

# Telerehabilitation for musculoskeletal disorders during the COVID-19 pandemic

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## ABSTRACT

**Aim:** To evaluate the clinical effectiveness of telerehabilitation for various musculoskeletal disorders during the COVID-19 pandemic.

**Methods:** This is a retrospective analysis of patients who underwent musculoskeletal telerehabilitation at a well-established physiotherapy centre in Central India between 1<sup>st</sup> April – 30<sup>th</sup> June 2020. A team of two experienced physiotherapists conducted one-on-one video-based physiotherapy sessions for every patient. The main outcome measures included pain reduction using the Numeric Pain Rating Scale (NPRS), functional goals achieved, and patient satisfaction. The effectiveness of treatment was determined based on the change in NPRS scores using the Wilcoxon signed-rank test. The relationship of percent change in NPRS and the functional score as well as the patient feedback score was obtained using Pearson's correlation coefficient.

**Results:** Of 77 patients who received telerehabilitation during the study period, 31 patients undergoing musculoskeletal rehabilitation who satisfied the eligibility criteria were included. There was a significant reduction in NPRS scores after rehabilitation ( $P < 0.0001$ ). However, the median number of sessions and the baseline NPRS scores differed insignificantly for various patient characteristics. The distribution of functional score and change in NPRS demonstrated a moderately positive and significant correlation ( $P = 0.001$ ). The relationship of patient feedback score with the change in NPRS was low positive.

**Conclusion:** Telerehabilitation resulted in significant pain reduction among patients with various musculoskeletal disorders during the COVID-19 pandemic. A positive correlation was demonstrated between change in NPRS scores, patient-reported functional goals, and patient satisfaction. Hence, telerehabilitation provided by a trained physiotherapist can be an effective approach for conservative management of musculoskeletal pain.

**KEYWORDS:** Telerehabilitation, Musculoskeletal disorder, Back pain, COVID-19.

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## INTRODUCTION

Musculoskeletal disorders are a leading cause of morbidity and disability globally. The

Global Burden of Disease study 2019 has estimated that low back pain is responsible for 2.5% of global disability-adjusted life years

(DALYs), while other musculoskeletal disorders are responsible for 1.6% of global DALYs [1]. It has also identified low back pain as the most prevalent condition that would benefit from rehabilitation globally [2]. These patients require physical therapy and rehabilitation to improve physical functioning, mental status, and quality of life. Clinical guidelines recommend non-surgical conservative care as the first-line approach for the management of most musculoskeletal disorders in the absence of red flag pathologies [3].

Coronavirus disease 2019 (COVID-19) caused by Severe Acute Respiratory Syndrome Coronavirus-2 infection is the biggest public health catastrophe in recent times [4].

Currently, India is ranked 2<sup>nd</sup> in the world after the United States to report 10,207,871 confirmed cases and 147,901 deaths as per the World Health Organization's (WHO) update dated 28<sup>th</sup> December 2020 [5]. The implementation of lockdown measures and the need for social distancing in the current COVID-19 pandemic has led to the rapid adoption of telehealth services. Taking up digital health interventions has been the only feasible approach for many institutions to manage their patients. The World Confederation for Physical Therapy (WCPT) / International Network of Physiotherapy Regulatory Authorities (INPTRA) Digital Physical Therapy Practice Task Force has concluded that the goal of digital physiotherapy is to facilitate the "effective delivery of physical therapy services by improving access to care and information and managing health care resources" [6].

Telerehabilitation refers to the use of information and communication technology to deliver rehabilitation services to people remotely [7]. Patient assessment, therapeutic interventions, remote monitoring of progress, education, and counselling are some of the services that can be provided in the comfort of their homes [8]. Access and adherence to usual in-person care can be difficult for many individuals due to higher out-of-pocket expenses and longer travel time. With the recent advancements in digital technology and the ready availability of video-conferencing devices like smartphones, tablets, etc., the use

of telephysiotherapy can yield better clinical outcomes by increasing patient engagement [9,10]. Self-engagement induces a behavioural change and has a positive impact on the overall clinical outcome. Lack of adequate skills to deliver telecare safely and effectively may be a barrier for some therapists [11].

