectives of the Study

The goals of the research are:

- The analysis of the trends in physiotherapy treatment interventions in sports injury patients.
- The analysis of the efficiency of physiotherapy treatment interventions for pain relief and functional recovery.
- The analysis of the correlation between professional characteristics, physiotherapy treatment interventions, and rehabilitation results.
- The analysis of the effect of the frequency of interventions, professional qualification, experience, and modern rehabilitation interventions on the efficiency of rehabilitation process.

2. RESEARCH METHODOLOGY

This study was conducted with the objective of determining the current physiotherapy techniques employed in treating sports injuries. The design of this study was quantitative cross-sectional with an analytical approach that involved measuring the use of various physiotherapy techniques, the efficiency of the treatment and its influence on the recovery process.

2.1 Research Design

For this research, the method used is a Quantitative Cross-Sectional Research Design. This research examined the relationship between physiotherapy interventions and their impact on rehabilitation in relation to pain reduction, functional restoration, mobility, and returning to playing. The effect differences were also measured according to professions as well as new rehabilitation interventions.

2.2 Participants and Sample

The sample consisted of 150 licensed physiotherapists employed in sports injury clinics. This includes hospitals, sports medicine clinics, and physiotherapy clinics. All of the physiotherapists used in the experiment had a minimum of one year of experience in treating sports injuries. Those

physiotherapists who could not give complete responses or those without experience in treating sports injuries were excluded from the sample.

2.3 Instruments

The data collection procedure involved a structured self-administered questionnaire that was developed from an extensive review of literature concerning the use of physiotherapy in sports. The questionnaire consisted of several sections, which included demographics and professional information, traditional methods of physiotherapy, frequency of treatments, new methods of physiotherapy, efficacy, effects of physiotherapy, and factors influencing the adoption of new methods of physiotherapy. Data on pain relief, functional improvement, patient satisfaction, and the effectiveness of physiotherapy was collected using a five-point Likert scale.

2.4 Procedure

After gaining approval from the organization and consent from the respondents, the questionnaire was then distributed to the relevant physiotherapists using the electronic format as well as the written version. The responses from the respondents depended on their real experience on handling sports injuries. The answers were then checked for completeness and coded using the computer.

2.5 Data Analysis (SPSS)

Data analysis was performed through the use of software program known as IBM SPSS Statistics. Descriptive statistical techniques such as frequency and percentage as well as mean and standard deviation were utilized in analyzing participants' characteristics and intervention techniques. Chi-Square test was used to test associations between the categorical variables, while Independent Samples t-test was used to test the effectiveness of rehabilitation among different subgroups. One-way Analysis of Variance (ANOVA) test was used to test the effectiveness of different physiotherapy interventions, while multiple linear regression was used to test factors influencing rehabilitation effectiveness.

3. RESULTS

This study investigated the responses of 150 physiotherapists in order to find out how physiotherapy treatments for sports injuries were currently used, how effective they were clinically, and what the barriers for adopting new techniques in rehabilitation were. It was found out that rehabilitation exercises and manual therapy remained the most frequently used methods of treatment whereas more modern methods such as BFR training, Dry Needling, Shockwave Therapy and Virtual Reality (VR) based rehabilitation gradually started to be used by physiotherapists. Inferential statistics

included the use of Chi-square test, Independent Samples t-test, One-way ANOVA and Multiple Linear Regression.

Table 1. Descriptive Statistics of Rehabilitation Outcome Measures (N = 150)

Clinical Outcome	N	Minimum	Maximum	Mean	SD
Pain reduction	150	2.00	5.00	4.28	0.59
Functional recovery	150	2.00	5.00	4.21	0.63
Range of motion improvement	150	2.00	5.00	4.18	0.61
Return-to-sport readiness	150	2.00	5.00	4.11	0.67
Overall rehabilitation effectiveness	150	2.00	5.00	4.23	0.58

