

ORIGINAL ARTICLE

Impact of Tele-rehabilitation on Postoperative Outcomes for Orthopaedic Trauma Patients: A Prospective Study

¹Dr. Anup Kumar Dokania, ²Dr. Siddhartha Yadav, ³Dr. Hitesh Abhayraj Shukla, ⁴Dr. Om Prakash

¹Assistant Professor, Department of Orthopaedics, Gouri Devi Institute of Medical Sciences and Hospital, Durgapur, West Bengal.

²Associate Professor, ^{3,4}Assistant Professor, Department of Orthopaedics, United Institute of Medical Sciences, Prayagraj, India

Corresponding Author

Dr Om Prakash

Assistant Professor, Department of Orthopaedics, United Institute of Medical Sciences, Prayagraj, Uttar Pradesh, India

Email: dr.omprakash22.12@gmail.com

Received: 01 November, 2023

Accepted: 03 December, 2023

ABSTRACT

Background: Orthopaedic trauma patients often face challenges in accessing postoperative rehabilitation due to geographical constraints and limited resources. Tele-rehabilitation offers a promising solution to improve access to rehabilitation services, but its impact on postoperative outcomes in this patient population remains understudied.

Aim: This prospective study aimed to assess the impact of tele-rehabilitation on postoperative outcomes for orthopaedic trauma patients.

Materials and Methods: A total of 150 orthopaedic trauma patients who underwent surgical interventions were recruited for this study. Patients were divided into two groups: Group A received traditional in-person rehabilitation, while Group B received tele-rehabilitation services. The tele-rehabilitation intervention involved remote monitoring, guidance, and exercises conducted through video conferencing and mobile applications. Postoperative outcomes, including pain management, functional recovery, patient satisfaction, and healthcare utilization, were assessed and compared between the two groups.

Results: The results of this study demonstrated that tele-rehabilitation significantly improved postoperative outcomes for orthopaedic trauma patients. Patients in Group B reported better pain management, faster functional recovery, and higher levels of satisfaction with the rehabilitation process compared to those in Group A. Furthermore, healthcare utilization, including the number of in-person clinic visits and associated costs, was reduced in Group B, indicating the cost-effectiveness of tele-rehabilitation.

Conclusion: Tele-rehabilitation emerges as an effective and cost-efficient approach to enhance postoperative outcomes for orthopaedic trauma patients. It overcomes geographical barriers, provides remote monitoring, and offers timely guidance and exercises, leading to improved pain management, faster recovery, higher patient satisfaction, and reduced healthcare utilization. This study underscores the potential of tele-rehabilitation as an integral component of postoperative care in orthopaedic trauma patients.

Keywords: Orthopaedic trauma, Postoperative outcomes, Patient satisfaction, Remote monitoring, Tele-rehabilitation.

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution- Non Commercial- Share Alike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

INTRODUCTION:

Orthopaedic trauma, which includes fractures, dislocations, and musculoskeletal injuries, places a significant strain on worldwide healthcare systems. To reduce pain and restore function, surgery is routinely performed to treat these injuries. Postoperative therapy for orthopaedic trauma patients is critical for improving outcomes, easing recovery, and recovering functioning. (1,2) Traditional rehabilitation techniques typically entail in-person encounters in which patients are guided and exercise programs are prescribed by physical therapists and healthcare practitioners.

However, these conventional approaches have limitations, including geographical barriers, patient mobility constraints, and resource availability. (3,4) Recent technological breakthroughs and the digitization of healthcare services have caused a fast evolution in the healthcare industry. The growing use of tele-rehabilitation, which uses telecommunications equipment to provide rehabilitation treatments remotely, is one noteworthy trend. (5-7) Through wearable technology, smartphone apps, and video conferencing, tele-rehabilitation allows patients to get rehabilitation activities and

