Turk J Phys Med Rehab 2024;70(4):506-516
DOI: 10.5606/tftrd.2024.13739
Available online at www.turkishjournalpmr.com

Original Article

Is home-based real-time video conferencing telerehabilitation as effective as conventional face-to-face rehabilitation in patients with operated for distal radius fracture? A single-blind, randomized prospective study

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ABSTRACT

Objectives: This study aims to investigate whether telerehabilitation is as effective as face-to-face rehabilitation in terms of joint range of motion (ROM), edema, and functionality in patients operated for distal radius fractures (DRFs).

Patients and methods: Between May 2022 and May 2023, a total of 54 patients (8 males, 46 females; mean age: 56.8±11.6 years; range, 24 to 77 years) who underwent volar plate due to DRF with direct X-ray and computed tomography (CT) were included in this single-blind, randomized study. The patients were randomly divided into the face-to-face rehabilitation group (FFG) and telerehabilitation group (TRG). The same rehabilitation program was applied as face-to-face and Home-Based Real-Time Video Conferencing (HBRVC) telerehabilitation. Demographic data and participation times in rehabilitation sessions were recorded. A perimeter was measured using the Figure of 8 method. The ROM of the joint was measured by goniometry. Hand grip strength was measured with a hand dynamometer, and pinch grip was measured with a pinch meter. The Patient-Rated Wrist Evaluation (PRWE) and Disabilities of the Arm, Shoulder and Hand Questionnaire (Quick-DASH) were used to assess functionality.

Results: In the initial evaluation, no statistically significant difference was found between age, smoking, dominant hand, operated hand, sex, and the number of participants in rehabilitation sessions ($p>0.05$). Comparing the values at Week 12 and Week 2, the change in pinch meter ($p=0.007$) and hand grip ($p=0.030$) values was higher in FFG than TRG. The Quick-DASH change ($p<0.001$) and PRWE change ($p=0.001$) values were statistically significantly lower in TRG than in FFG.

Conclusion: The HBRVC telerehabilitation program seems to be as effective as face-to-face rehabilitation on joint ROM and edema in patients undergoing volar plate fixation for DRF. However, the telerehabilitation method on functionality and muscle strength is less effective than face-to-face rehabilitation.

Keywords: Edema, range of motion, rehabilitation, telerehabilitation, wrist fractures.

Distal radius fractures (DRF) are the most common fractures encountered in orthopedic practice.[1] The prevalence of DRFs is expected to increase yearly due to prolonging life expectancy and osteoporosis.[2,3] The popularity of surgical treatment modalities for treating DRFs is increasing yearly.[4] Open reduction and volar plate application are more frequently preferred while considering the surgical treatment of DRFs.[5] There is a need for rehabilitation after surgical treatment of DRFs. Good clinical results have been obtained due to early movement and appropriate rehabilitation after surgery.[6] The positive effects of postoperative rehabilitation on hand grip strength, wrist range of motion (ROM), and return to daily activities have been demonstrated.[7] Rehabilitation may be disrupted, particularly as patients living in rural areas have difficulty in accessing the hospital.[8] Telerehabilitation has been frequently used to prevent treatment disruptions in patients undergoing orthopedic

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Received: August 23, 2023 **Accepted:** December 04, 2023 **Published online:** April 26, 2024

Cite this article as: Horoz L, Karaçay BÇ, Ceylan İ, Çakmak MF. Is home-based real-time video conferencing telerehabilitation as effective as conventional face-to-face rehabilitation in patients with operated for distal radius fracture? A single-blind, randomized prospective study. Turk J Phys Med Rehab 2024;70(4):506-516. doi: 10.5606/tftrd.2024.13739.

surgery such as arthroscopy and arthroplasty, and its effectiveness has been demonstrated.[9,10] There is a limited number of literature data on trauma patients, and the effectiveness of telerehabilitation has been shown in humeral head fractures and elbow circumference fractures.[11,12] Studies in the literature do not include patients undergoing telerehabilitation after an isolated trauma surgery and do not include a standard rehabilitation program. A recent review reported that all studies showing the efficacy of telerehabilitation in patients after upper extremity surgery show low evidence and weak methodology.[13]

In the present study, we aimed to investigate whether telerehabilitation is as effective as face-to-face rehabilitation in terms of joint ROM, edema, strength, and functionality in patients operated for DRFs.