While the effectiveness of telerehabilitation has been established in developed countries, it is still an emerging practice in developing nations. Numerous studies from the developed world have concluded that remote rehabilitation is an effective alternative to centre-based treatment for providing quality services with high patient satisfaction [12-16]. Some of the documented studies have also reported higher patient satisfaction levels with teletherapy as compared to in-person care [17]. The potential of digital therapy in resource-poor nations needs to be assessed to reduce the economic costs and promote wider adoption of these services.

The purpose of the present study was to evaluate the clinical effectiveness of telerehabilitation for various musculoskeletal disorders during the COVID-19 pandemic.

## MATERIALS AND METHODS

**Study Design:** In this retrospective observational study, the case records of patients who underwent musculoskeletal telerehabilitation between 1<sup>st</sup> April – 30<sup>th</sup> June 2020 at a well-established physiotherapy centre in Central India were retrieved (from the computerized database) after ethical committee approval. All patients more than 18 years of age who had been advised physiotherapy for musculoskeletal pain and those with video-conferencing facilities at home were included. Patients undergoing less than 10 telerehabilitation sessions over two weeks were excluded. Patients of neuro, vestibular, gynaecological, and post-pregnancy rehabilitation were also excluded. The baseline characteristics recorded in the computerized database included age, gender, occupation, BMI, presence of systemic illness, joint involved, pain duration, and Numeric Pain Rating Scale (NPRS) scores. A standardized patient care pathway was followed which included pre-treatment

assessment, telerehabilitation, and post-treatment feedback.

**Telerehabilitation protocol:** After a thorough history-taking and clinical assessment on video-consultation, a customized treatment protocol was designed for each patient by a single senior physiotherapist (>30 years of experience). The underlying problem was discussed with each patient using a 3D anatomy model before starting rehabilitation. Every patient was asked to identify their functional goals at the beginning of treatment. Prior diagnostic work-up, lifestyle, comorbidities, and self-reported functional goals were also considered while planning treatment. All the patients underwent one-on-one video-based physiotherapy sessions with a trained physiotherapist (>5 years of experience). The therapist closely observed patient movements and actively engaged with them regarding the exercises performed. The camera feed of the patient served as a mirror, thus providing a second level of corrective feedback. In case the patient faced difficulty, a mobile application (PhysiApp) showing instructional videos on how to perform exercises was also used. Alternative equipment readily available at home were used for exercises. Regular review sessions were conducted to monitor clinical progress and ensure patient safety by the senior physiotherapist. Thus, the different aspects of the program included the initial assessment, treatment, and review sessions which were performed by two physiotherapists. Each exercise session was conducted using a video-conferencing tool with an average duration of 35-40 minutes. The sessions were conducted on a daily or alternate basis for most patients depending on patient condition and convenience. The telerehabilitation program was declared complete when both the therapist and the patient were satisfied with the patient's progress.

**Outcome measures:** The outcome was measured based on three parameters – pain intensity assessed using NPRS score, self-reported functional goals, and patient satisfaction. The NPRS is an 11-point scale to evaluate pain in the range of 0-10 with higher

scores suggestive of greater pain intensity (0 being no pain and 10 being the worst imaginable pain). Patients were orally asked to state the numeric value on this scale which best describes the intensity of their pain in the last 24 hours. For every patient, two values (baseline and completion of treatment) of NPRS scores were retrieved from the case records. Our definition of minimal improvement in pain was a 30% or 3-point reduction in the NPRS score from the baseline [10]. The weighted average of goals achieved by the end of treatment was calculated to derive a functional score in the range of 0-1. A pretested validated questionnaire on a 5-point Likert scale was used to evaluate the patient experience during the program. The feedback from all the patients was retrieved from the database for analysis.