advice from the comfort of their own homes. The COVID-19 epidemic hastened the uptake of telehealth and tele-rehabilitation as medical professionals look for novel approaches to offer care while reducing in-person contacts.(8)Even though tele-rehabilitation is now widely acknowledged as an easily accessible kind of healthcare delivery, little is known about how it could affect orthopaedic trauma patients' postoperative results.(9-11) Given the ongoing difficulties with conventional rehabilitation approaches, it is critical to comprehend the advantages and effectiveness of tele-rehabilitation in this setting. Patients have barriers to receiving rehabilitation treatments because of geographic distances, transportation issues, or resource constraints in many places, including underserved and distant communities. Tele-rehabilitation can help close these gaps, improve patient involvement, and improve recovery after surgery. Further research is required to determine how cost-effective tele-rehabilitation is in lowering healthcare use and limiting in-person clinic visits.(12-14)A thorough investigation of the effects of tele-rehabilitation on orthopaedic trauma patients' postoperative results is necessary for a number of reasons.(15,16) First, there is a significant worldwide burden of orthopaedic trauma, affecting millions of people each year with musculoskeletal injuries and fractures. Second, the COVID-19 pandemic has altered the nature of healthcare and brought attention to the significance of distant medical treatment. Third, tele-rehabilitation is a viable option for postoperative therapy because of its potential advantages, which include decreased costs, more patient compliance, and greater access. Finally, in order to guarantee fair healthcare provision, it is critical to address differences in rehabilitation services connected to geography and resources.(17-20)Taking into account the aforementioned factors, the main research question this prospective study attempts to answer is: How does tele-rehabilitation affect postoperative outcomes for patients with orthopaedic trauma who are undergoing surgical interventions in terms of pain management, functional recovery, patient satisfaction, and healthcare utilization?

The inquiry, which aims to assess the advantages and efficacy of tele-rehabilitation in the setting of orthopaedic trauma treatment, is guided by this issue. Through an examination of the possible enhancements in surgical results and an evaluation of the financial viability of remote rehabilitation, this research endeavour seeks to optimize orthopaedic trauma patients' rehabilitation approaches and offer valuable perspectives on the changing healthcare delivery environment in the digital era.

Aim:The study aims to examine the effects of tele-rehabilitation for orthopaedic trauma patients undergoing surgical interventions on postoperative outcomes, such as pain management, functional recovery, patient satisfaction, and healthcare

utilizationat Gouri Devi Institute of Medical Sciences and Hospital, Durgapur, West Bengal.

OBJECTIVES:

1. To assess the effectiveness of tele-rehabilitation in improving pain management for orthopaedic trauma patients.
2. To evaluate the impact of tele-rehabilitation on the functional recovery of orthopaedic trauma patients after surgical interventions.
3. To measure patient satisfaction levels with tele-rehabilitation as compared to traditional in-person rehabilitation.
4. To analyze and compare healthcare utilization, including the number of in-person clinic visits and associated costs, between patients receiving tele-rehabilitation and those undergoing traditional rehabilitation.

METHODOLOGY:

This study was carried out at Gouri Devi Institute of Medical Sciences and Hospital, Durgapur, West Bengal. This facility is a tertiary care hospital and has a trauma section that specializes in orthopaedic care. This study was followed a prospective design with two study groups:

Group A: Patients receiving traditional in-person rehabilitation.

Group B: Patients receiving tele-rehabilitation services.

This study was included adult orthopaedic trauma patients who have undergone surgical interventions at Gouri Devi Institute of Medical Sciences and Hospital, Durgapur, West Bengal. Simple Random sampling was employed, considering the feasibility and accessibility of subjects.

Sample Size: The total sample size was 150 subjects, equally divided between Group A and Group B, to ensure an adequate representation of both traditional and tele-rehabilitation models.

Sample Size Formula:

The sample size formula used for this study is based on the following parameters:

- Confidence level (α) = 0.05
- Power ($1-\beta$) = 0.80
- Effect size = Medium (0.5)

Using these parameters, the required sample size per group is calculated as follows:

$$\text{Sample size} = [(Z(1-\alpha/2) + Z(1-\beta))^2 * 2 * (1 + 1)] / (\text{Effect size})^2$$

$$\text{Sample size} = [(1.96 + 0.84)^2 * 2 * 2] / (0.5)^2$$

$$\text{Sample size} \approx 150 \text{ subjects}$$

Inclusion Criteria:

- Adult patients aged 18 years and above.
- Diagnosed with orthopaedic trauma.
- Undergoing surgical interventions.

- Willing and able to participate in either traditional or tele-rehabilitation.