PATIENTS AND METHODS

Study design and study population

This single-blind, randomized-controlled, prospective study was conducted at Kırşehir Ahi Evran University Faculty of Medicine, Departments of Orthopedics and Traumatology and Physical Medicine and Rehabilitation (PMR) between May 25th 2022 and May 11th 2023.

A total of 54 patients (8 males, 46 females; mean age: 56.8±11.6 years; range, 24 to 77 years) who underwent volar plate due to DRF with direct X-ray and computed tomography (CT) were evaluated. A written informed consent was obtained from each patient. The study protocol was approved by the Kırşehir Ahi Evran University Ethics Committee (date: 10.05.2022, no: 2022-09/96). The trial was registered on Clinicaltrials.gov before the first patient was recruited (Clinical Trial ID: NCT05537493). The study was conducted in accordance with the principles of the Declaration of Helsinki. Patients who did not develop any major postoperative complications (such as neurovascular injury, hematoma) and who had WhatsApp application on their mobile phone, tablet, or laptop device were included in the study. Exclusion criteria were the presence of polytrauma, surgical intervention other than the volar plate, previous extremity-related surgery history, injury in more than one anatomical region of the relevant extremity, and

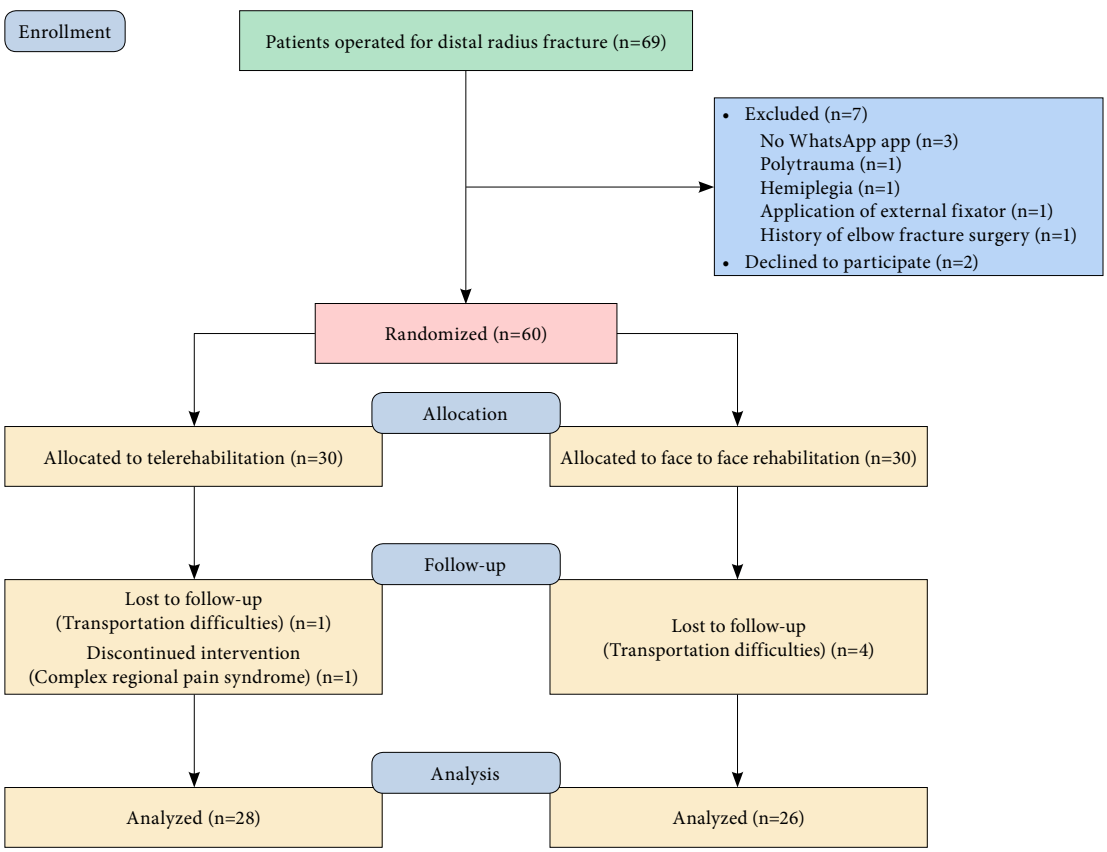

Figure 1. Study flowchart.

limitation (such as hemiplegia, contracture) in the relevant extremity (Figure 1).