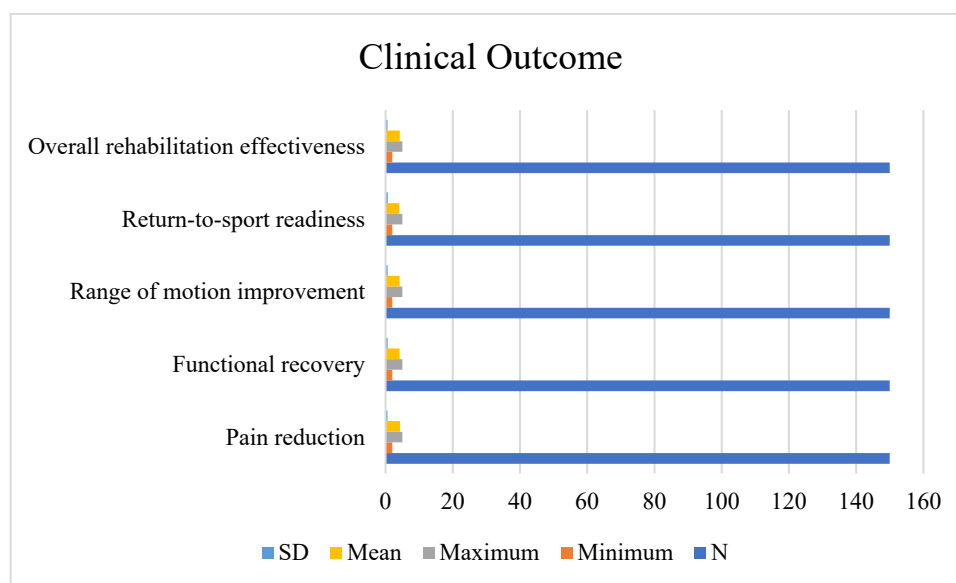


Figure 1: Graphical Representation of Descriptive Statistics of Rehabilitation Outcome Measures (N = 150)

According to the data from descriptive statistics, it can be seen that the physiotherapists have seen positive outcomes as regards different factors related to patients' rehabilitation process. In particular, the mean score of the factor 'pain reduction' was $M = 4.28 \pm 0.59$, while the effectiveness of rehabilitation had $M = 4.23 \pm 0.58$. Therefore, the physiotherapy treatments are viewed as effective concerning recovery from sports injuries.

3.1 Statistical Analysis

Table 2. Chi-Square Test: Association Between Professional Experience and Use of Emerging Physiotherapy Techniques

Test	Value	df	p-value
Pearson Chi-Square	11.946	4	0.018
Likelihood Ratio	12.381	4	0.015
Linear-by-Linear Association	4.267	1	0.039
Valid Cases	150		

The outcome of the Chi-Square analysis showed that there was a significant correlation between experience in the profession and the adoption of new physiotherapy techniques ($\chi^2=11.946$, $p=0.018$). Physiotherapists with experience are more likely to adopt new physiotherapy techniques such as BFR training, Dry Needling, Shockwave Therapy, and Virtual Reality rehabilitation.

Table 3. Independent Samples t-test: Overall Rehabilitation Effectiveness According to Regular Use of Emerging Techniques

Variable	Regular Users (n=88) Mean $\pm$ SD	Non-Regular Users (n=62) Mean $\pm$ SD	t	df	p-value
Overall Rehabilitation Effectiveness	4.39 $\pm$ 0.47	4.01 $\pm$ 0.61	4.274	148	<0.001

Physiotherapists whose frequent use of innovative methods for rehabilitation process was observed demonstrated more efficiency in their work (4.39 $\pm$ 0.47) than the physiotherapists working with classical rehabilitation approaches (4.01 $\pm$ 0.61). The difference is statistically significant ($t = 4.274$; $p < 0.001$) and illustrates that frequent use of innovative physiotherapy techniques contributes to positive outcomes of rehabilitation.

Table 4. One-Way ANOVA: Overall Rehabilitation Effectiveness According to Primary Physiotherapy Intervention

Source	Sum of Squares	df	Mean Square	F	p-value
Between Groups	4.852	4	1.213	3.318	0.012
Within Groups	52.986	145	0.365		