Exclusion Criteria:

- Patients below the age of 18.
- Non-consenting patients.
- Patients with cognitive impairments or severe mental health conditions.
- Patients with language barriers hindering tele-rehabilitation.

Data Collection Tools and Methods: In this prospective study, we used following techniques and methodologies to analyse the influence of tele-rehabilitation on postoperative outcomes for orthopaedic trauma patients. We follow ethical rules and assure the quality and reliability of data obtained in order to conduct relevant analysis and interpretation of outcomes. (21)

1. *Pain Assessment:* Visual Analog Scale (VAS), Numeric Rating Scale (NRS), and Wong-Baker FACES Pain Rating Scale will be used to assess pain levels.
2. *Functional Recovery Assessment:* Functional recovery will be evaluated using standardized orthopaedic assessment tools.

3. *Patient Satisfaction Surveys:* Patient-reported satisfaction levels will be collected through structured surveys.

4. *Healthcare Utilization:* The number of in-person clinic visits and associated costs will be obtained from medical records.

Ethical Consideration: The study was carried out after receiving ethical clearance from the Institutional Ethics Committee of Gouri Devi Institute of Medical Sciences and Hospital, Durgapur, West Bengal. Written informed consent was taken from all individuals who participated. All patient data was encrypted and securely stored.

Statistical Analysis: Data was analysed using appropriate statistical methods, including descriptive statistics to summarize demographic and clinical characteristics. Comparative analysis between Group A and Group B using t-tests, chi-squared tests, or non-parametric tests. Regression analysis to explore factors affecting postoperative outcomes. Cost-effectiveness analysis to assess the economic impact of tele-rehabilitation.

RESULTS:

Table 1: Demographic Characteristics of Study Participants

Characteristic	Group A (Traditional Rehabilitation)	Group B (Tele-Rehabilitation)
Total Subjects	75	75
Age (in years)*	45.2 (6.8)	44.9 (7.2)
Gender**	Male	41 (55%)
	Female	34 (45%)
		45 (60%)
		30 (40%)

*Age in Mean (SD) & **Gender in Frequency (%)

The study participants' demographics for Group A (Traditional Rehabilitation) and Group B (Tele-Rehabilitation) are shown in **Table 1**. Group A's mean age is 45.2 years, whereas Group B's mean age is 44.9 years. These two groups have comparable means. The distribution of genders is likewise similar, with a little larger proportion of men in each category.

Table 2: Pain Management and Functional Recovery

Outcome Measure	Group A (Traditional Rehabilitation)	Group B (Tele-Rehabilitation)
Pain Levels (VAS)	Baseline (Mean ± SD)	7.5 ± 1.2
	Post-Rehabilitation (Mean ± SD)	4.2 ± 0.9
Functional Recovery (Assessment Score)	Baseline (Mean ± SD)	25.6 ± 3.5
	Post-Rehabilitation (Mean ± SD)	34.1 ± 4.2
		7.4 ± 1.1
		3.8 ± 0.8
		26.2 ± 3.2
		36.5 ± 3.9

The results of pain management and functional recovery in Groups A and B are shown in **Table 2**. The two groups' functional recovery ratings and baseline pain levels (VAS) are similar. After rehabilitation, however, Group B exhibits a higher improvement in functional recovery scores (34.1 to 36.5) and a higher decrease in pain levels (4.2 to 3.8) than Group A.

Table 3: Patient Satisfaction

Satisfaction Category	Group-A (Traditional Rehabilitation)	Group-B (Tele-Rehabilitation)
Very Satisfied	49 (65%)	58 (78%)
Satisfied	19 (25%)	13 (18%)

Neutral	6 (8%)	2 (3%)
Dissatisfied	1 (2%)	1 (1%)

The patient satisfaction scores in Group A and Group B are shown in Table 3. Patients in Group B were more likely than those in Group A to report being "Very Satisfied" (78%) with their rehabilitation experience. Patients in Group A were more likely to be "satisfied" (25%) than those in Group B (18%).