Surgery procedure

The patients were operated under general anesthesia and tourniquet control. The Henry approach was applied to all patients. The tendon bed was opened toward the flexor carpi radialis muscle; then a sharp dissection was separated from the pronator quadratus muscle distal radius attachment site, and the fracture line was reached. A temporary Kirschner wire (K-wire) was applied after the anatomical reduction was achieved under traction. The variable angle distal plate was appropriately placed under fluoroscopy control. First, a cortical screw was applied to the oblong hole in the shaft of the plate. After the shaft screw, distal locking screws were applied, and finally, shaft locking screws were applied. Screw lengths were checked under the scope, and unsuitable screws were changed. A short arm splint was applied to the patients in the neutral position for two weeks postoperatively. All surgical interventions and plaster application of all patients were performed by the same orthopedist.

Diclofenac sodium tablets 50 mg twice daily were given to all patients for 14 days postoperatively. After Day 14, the patients were not allowed to use non-steroidal anti-inflammatory drugs (NSAIDs). On Day 14, the sutures of the patients were removed, the splint treatment was terminated, and the patients were referred to the attending physician for randomization.

Randomization and blinding

The patients were divided into telerehabilitation group (TRG) and face-to-face rehabilitation group (FFG) using the 1:1 randomization method. Randomization was performed by the same investigator using a computer-generated list of random numbers on Excel© 2019 for Mac (Microsoft, Redmond, WA, USA) software. The physician who evaluated blinding was unaware of the groups.

Interventions

A forearm plaster splint was applied to all patients for two weeks after the operation. The free and full-fingers motion was allowed during the plaster immobilization. After removing the casts of the patients in the orthopedics clinic, suggestions were made to the patients. It was recommended that patients continue their activities of daily living, including eating and self-care. Weight-bearing activities were restricted for six weeks postoperatively. The patients were referred to the PMR clinic for evaluations and rehabilitation on the day the splint was removed. After the first measurements were made, the patients were included in the rehabilitation program. The same rehabilitation program was applied to both the TRG and FFG.

The rehabilitation program was created by a physical therapy specialist, orthopedic surgeon, and physiotherapist before the study. The splint was removed in the second week according to the rehabilitation program. Forearm, wrist, and finger passive ROM stretching and active assisted ROM stretching exercises were performed between Weeks 2 and 4. Isometric strengthening, isotonic strengthening, and strengthening exercises with light-medium hard play dough were applied between Weeks 4 and 8. The same rehabilitation program was used to all patients participating in the study. Face-to-face rehabilitation group implemented this program face-to-face, while patients at TRG implemented it as a Home-Based Real-Time Video Conference (HBRVC). In addition, any physical therapy agent (hot, cold, electrotherapy, contrast bath, laser), manipulation, or mobilization techniques were not applied to the patients in both groups, except for the exercises detailed in the rehabilitation program.

This rehabilitation program was applied face-to-face to the patients in FFG by the same physiotherapist for eight weeks, five days a week, each session lasting 45 min.

In the first session of the TRG, the exercises were explained face-to-face by the physiotherapist. The video of these exercises was shared with the patients, and the patient was discharged. Individual interviews were held with the patients five times a week via the WhatsApp application on their mobile phones, tablets, or laptops, via the HBRTVC method. Individual interviews were preferred to individualize the exercises under the supervision of a physiotherapist. The patients in the TRG were called face-to-face on the first day of the fourth week when they would start strengthening exercises, and the exercises were taught. Likewise, videos of these exercises were shared with the patients. Video conferencing was continued five times a week. This program lasted eight weeks in total. Since the results of 12 weeks are widely used in the literature in evaluating the clinical effects of operated DRFs, the mid-term results were assessed at Week 12 after the rehabilitation program was completed.[14-17]

Outcome measurements

Patients' age, sex, dominant hand, smoking, and operated hand data were recorded. In addition, the days that the patients in FFG came to the rehabilitation session were recorded by the physiotherapist. Exercise diaries were given to the patients in TRG. Patients in TRG were asked to mark their video conference days and the days when they exercised themselves in their exercise diary.