**Statistical Analysis:** The data on demographic, socio-economic, and joint pain related parameters was retrieved from the database for analysis. The NPRS scores taken before and after treatment were summarized in terms of mean and standard deviation. The effectiveness of treatment was determined based on the change in NPRS scores using the Wilcoxon signed-rank test. The median number of sessions and the baseline NPRS scores were compared for different patient characteristics using the Wilcoxon rank-sum test. The relationship of percent change in NPRS and the functional score as well as patient feedback score was obtained using Pearson's correlation coefficient. All the analyses were performed using SPSS ver. 20.0 (IBM Corp. ARMONK USA) software and the statistical significance was tested at a 5% level.

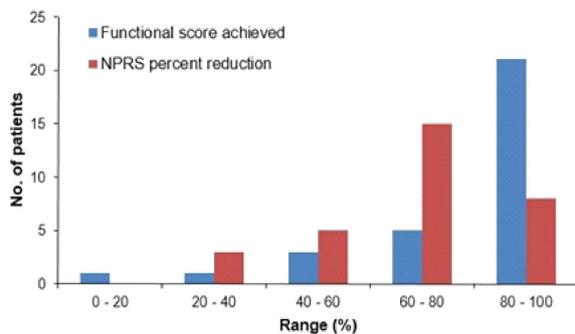
## RESULTS

We provided telerehabilitation services to a total of 77 patients during the study period. These included patients of musculoskeletal (46), neuro (11), vestibular (8), gynaecological (5), and post-pregnancy rehabilitation (7). Out of 46 patients who underwent musculoskeletal rehabilitation, 31 satisfying the eligibility criteria were included. The mean age of patients was 46.10 (SD: 14.33) years, and there were 18 females and 13 males. The mean BMI

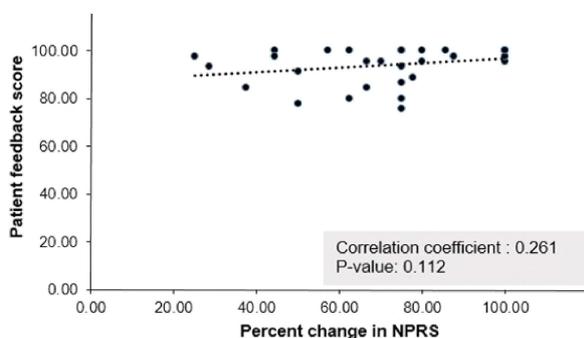
of patients was 25.71 (SD: 3.69) kg/m<sup>2</sup> (Table 1). The majority of cases had back pain (45.16%), followed by the shoulder (19.35%) and neck (12.9%) pain. There were 21 (67.7%) cases who presented with chronic pain. The mean NPRS score at baseline was 7.48 (SD: 1.84).

The comparison of NPRS scores before and after telerehabilitation was obtained as shown in Table 2. The analysis was performed according to different patient characteristics. The median number of sessions and the baseline NPRS scores differed insignificantly ( $P > 0.05$ ) for different patient characteristics. However, the before and after-rehabilitation NPRS scores showed a statistically significant difference as indicated by  $P < 0.0001$ .

The distribution of functional score and NPRS percent reduction showed a positive association as shown in Figure 1. A correlation analysis between the two resulted in a moderately positive relationship (correlation coefficient = 0.547), which was statistically significant ( $P = 0.0015$ ) as shown in Figure 2.