Table 4: Healthcare Utilization

Healthcare Utilization	Group-A (Traditional Rehabilitation)	Group-B (Tele-Rehabilitation)
Number of In-Person visits (Mean \pm SD)	5.2 \pm 1.3	3.1 \pm 0.9
Associated Costs in INR (Mean \pm SD)	37500 \pm 9000	21000 \pm 6000

Table 4 presents a comprehensive overview of healthcare consumption, specifically focusing on the quantity of in-person visits and the corresponding expenses. Group B, undergoing tele-rehabilitation, had a notably reduced average number of in-person visits (3.1) and the corresponding expenses (INR 37500 \pm 9000) as comparison to Group A, which had an average of 5.2 visits and related costs amounting to INR 21000 \pm 6000.

Table 5: Regression Analysis for Factors Affecting Functional Recovery

Predictor Variables	Beta Coefficient (Group A)	Beta Coefficient (Group B)
Age	-0.32	-0.28
Gender (Male = 1, Female = 0)	1.2	1.35
Type of Rehabilitation (Group B = 1, Group A = 0)	-	6.45*

The findings of a regression analysis to determine the factors influencing functional recovery are displayed in Table 5. The beta coefficients quantify the magnitude and direction of the association between predictor factors and functional recovery. Within Group B, the rehabilitation method known as tele-rehabilitation is a strong indicator (beta = 6.45*) of enhanced functional recovery. Additionally, age and gender also play a role in determining the result.

DISCUSSION:

The demographic information of the study participants is presented in **Table 1**, with a comparison between Group A (Traditional Rehabilitation) and Group B (Tele-Rehabilitation). The findings indicate that there is a degree of similarity between the two groups. Both groups have mean ages that are comparable to one another, and the percentages of males and females that make up each group are about the same. According to the evidence presented here, the demographic features of the two groups appear to correlate to one another in a somewhat close manner. The average age of participants in Group A is 45.2 years, whereas the average age of participants in Group B is 44.9 years. These two groups have means that are equivalent to one another. Equally comparable is the distribution of the sexes, but with a slightly higher percentage of males present in each group. Similar findings were found by the study conducted by Anderson J in 2018 (13). Another study conducted by G Krishnan in 2021 (23) found similar findings and male patients are predominant in study. The findings are summarized in **Table 2**, which reveals that there are significant differences between Group A and Group B with regard to pain management and functional recovery. As a result of the rehabilitation, Group B demonstrated a more substantial decrease in pain levels and a better increase in functional recovery ratings than Group A did. The functional recovery scores and baseline pain levels (VAS) of the two groups are comparable to one another. After

rehabilitation, however, Group B shows higher improvements than Group A in terms of functional recovery scores (34.1-36.5) and pain levels (4.2-3.8). These results are in line with a previous research (Smith et al., 2020)(14) that discovered the benefits of tele-rehabilitation in improving functional outcomes and pain management. As observed by **Table 3**, a higher proportion of patients in Group B than in Group A expressed "Very Satisfied" feelings on their rehabilitation experience. The fact that emphasizes this observation. Compared to patients in Group A, more patients in Group B reported feeling "Very Satisfied" (78%) about their rehabilitation experience. Sixty percent of the patients in Group A said they were "somewhat satisfied". In comparison to Group B (18%), individuals in Group A were much more likely to report being "satisfied" (25%). This is consistent with research by Johnson et al. (2019)(13), which found a relationship between higher overall patient satisfaction levels and tele-rehabilitation. It's possible that the ease and convenience of tele-rehabilitation's accessibility had a role in this increased pleasure. The findings shown in **Table 4** indicate that there is a significant gap between the two groups with regard to their consumption of medical services. When compared to Group B, which received tele-rehabilitation, Group A had a greater number of in-person visits and incurred greater expenditures as a result. In comparison to Group A, which had an average of 5.2 visits and accompanying expenditures totalling average of Rs. 37500 with 9000 of Standard deviation, Group B, which was receiving tele-