The joint ROM measurements was made using a goniometer. The wrist flexion, extension, abduction, adduction, forearm supination and pronation, passive ROM were measured.

Peripheral measurement was made with a tape measure to evaluate skin and subcutaneous edema. Both hands and wrists of the patient were measured using the figure of eight methods with the help of a tape measure. The difference between both upper extremities was recorded in cm.[18]

The short version of the Disabilities of the Arm, Shoulder and Hand Questionnaire (Quick-DASH) was used to assess the patient's hand function. The questionnaire was applied face-to-face to all patients. The Quick-DASH is a self-report questionnaire developed to evaluate the upper extremity functionality. High scores on the Quick-DASH indicate greater disability and disease severity. The maximum score on the test is 100 and represents the most severe level of disability.[19] The validity, reliability, and cultural adaptation of the test were conducted.[20]

The Patient-Rated Wrist Evaluation (PRWE) questionnaire was used to evaluate the patients' activities of daily living, pain, and disability. The patient scores a maximum of 50 points on the PRWE pain subscale and a maximum of 50 on the function PRWE subscale. The total PRWE score assesses pain and disability together. Higher scores indicate more significant pain and disability. The questionnaire's validity, reliability, and cultural adaptation have been made.[21] The Visual Analog Scale (VAS) was used to evaluate the pain levels of the patients.[22]

The combined activities of the intrinsic and extrinsic muscles of the hand were evaluated with the hand grip strength. A Jamar® dynamometer (Sammons Preston Rolyan, Chicago, USA) with a measuring range between 0 and 90 kg was used for hand grip strength measurement. Measurements were made in kg in the standard position as the American Association of Hand Therapists (ASHT) recommended. It was evaluated by calculating the percentage relative to the uninjured side.

A pinch meter was used for the pinch grip. Measurements with a pinch meter were made in the standard position and recorded in kg. It was evaluated by calculating the percentage relative to the uninjured side.

Statistical analysis

Statistical analysis and sample size calculation were performed using the G*Power version 3.1.9.4 software (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany). The t-test was used for the difference between two independent means. When the effect size was 1.59, and the power of the test was 95%, the total sample size was calculated as 50 people with 25 individuals in each group.[23]

Statistical analysis was performed using the IBM SPSS for Windows version 26.0 software (IBM Corp., Armonk, NY, USA). Descriptive data were expressed in mean ± standard deviation (SD), median (min-max) or number and frequency, where applicable. Relationships between categorical variables were examined with the chi-square test. The Shapiro-Wilk test was used to assess whether the data for the variables showed a normal distribution. The t-test was Mann-Whitney U tests were used to compare two independent groups. One-way analysis of variance (ANOVA) or Friedman test was used for repeated measurements more than twice, multiple comparison tests were performed when significant differences were found, and Bonferroni corrected significance values were considered in the findings. A p value of <0.05 was considered statistically significant.

RESULTS

In the initial evaluation of the patients, no statistically significant difference was found between age, smoking, dominant hand, operated hand, sex, and the number of participants in rehabilitation sessions (p>0.05) (Table 1). No significant difference was observed in the distribution of patients in terms of AO/OTA fracture classification between the two groups (p>0.05).