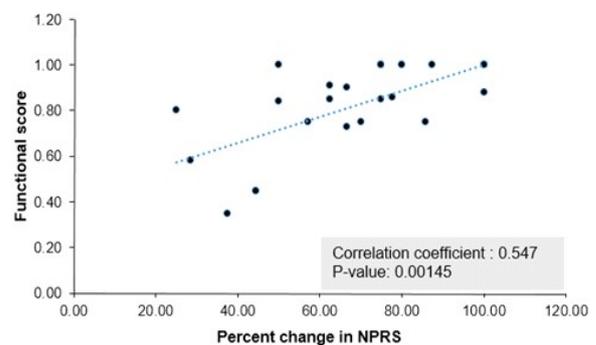


**Fig. 1:** Histogram showing frequencies of the functional score achieved and NPRS reduction (%).



**Fig. 3:** Scatter plot showing the relationship between percent change in NPRS and patient feedback score.

The feedback of patients on various aspects of telerehabilitation was obtained and summarized in Table 3. Out of 31 patients, 21 (67.7%) were very confident with the video-based treatment, and 25 (80.6%) agreed that they would definitely recommend it to others. The online treatment was definitely found as effective as traditional sessions at the physiotherapy centre by 14 (45.2%) patients. None of our patients reported any issues related to audio-visual clarity. As high as 25 (80.6%) patients were satisfied with telerehabilitation and 30 (96.8%) patients expressed the convenience of timings. With respect to the cost-effectiveness of the treatment modality, 19 (61.3%) patients expressed strong agreement and 10 (32.3%) indicated agreement. The overall treatment experience was rated as very good by 26 (83.9%) and good by 5 (16.1%) patients. The relationship of patient feedback score with percent change in NPRS was low positive and statistically insignificant ( $P = 0.112$ ) as shown in Figure 3.



**Fig. 2:** Scatter plot showing the relationship between percent change in NPRS and the functional score achieved.

**Table 1:** Demographics and baseline characteristics.

Characteristics Categories		Descriptive statistics
Age (years) [Mean (SD)]		46.10 (14.33)
Sex [No. (%)]	Female	18 (58.1)
	Male	13 (41.9)
Occupation [No. (%)]	Unemployed	16 (51.6)
	Employed	15 (48.4)
BMI (kg/m <sup>2</sup> ) [Mean (SD)]		25.71 (3.69)
Systemic illness [No. (%)]	No	18 (58.1)
	Yes	13 (41.9)
Joint [No. (%)]	Back	14 (45.16)
	Neck	4 (12.90)
	Shoulder	6 (19.35)
	Other	7 (22.58)
Pain duration [No. (%)]	Acute	3 (9.67)
	Sub-acute	7 (22.58)
	Chronic	21 (67.7)
Baseline NPRS [Mean (SD)]		7.48 (1.84)

**Table 2:** NPRS score before and after telerehabilitation for different patient characteristics.

Characteristics	Sessions	Baseline NPRS	End NPRS	P-value*	
		Mean (SD); Median			
Age in years	<=45	17.44 (10.45); 12.05	7.37 (1.86); 8	2.25 (1.84); 2.5	< 0.0001
	>45	19.20 (16.05); 13	7.60 (1.88); 8	2.26 (1.75); 2	< 0.0001
Sex	Female	19.94 (15.99); 13	7.67 (1.81); 8	2.38 (1.75); 2	< 0.0001
	Male	16.00 (8.21); 13	7.23 (1.92); 8	2.07 (1.85); 2	< 0.0001
Occupation	Unemployed	19.56 (15.89); 13	7.63 (1.93); 8	2.19 (1.38); 2	< 0.0001
	Employed	16.93 (10.10); 13	7.33 (1.80); 8	2.33 (2.16); 2	< 0.0001
Systemic illness	No	16.83 (9.98); 12.5	7.44 (1.95); 8	2.17 (1.86); 2	< 0.0001
	Yes	20.31 (17.04); 14	7.54 (1.76); 8	2.38 (1.71); 2	< 0.0001
Pain duration	Acute	39.00 (32.42); 33	8.67 (0.58); 9	2.33 (0.58); 2	< 0.0001
	Sub-acute	19.57 (10.75); 14	7.71 (1.50); 8	1.43 (1.13); 2	< 0.0001
	Chronic	14.90 (6.84); 12.50	7.24 (2.02); 8	2.52 (1.99); 2	< 0.0001
Joint	Back	14.85 (6.48); 12.5	7.28 (2.23); 8	2.35 (1.78); 2	< 0.0001
	Neck	12.75 (3.77); 11.5	7.00 (2.00); 8	2.00 (2.16); 1.5	< 0.0001
	Shoulder	15.33 (6.68); 13.0	7.83 (0.40); 8	2.00 (2.09); 1.5	< 0.0001
	Other	15.50 (3.69); 16.0	7.85 (1.86); 9	2.43 (1.61); 3.0	< 0.0001
<b>Overall</b>		18.29 (13.25); 13.0	7.48 (1.84); 8	2.26 (1.77); 2	< 0.0001