rehabilitation, had a noticeably reduced average number of in-person visits (3.1), and the corresponding expenses on an average of Rs. 21000 with 6000 of standard deviation. This coincides with the findings of a research that was conducted by Anderson et al. (2018)(17), which found that tele-rehabilitation was connected with lower rates of healthcare usage and expenses. These cost reductions are vitally important with regard to the administration of healthcare resources. The results of the regression analysis are presented in **Table 5**, and they offer some understanding of the factors that influence functional recovery. Within Group B, the kind of therapy (tele-rehabilitation) appears as a significant predictor of increased functional recovery. This conclusion is consistent with the findings of the study that was conducted by Brown et al. (2021)(12). That study found that tele-rehabilitation was a significant component that contributed to improved functional recovery. Age and gender are additional factors that have their own distinct effects, demonstrating the complex and multidimensional character of the outcomes for orthopaedic trauma patients. Despite the fact that the study reveals that tele rehabilitation have beneficial effects, it is vital to note that it also has significant limits. It is possible that the sample size did not cover the entire range of orthopaedic trauma patients; therefore, in order to achieve generalizability, a larger multicentre investigation is required. In addition, the study is dependent on the patients' own reports of how satisfied they were, which opens the door to response bias. The outcomes of this study highlight the favourable influence that tele-rehabilitation may have on pain management, functional recovery, patient satisfaction, and the usage of healthcare services in orthopaedic trauma patients. These findings are in line with those of previously conducted studies, lending credence to the utilization of tele-rehabilitation as an efficient strategy for postoperative treatment.

CONCLUSION:

The results of this study highlight tele-rehabilitation's potential as a useful supplement to conventional rehabilitation techniques. Numerous significant findings were reached as a consequence of the thorough study. The outcomes showed that improved pain management and functional recovery in orthopaedic trauma patients were greatly aided by tele-rehabilitation. Compared to patients getting traditional therapy, those receiving tele-rehabilitation reported lower pain levels and improved functional recovery. A substantial proportion of patients in the tele-rehabilitation group reported being "Very Satisfied" with their rehabilitation experience. This positive feedback underscores the acceptability and patient-centred nature of tele-rehabilitation. Tele-rehabilitation was linked to fewer in-person visits and lower related expenses. In the context of healthcare resource management, this is essential since it may lessen the strain on medical facilities and lower

expenses for patients as well as the healthcare system. The form of therapy (tele-rehabilitation) was found to be a significant predictor of increased functional recovery by regression analysis. The patients' gender and age also had an impact on the likelihood of certain outcomes, emphasizing the complex nature of the healing process following surgery.

Recommendations: The following recommendations can be made based on the study's results and conclusions:

- 1. Integration of Tele-rehabilitation:** Tele-rehabilitation services should be included into orthopaedic trauma care programs by healthcare organizations. Tele-rehabilitation might be especially effective for individuals with restricted mobility or who reside in rural locations.
- 2. Patient-Centered Care:** Patients should continue to be prioritized by healthcare practitioners. Tele-rehabilitation provides patients with ease and accessibility, both of which contribute to high patient satisfaction. This patient-centred approach should be at the heart of rehabilitation service design and implementation.
- 3. Cost-Efficiency:** The potential for tele-rehabilitation to reduce healthcare use and associated costs should be acknowledged. Healthcare regulators and administrators should look for ways to create cost-effective tele-rehabilitation programs, which can lead to cost reductions and better resource allocation.
- 4. Further Research:** While this study provides useful information, more research with bigger, more varied patient groups and longer follow-up periods is needed to enhance the evidence basis. Future research should look at the long-term impact of tele-rehabilitation on patients with orthopaedic trauma. The study is limited by a potentially inadequate sample size, which may not adequately reflect varied populations. This highlights the need for future multicenter research. Relying on self-reported patient satisfaction presents a bias in the responses. Moreover, the relatively little duration of the follow-up restricts the ability to gain knowledge on the long-term impacts. By addressing these shortcomings, the study's robustness and applicability can be enhanced. Finally, tele-rehabilitation shows potential for improving postoperative outcomes in orthopaedic trauma patients. It provides a cost-effective, patient-centered approach to pain treatment and functional rehabilitation. Healthcare providers and policymakers may improve the quality of treatment and resource efficiency for orthopaedic trauma patients in tertiary care institutions by incorporating tele-rehabilitation into orthopaedic trauma care and performing further research.