Total	57.838	149			
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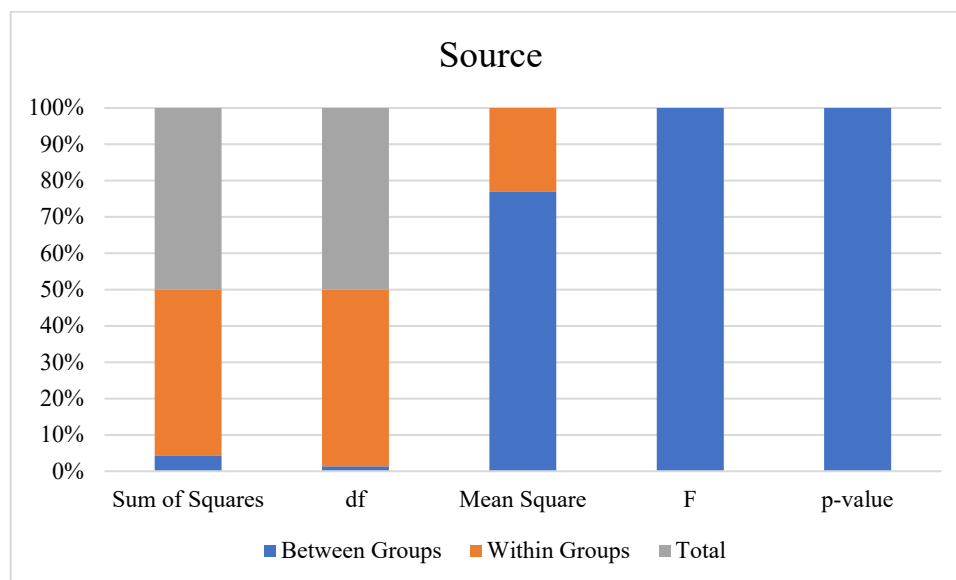


Figure 2: Graphical Representation of One-Way ANOVA: Overall Rehabilitation Effectiveness According to Primary Physiotherapy Intervention

Table 5: Group Mean Scores

Primary Intervention	Mean $\pm$ SD
Exercise Therapy	4.34 $\pm$ 0.49
Manual Therapy	4.25 $\pm$ 0.55
Dry Needling	4.19 $\pm$ 0.58
Shockwave Therapy	4.13 $\pm$ 0.60
Electrotherapy	3.98 $\pm$ 0.67

One way ANOVA showed a statistically significant difference between the effectiveness of rehabilitation using various physiotherapy methods ($F = 3.318$, $p = 0.012$). The highest effectiveness was observed in exercise therapy, followed by manual therapy; the lowest effectiveness was recorded for electrotherapy. Therefore, it can be concluded that the treatment outcome depends on the main approach used for rehabilitation.

Table 6. Model Summary of Multiple Linear Regression Analysis Predicting Overall Rehabilitation Effectiveness

R	R ²	Adjusted R ²	Std. Error
0.654	0.428	0.412	0.445

From the model summary, we can tell that the multiple linear regression model showed some association between the independent variables and the effectiveness of the rehabilitation process ($R = 0.654$). The model has accounted for 42.8% ($R^2 = 0.428$) of the variability in the rehabilitation effectiveness, and the adjusted R^2 of 0.412 clearly shows that the chosen independent variables reliably predict the treatment results. We can conclude that the frequency of the intervention, professionalism in the training, experience in the field and application of new methods of physiotherapy all contribute to rehabilitation effectiveness.

Table 7. ANOVA for Multiple Linear Regression Model

Source	Sum of Squares	df	Mean Square	F	p-value
Regression	24.762	4	6.191	31.287	<0.001
Residual	33.076	145	0.228		
Total	57.838	149			

The output of the ANOVA shows that the regression model is significant ($F = 31.287$, $p < 0.001$). This clearly shows that there exists a significant relationship between the predictor variables and variations in the rehabilitation effectiveness level. Therefore, it is safe to conclude that the regression model fits well.

Table 8. Regression Coefficients Predicting Overall Rehabilitation Effectiveness

Predictor	B	Std. Error	β	t	p-value
Constant	1.527	0.296		5.159	<0.001
Frequency of intervention sessions	0.271	0.061	0.338	4.442	<0.001
Professional training	0.244	0.068	0.276	3.588	<0.001
Clinical experience	0.086	0.042	0.154	2.048	0.042