\*P-value obtained using Wilcoxon signed-rank test

**Table 3:** Patient feedback for Telerehabilitation.

Question item	Levels	No. (%)	Question item	Levels	No. (%)
Confidence with video-based treatment	Very confident	21(67.7)	Satisfaction with treatment	Very satisfied	25(80.6)
	Fairly confident	7 (22.6)		Satisfied	6 (19.4)
	Not sure	1 (3.2)		Not sure	0 (0.0)
	Slightly confident	2 (6.5)		Dissatisfied	0 (0.0)
	Not confident at all	0 (0.0)		Very dissatisfied	0 (0.0)
Recommendation to others	Definitely recommend	25(80.6)	Convenience of timings	Very convenient	30(96.8)
	Probably recommend	4 (12.9)		Fairly convenient	0 (0.0)
	Not sure	2 (6.5)		Not sure	0 (0.0)
	Probably not recommend	0 (0.0)		Somewhat inconvenient	0 (0.0)
	Definitely not recommend	0 (0.0)		Very inconvenient	1 (3.2)
Teletherapy effectiveness against traditional	Definitely yes	14(45.2)	Cost-effectiveness	Strongly agree	19(61.3)
	Probably yes	9 (29)		Agree	10 (32.3)
	Not sure	5 (16.1)		Not sure	0 (0.0)
	Probably not	2 (6.5)		Disagree	1 (3.2)
	Definitely Not	1 (3.2)		Strongly disagree	1 (3.2)
Visual clarity	Very clear	31 (100)	Overall experience	Good	5 (16.1)
	Mostly clear	0 (0.0)		Very good	26(83.9)
	Not sure	0 (0.0)		Average	0 (0.0)
	Not really clear	0 (0.0)		Bad	0 (0.0)
	Not at all clear	0 (0.0)		Very bad	0 (0.0)
Audio clarity	Very clear	31 (100)			
	Mostly clear	0 (0.0)			
	Not sure	0 (0.0)			
	Not really clear	0 (0.0)			
	Not at all clear	0 (0.0)			

**DISCUSSION**

Telecare promotes the standardization of treatment protocols and addresses the local shortage of therapists to deal with the ever-increasing burden of musculoskeletal problems [18]. The benefits of telerehabilitation are manifold for both the patient and

the therapist. A teletherapist can cater to remote patients with disabilities negating the access issues to a physiotherapy centre. Access to high-quality care despite geographical isolation, reduced travel and waiting time, flexibility, and cost-effectiveness are some of the benefits to the patient [19]. On the other

hand, difficulty to navigate through the system due to limited computer literacy, unreliable internet connection, language barrier, inability to perform an actual physical assessment, patient privacy, and safety concerns are some of the challenges associated with digital health interventions [20-22]. Therefore the appropriate selection of patients and communication technology is crucial for the success of digital therapy.

The nation-wide lockdown during the COVID-19 pandemic prompted us to come up with a digital physiotherapy program. Out of 77 patients that underwent telerehabilitation during the study period, we retrospectively analysed the results of 31 patients with musculoskeletal pain fulfilling our eligibility criteria. To the best of our knowledge, this is the first study done on Indian patients to evaluate the effectiveness of telerehabilitation using a video-conferencing platform.

The age and gender demographics of patients in our study showed a uniform distribution. Back pain (45.16%) was the most common musculoskeletal problem encountered. Three cases of post-traumatic rehabilitation were also included in this study. Most of the patients (68%) suffered from chronic musculoskeletal pain, while 22% complained of subacute pain, and 10% presented with acute pain. Thus, we treated a heterogeneous group of patients with respect to the cause and the duration of pain experienced. Similar findings were reported by Adhikari et al, however, most of the studies in the literature studied patients with a specific joint subgroup [23-26].