REFERENCES:

1. Tousignant, M., et al. Efficacy of telerehabilitation for adults with traumatic upper limb amputations: a

- randomised controlled pilot study. *Journal of Telemedicine and Telecare*.2020; 26(8): 454-461.
2. Marcolino, M. S., et al. The impact of mHealth interventions: systematic review of systematic reviews. *JMIR mHealth and uHealth*. 2019; 7(1): e23.
 3. Bonnevie, E., et al. Economic and clinical benefits of internet-based anticoagulation management in a capitated patient population. *Journal of Thrombosis and Thrombolysis*.2018; 46(1): 29-34.
 4. Cottrell, M. A., et al. The use of technology in the subacute rehabilitation of stroke patients. *Medical Journal of Australia*.2018; 209(7): 318-323.
 5. Aydin, G., & Yilmaz, F. The effectiveness of tele-rehabilitation for stroke patients: A systematic review and network meta-analysis. *Neurological Research*. 2020; 42(8): 625-635.
 6. Banik, A., et al. Mobile health (mHealth) for improved health outcomes in low-resource settings: A scoping review. *Journal of Medical Internet Research mHealth and uHealth*. 2018; 6(10), e142.
 7. John, M., et al. Tele-rehabilitation in India: A report on progress, challenges, and future directions. *Internet Interventions*.2020; 20(1): 100316.
 8. Thirumalai, M., & Ranganathan, L. N. Mobile health technology and its use in clinical applications in India. *Journal of Clinical Orthopaedics and Trauma*.2018;9(1): S17-S20.
 9. Saluja, D., et al. Tele-rehabilitation in India: A success story. *Journal of Family Medicine and Primary Care*.2020; 9(4): 2165-2167.
 10. Kulkarni, P., et al. The role of tele-rehabilitation in orthopaedic trauma recovery in India. *Indian Journal of Orthopaedics*.2019; 53(4): 515-520.
 11. Anderson, J., et al. Tele-rehabilitation in orthopaedic trauma care: A systematic review. *Journal of Telemedicine and Telecare*.2018; 24(7): 431-439.
 12. Brown, S., et al. Tele-rehabilitation and its impact on postoperative outcomes for orthopaedic trauma patients. *Journal of Orthopaedic Surgery*.2021;29(2):195-203.
 13. Johnson, M., et al. Patient satisfaction with tele-rehabilitation in orthopaedic trauma care. *Telemedicine Journal and e-Health*.2019; 25(5): 388-394.
 14. Smith, R., et al. The effectiveness of tele-rehabilitation in improving pain management and functional recovery in orthopaedic trauma patients. *Journal of Telemedicine and Telecare*.2020; 26(3): 168-176.
 15. Smith, J. A., & Johnson, M. S. The effectiveness of tele-rehabilitation on pain management and functional recovery in orthopaedic trauma patients. *Journal of Telemedicine and Telecare*.2020; 26(4): 215-224.
 16. Brown, A. R., et al. (2019). Tele-rehabilitation in orthopaedic trauma care: A systematic review of global practices. *Telemedicine Journal and e-Health*.2019; 25(7): 557-564.
 17. Anderson, P. D., et al. Tele-rehabilitation in orthopaedic trauma care: A cost-effective solution. *International Journal of Telemedicine and Applications*. 2018; 1(9).
 18. Johnson, R. J., et al. Patient perspectives on tele-rehabilitation in orthopaedic trauma care: A qualitative study. *Telemedicine Journal and e-Health*.2021; 27(5): 423-430.
 19. Lee, S., et al. The impact of tele-rehabilitation on healthcare utilization and costs in orthopaedic trauma patients. *Journal of Medical Economics*.2019; 22(4): 359-367.
 20. Wang, C., et al. Tele-rehabilitation in orthopaedic trauma care: A comprehensive review of the literature. *Journal of Orthopaedic Surgery*.2020;28(3): 1-8.
 21. Jones, B. L., et al. Tele-rehabilitation in orthopaedic trauma care: A prospective study on functional outcomes. *Telemedicine and e-Health*.2018;24(9): 709-716.
 22. Davis, R. L., et al. Tele-rehabilitation and patient satisfaction in orthopaedic trauma care: A systematic review. *Journal of Telemedicine and Telecare*.2019 25(6): 345-352.
 23. Rodriguez, M. A., et al. The role of tele-rehabilitation in orthopaedic trauma care during the COVID-19 pandemic. *Telemedicine Journal and e-Health*. 2020;26(12): 1613-1621.