Use of emerging techniques	0.298	0.063	0.361	4.734	<0.001
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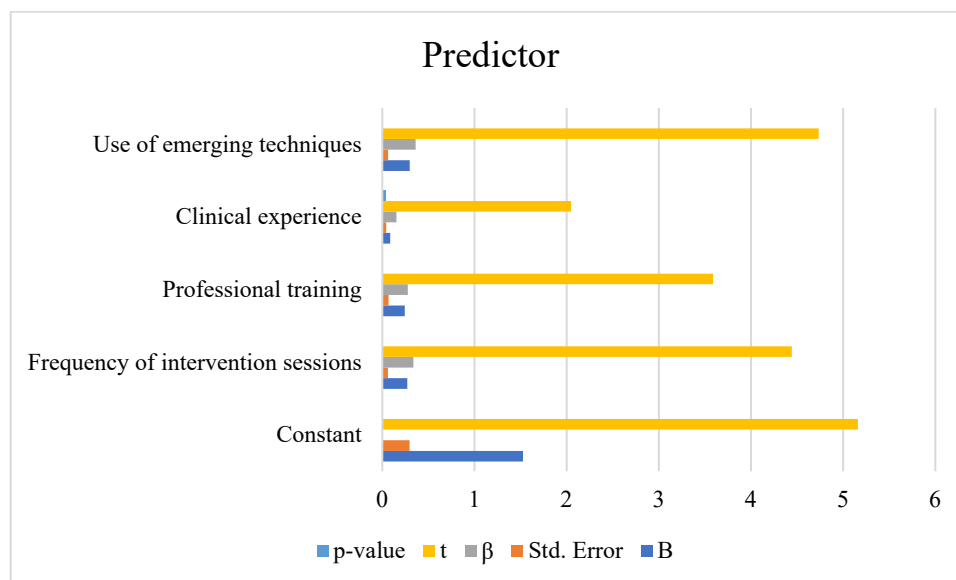


Figure 3: Graphical Representation of Regression Coefficients Predicting Overall Rehabilitation Effectiveness

It is found that emerging physiotherapy techniques ($\beta = 0.361$, $p < 0.001$) are the most important determinant of the efficacy of overall rehabilitation followed by number of interventions ($\beta = 0.338$, $p < 0.001$) and professional training ($\beta = 0.276$, $p < 0.001$). Clinical experience ($\beta = 0.154$, $p = 0.042$) was an important determinant too; however, the impact of clinical experience on rehabilitation outcomes was relatively small. It means that the implementation of the latest rehabilitation techniques, as well as the sufficient amount of professional training and treatment, positively affects rehabilitation outcomes.

4. DISCUSSION

This paper investigates the present trends and newly developed physiotherapy approaches in dealing with sports injuries and the effectiveness of these therapies among physiotherapists. Statistically proven correlations were found between certain features of physiotherapists' work and the outcomes of treatment. These results are helpful in understanding the increasing popularity of modern physiotherapy approaches and the role that they play in reducing pain, functional improvement, and rehabilitation success rate. The discussion considers these results in connection with the study aims, compares them to the latest literature on the topic, points out the clinical significance, limitations, and further research directions.

4.1 Interpretation of Findings

The current study analyzed the latest trends and new physiotherapy techniques utilized for treatment of sports injuries. It has been shown that contemporary physiotherapists consider modern approaches to rehabilitation as very efficient in terms of pain reduction, functional recovery, restoration of range of movement, and return-to-sport activities. The most commonly used conventional physiotherapy approaches include exercise therapy and manual therapy. BFR training, Dry Needling, Shockwave Therapy, and Virtual Reality-assisted rehabilitation represent the new techniques used by physiotherapists. Moreover, physiotherapists who used advanced approaches to rehabilitation achieved much better rehabilitation results compared to the physiotherapists who mostly used conventional techniques. Multiple regression analysis has indicated that professional training, number of rehabilitation sessions, experience of physiotherapists, and utilization of new physiotherapy techniques were among the predictors of rehabilitation efficiency.

4.2 Comparison with Recent Literature

The findings of the present study are consistent with recent research on sports rehabilitation. Souaifi et al. (2025)¹¹ reported that artificial intelligence, wearable technology, and motion analysis improve injury assessment and rehabilitation, supporting the present finding that the use of emerging techniques enhances rehabilitation effectiveness. Similarly, Sulaiman (2024)¹² and Takáč (2025)¹³ emphasized that while exercise therapy and manual therapy remain the foundation of rehabilitation, integrating advanced technologies leads to better functional recovery and return-to-sport outcomes.

Furthermore, the significant influence of professional training, intervention frequency, and modern rehabilitation techniques identified in this study agrees with the findings of Liang et al. (2024)¹⁴ and Nath et al. (2025),¹⁵ who highlighted that multidisciplinary treatment approaches, technology-assisted rehabilitation, and continuous professional education contribute to improved clinical outcomes. Overall, the present findings reinforce the growing evidence supporting the integration of innovative physiotherapy techniques with conventional rehabilitation practices.