According to the results of the postoperative second week, pinch meter (p=0.012) and hand grip strength (p=0.01) values were higher in the TRG group. The Quick-DASH value was higher in the FFG group (p=0.030). There was no significant difference in the results at the postoperative eighth

TABLE 1
Demographic and clinical characteristics of the participants

	TRG (n=28)			FFG (n=26)			
	n	%	Mean±SD	n	%	Mean±SD	*p*
Age (year)			56.0±9.5			57.7±13.4	0.239[1]
Sex							0.128[2]
Female	24	73.8		22	74.7		
Male	4	14.2		4	15.3		
Dominant side							0.405[2]
Right	23	82.2		22	74.7		
Left	5	17.8		4	15.3		
Operated hand							0.388[2]
Right	12	42.8		12	46.1		
Left	16	57.2		14	53.9		
Smoking	22	78.5		21	80.8		0.121[2]
Non smoking	6	21.5		5	19.2		
Rehabilitation sessions attended			28.41±2.01			26.96±2.72	0.0721
AO/OTA Fracture Classification							0.809[2]
A type	5	17.8		5	19.2		
B type	8	28.5		9	34.6		
C type	15	53.7		12	46.2		

TRG: Telerehabilitation group; FFG: Face-to-face rehabilitation group; SD: Standard deviation; [1] Mann Whitney U Test; [2] Chi-square tests.

weeks compared to the study groups (p>0.05). Wrist extension ROM (p=0.049), pinch meter (p=0.022), and hand grip strength (p=0.006) values were significantly higher in FFG than in TRG at 12 weeks. The PRWE (p=0.023) value was considerably higher in TRG than in FFG at 12 weeks (Table 2). Regarding VAS scores, no significant difference was observed at eight weeks of follow-up, while the VAS was found to be significantly higher in the TRG group at 12 weeks.

In repeated measurements, diameter measurement results in both TRG and FFG were significantly lower at the postoperative eighth week and postoperative 12th week compared to the postoperative second week (p<0.001). In repeated measurements, all ROM measurement results except forearm pronation were significantly higher in both TRG and FFG compared to the postoperative second week (p<0.001). In repeated measurements, pinch meter and hand grip strength measurements were found to be significantly higher in both TRG and FFG compared to the postoperative second week (p<0.001). The Quick-DASH results and the PRWE results were significantly lower in the TRG as well as in the FFG compared to the postoperative second week (p<0.001) (Table 2).

When the difference of the values between the postoperative 12th week and the postoperative second week was taken and analyzed accordingly, the change in pinch meter (p=0.007) and hand grip (p=0.030) values was higher in FFG than TRG. The Quick-DASH change (p<0.001) and PRWE change (p=0.001) values were statistically significantly lower in TRG than in FFG (Table 3).

DISCUSSION

According to the results of this study, face-to-face rehabilitation was superior to telerehabilitation in patients who underwent surgical repair with a volar plate for DRF, particularly in pinch grip, palmar grip, and functional scores. Telerehabilitation was as effective as face-to-face rehabilitation on the joint ROM and edema.

In DRFs, there is no standard algorithm for both surgical treatment and postsurgical rehabilitation.[24-26] it has been reported that conventional rehabilitation is not effective in the postoperative rehabilitation of DRFs repaired by the application of a volar plate.[27,28] In the studies in the literature, patients who were given home-based exercise programs and those who were given face-to-face rehabilitation were compared, and the superiority of face-to-face rehabilitation could not be demonstrated. The reasons for this include the lack of a standard rehabilitation program, the patient's high pain threshold, and the overprotective approaches of the patient and physiotherapist. The 30-session

TABLE 2
Comparison of differences in measurements by groups and difference analysis findings on edema, ROM, muscle strength and functionality values in repeated measurement