We also recorded the presence of systemic illnesses like diabetes, hypertension, and thyroid disorders in our case record form. We observed that the presence of these systemic illnesses had no significant impact on the treatment in terms of the number of sessions required and the change in NPRS scores at the end of treatment.

As our treatment protocols were tailor-made for patients with different musculoskeletal pains, we observed a broad distribution of the number of treatment sessions taken ranging from 10 to 74 with the mean being 18. We

observed that patients with neck pain required marginally smaller number of treatment sessions as compared to those with back and shoulder pain. The patients undergoing post-traumatic rehabilitation took significantly greater number of sessions to achieve a comparable pain reduction. This is in line with the fact that these patients require longer treatment times even with in-person care because of prior immobilization and risk of overload injury [27].

In our study, the mean NPRS score at baseline was 7.48 indicating the presence of significant pain in most of the patients. Across various patient characteristics like age, gender, joint involvement, pain duration, etc., we found a significant reduction in NPRS scores of 69.78 % at the end of treatment ( $P < 0.0001$ ). In a large longitudinal cohort study using digital care for chronic musculoskeletal pain by Bailey et al, the average pain improvement was reported as 68.5% [11]. Our results are comparable with various studies that demonstrated significant pain reduction with telerehabilitation [28-33].

We found that the majority of patients (68%) achieved more than 80% functional goals at the end of treatment. We observed a significant positive correlation between the functional score achieved and the percent change in NPRS score with a  $P$ -value of 0.001. In a recently published study by Nelson et al, no significant difference was noted between patients taking telerehabilitation and in-person treatment with respect to self-reported functional outcomes [24].

Telerehabilitation experience was analysed using a questionnaire that was initially developed by Lovo et al and was modified to include nine questions on a 5-point Likert scale [34]. The overall treatment experience was rated very good by 84% patients in our study whereas the overall experience was very satisfying in 68% patients as published by Lovo et al [34]. Cottrell et al reported that patient satisfaction with telerehabilitation in chronic musculoskeletal spinal conditions in the tertiary hospital setting was significantly higher as compared to those undergoing in-person treatment (median: 97 vs. 76.5;

$P = 0.021$ ) [17]. A high level of patient satisfaction with telerehabilitation was also reported in the literature by various researchers [12,24,35,36]. We additionally included patient response on the convenience of treatment timings and cost-effectiveness in our questionnaire which were not reported by previous authors.

**Strengths and Limitations:** The main highlights of this study were one-on-one telerehabilitation sessions with a trained physiotherapist and a completely remote nature of the rehabilitation program with no in-person sessions. In addition, every patient was managed by a team of two physiotherapists during the course of treatment to ensure patient progress. We also incorporated quantitative functional scores and patient feedback scores as outcome measures. Finally, we included a diverse patient population and considered important medical history variables like the presence of systemic illnesses, anxiety, and depression during treatment planning.

However, this study had several limitations including a relatively small sample size, short duration, and a retrospective study design. As this study was performed during the COVID-19 lockdown, we included all patients with musculoskeletal pain and did not restrict to one joint subgroup for analysis. We recommend a longitudinal study with a large sample size targeting a particular musculoskeletal condition with frequent follow-ups.

## CONCLUSION

We observed that telerehabilitation resulted in significant pain reduction among patients with various musculoskeletal disorders during the COVID-19 pandemic. A positive correlation was demonstrated between change in NPRS scores, patient-reported functional goals, and patient satisfaction. Thus technology-based telerehabilitation solution supervised by a trained physiotherapist can be an effective approach for conservative care in patients with musculoskeletal pain.

## ABBREVIATIONS

**COVID-19** - Coronavirus Disease 2019

**NPRS** - Numeric Pain Rating Scale

**DALYs** - Disability-Adjusted Life Years

WHO - World Health Organization

WCPT - World Confederation for Physical Therapy

INPTRA - International Network of Physiotherapy Regulatory Authorities

**Conflicts of interest: None**

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