4.3 Clinical Implications

There are many significant implications of the findings for the practices of sports physiotherapy:

1. Physiotherapists must incorporate the evidence-based new approaches into their work including BFR training, Dry Needling, ESWT and other techniques as well as the rehabilitation technology.
2. The continuous education and specialized training of clinicians is crucial for enhancing the efficiency of rehabilitation and implementation of new techniques.
3. The individual programs of rehabilitation should be developed depending on the level of injury, therapeutic goals and the type of sport.
4. The sports rehabilitation centers must purchase the new equipment including the sensors, motion analysis system, Virtual Reality and tele-rehabilitation.

4.4 Limitations

There are a number of limitations for the current study that should be noted while interpreting the results:

- The cross-sectional design does not allow any conclusion about the cause-and-effect relationship.
- Results of rehabilitation were mostly based on self-reporting by physiotherapists instead of using objective patient outcomes.
- Sample size, which was 150 patients, can be seen as a limitation of generalization of the results.
- Variation in injury types, rehabilitation periods and sport-specific requirements was not considered separately.
- Follow-up of the long-term effects of rehabilitation on performance was not performed.

4.5 Future Directions

Future studies on sports physiotherapy would need to build up its evidence base by:

- Conducting multi-center longitudinal research with larger and diverse samples of physiotherapists and athletes.
- Comparing traditional physiotherapy treatments with novel rehabilitation therapies through randomized control trials and quantifiable functional outcomes.
- Conducting research to understand the effectiveness of AI-assisted rehabilitation, wearables and Virtual Reality based physiotherapy in the long run.
- Suggesting clinical guidelines for the adoption of advanced physiotherapy techniques in sports injury rehabilitation practices.
- Analyzing patient satisfaction levels, cost-effectiveness and injury recurrence rates through novel rehabilitation techniques.

5. CONCLUSION

The current study assessed the present trends as well as new physiotherapy methods that are employed in managing sports injuries along with the factors affecting rehabilitation effectiveness. It was found that physiotherapy is still one of the most important components in sports injury rehabilitation, where the traditional physiotherapy interventions along with the emerging techniques make for better outcomes. The exercise and manual therapies have still been extensively practiced while the BFR training, Dry Needling, Shockwave Therapy, and Virtual Reality rehabilitation are the techniques that are more and more often used in clinical practice. At the same time, the statistical

analyses showed that the professional training of physiotherapists, frequency of rehabilitation sessions, their experience, and the application of emerging physiotherapy techniques affect rehabilitation outcomes significantly. In other words, the integration of innovative methods with traditional physiotherapy can help improve pain management and functional rehabilitation of athletes.

5.1 Summary of Findings

The important findings from the research include:

- High effectiveness of physiotherapy techniques used for sports injury management was noted.
- Pain reduction was seen to be the highest perceived benefit for rehabilitation, followed by functional recovery and improvement in range of motion.
- The experience of professionals had a strong association with the use of new physiotherapy techniques.
- The physiotherapists that used advanced rehabilitation techniques had significantly more effective rehabilitation processes compared to the ones that used traditional treatments.
- The effectiveness of rehabilitation also varied significantly based on the physiotherapy techniques used.
- The multiple regression analysis showed that the use of new rehabilitation techniques, professional training, frequency of rehabilitation, and clinical experience were the predictors of rehabilitation effectiveness.

5.2 Significance of the Study

This research adds to the already existing literature in the area of sports physiotherapy through a thorough assessment of the existing and new rehabilitation procedures. It brings out the importance of adopting innovations in order to improve the success rate of rehabilitation through evidence-based decision making. The results of this research will help the physiotherapists, sports medicine practitioners, rehabilitation centers, and health care policy makers to develop standard rehabilitation protocol, enhance professional training programs, and adopt advanced rehabilitation technologies.

5.3 Recommendations

On the basis of the results obtained from the study, the following recommendations have been made:

- Physiotherapists Must use emerging rehabilitation techniques based on evidence along with traditional methods of treatment to improve recovery from sports injuries.
- The training of professionals in the advanced methods of physiotherapy should be carried out through regular training programs.

- The rehabilitation program should be customized in accordance with the extent of injury, functional requirements, and demands of the sport.
- The sports rehabilitation centers should adopt the most recent technologies for rehabilitation purposes, including wearable monitoring devices, Virtual Reality, and artificial intelligence-based rehabilitation technology.
- Clinical protocols should be developed to enable the safe and effective implementation of emerging physiotherapy techniques based on evidence.
- The future studies in the field should include large sample size longitudinal studies conducted in multiple centers.

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