Variables		Group	Post-op 2nd Week[1] Mean±SD	Post-op 2nd Week[1] Median	Post-op 2nd Week[1] Min-Max	*p*	8th Week[2] Mean±SD	8th Week[2] Median	8th Week[2] Min-Max	*p*	12th Week[3] Mean±SD	12th Week[3] Median	12th Week[3] Min-Max	*p*	*p*	Difference post hoc* *p*
Edema	Diff. Circ.	TRG	2.114±1.5579	2	0-3	0.093	0.77±0.922	0.5	0-3	0.078	0.23±0.528		0-2	0.071	**<0.001**	2<1 3<1
		FFG	3.000±1.865	3	0-6		1.50±1.445	1	0-5		0.71±1.042	0	0-3		**<0.001**	2<1 3<1
Range of motion	Wrist flexion, degree	TRG	33.41±16.503	3	0-60	0.371	56.36±14.490	60	25-80	0.678	70.00±12.247	75	90-55	0.332	**<0.001**	1<2 1<3 2<3
		FFG	27.29±22.649	27.5	0-70		54.58±14.365	50	30-90		66.88±11.592	70	80-45		**<0.001**	1<2 1<3 2<3
	Wrist extension, degree	TRG	17.27±12.025	17.5	0-35	0.321	46.59±14.090	50	20-60	0.792	59.09±7.813	60	40-75	**0.049**	**<0.001**	1<2 1<3 2<3
		FFG	14.79±12.290	15	0-35		45.63±10.458	47.5	25-60		63.13±9.186	70	35-70		**<0.001**	1<2 1<3 2<3
	Wrist abduction, degree	TRG	18.41±12.477	20	0-35	0.212	30.45±10.791	32.5	10-45	0.216	34.77±11.284	40	15-50	0.848	**<0.001**	1<2 1<3
		FFG	13.13±12.052	12.5	0-35		26.88±12.407	25	10-60		36.25±8.999	40	20-60		**<0.001**	1<2 1<3 2<3
	Wrist adduction, degree	TRG	9.32±6.035	10	0-20	0.155	17.50±5.926	17.5	10-30	0.343	20.68±3.872	20	15-30	0.061	**<0.001**	1<2 1<3
		FFG	6.88±6.563	5	0-20		18.54±5.985	20	5-30		22.92±5.090	20	10-30		**<0.001**	1<2 1<3
	Forearm supination, degree	TRG	67.05±18.300	70	25-90	0.388	78.86±12.338	80	55-90	0.936	85.23±9.060	90	60-90	0.805	**<0.001**	1<2 1<3
		FFG	62.50±18.939	65	15-90		78.96±12.157	80	50-90		85.42±8.712	90	50-90		**<0.001**	1<2 1<3
	Forearm pronation, degree	TRG	86.14±13.967	90	25-90	0.290	87.73±6.119	90	70-90	0.549	89.09±2.942	90	80-90	0.504	0.368	-
		FFG	86.27±12.025	90	15-90		86.67±7.614	90	60-90		89.58±2.041	90	80-90		0.056	-

TABLE 2
Continued

Variables		Group	Post-op 2nd Week[1] Mean±SD	Post-op 2nd Week[1] Median	Post-op 2nd Week[1] Min-Max	*p*	8th Week[2] Mean±SD	8th Week[2] Median	8th Week[2] Min-Max	*p*	12th Week[3] Mean±SD	12th Week[3] Median	12th Week[3] Min-Max	*p*	*p*	Difference post hoc* *p*
Muscle Strength	Pinch, % relative to the healthy side	TRG	44.51±19.406	41.67	16.67-73.43	**0.012**	62.81±16.119	62.50	28.57-100	**0.655**	74.32±16.464	78.89	37.5-100	**0.022**	**<0.001**	1<2 1<3 2<3
		FFG	31.31±12.456	25	15.38-62.50		64.81±14.096	61.25	40-100		86.27±13.333	84.52	66.67-100		**<0.001**	1<2 1<3 2<3
	Hand grip strength, % relative to the healthy side	TRG	34.38±17.062	36.64	2.63-68.57	**0.001**	55.58±12.528	54.37	21.82-73.53	0.784	65.94±11.139	65.17	36.36-84.21	0.006	**<0.001**	1<2 1<3 2<3
		FFG	16.04±13.436	9.55	2.50-45.16		56.57±11.574	60.00	30.77-72		76.00±12.359	75.00	52-93.75		**<0.001**	1<2 1<3 2<3
Functions	Quick-DASH	TRG	60.91±19.508	62.5	20-97	**0.030**	35.91±15.510	35.5	5-63	0.333	23.141±7.485	19.5	3-55	0.080	**<0.001**	2<1 3<1 3<2
		FFG	72.71±16.609	74.5	25-95		41.17±20.331	35.5	12-75		16.381±7.497	9	0-53		**<0.001**	2<1 3<1 3<2
	PRWE	TRG	61.64±26.991	66.50	13-98	0.053	37.45±23.040	37.50	5-72	0.676	23.091±8.426	20.50	0-65	**0.023**	**<0.001**	2<1 3<1 3<2
		FFG	76.42±20.976	81	13-100		34.00±20.293	28.5	7-76		12.711±4.493	6	0-41		<0.001	2<1 3<1 3<2
	VAS	TRG	6 ±1.222	6	5-8	0.892	4±1.340	4	3-6	0.482	4±1.883	4	2-6	**0.004**	**<0.001**	2<1
		FFG	6±1.380	6	5-8		3±1.320	3	2-5		2±1.824	2	1-3		**<0.001**	3<1 3<2

ROM: Range of motion; SD: Standard deviation; Diff. Circ.: The difference between the circumference measurement of the operated hand and the healthy hand; TRG: Telerehabilitation group; FFG: Face-to-face rehabilitation group; DASH: Disabilities of arm, shoulder and hand questionnaire; PRWE: Patient-rated wrist evaluation questionnaire; VAS: Visual Analogue Scale; * Difference: The numbers refer to superscripts on repeat measurements and indicate which measurements differ in repeated measurements.

TABLE 3
Analysis findings regarding the difference between postoperative 12th week measurement and postoperative measurement according to the groups

Variables	Difference between post-op 12th Week and post-op 2nd week	Difference between post-op 12th Week and Post-op 2nd week		*p*
	Mean±SD	Median	Min-Max	
Diff. Circ.				
TRG	–1.88±1.11	2	–5-0	0.599
FFG	–2.08±1.38	2	–6-0	
Wrist flexion ROM				
TRG	36.59±19.11	32.5	10-80	0.782
FFG	39.58±21.66	32.5	10-75	
Wrist extension ROM				
TRG	41.81±13.50	42.5	15-60	0.108
FFG	48.33±13.40	50	20-70	
Forearm supination ROM				
TRG	18.18±17.49	10	0-65	0.335
FFG	22.91±18.29	17.5	0-65	
Forearm pronation ROM				
TRG	2.95±14.19	0	0-80	0.669
FFG	2.91±16.54	0	0-65	
Pinch				
TRG	2.41±1.27	2.2	0.5-4	0.007
FFG	3.43±1.42	3	1.5-8	
Hand grip strength				
TRG	12.56±5.50	13	4-24	0.030
FFG	16.95±6.46	17	8-37	
Quick-DASH				
TRG	–37.77±17.26	–37	–10-74	<0.001
FFG	–56.33±15.22	–59	–23-78	
PRWE				
TRG	–38.54±23.8	–38.5	–9-77	0.001
FFG	–63.70±18.4	–68.5	–13-88	
VAS				
TRG	2.57±1.39	2	1-3	0.001
FFG	4.23±1.15	4	2-5	

SD: Standard deviation; Diff. Circ.: The difference between the circumference measurement of the operated hand and the healthy hand; TRG: Telerehabilitation group; FFG: Face-to-face rehabilitation group; ROM: Range of motion; DASH: Disabilities of arm, shoulder and hand questionnaire; PRWE: Patient-rated wrist evaluation questionnaire; VAS: Visual Analog Scale.

rehabilitation program implemented in this study was created by an experienced team in orthopedic rehabilitation consisting of a physical therapy and rehabilitation specialist, orthopedic surgeon and physiotherapist. It was observed that the functional results of the facial rehabilitation group were better than those of patients of the telerehabilitation applied with the HBRTVC method. When patients apply for the rehabilitation program under the guidance of a physiotherapist, adherence to treatment and daily activities may be more encouraged, which may contribute to improvement in functionality.

In the current study, an improvement was observed in the wrist extension values of the FFG at 12 weeks. After the repair of DRFs with a volar plate, extension limitations and contractures in the volar capsular structures may be encountered.[29,30] Therefore, improving wrist extension joint ROM is a crucial rehabilitation goal for patients undergoing surgery for DRF. In this study, patients received face-to-face or videoconference-assisted rehabilitation for the first eight weeks. All patients were followed with home-based exercise between Weeks 8 and 12. Since the patients in the FFG received face-to-face rehabilitation at the hospital between the second and eighth weeks, they just switched to home-based exercise during this period. The authors speculated that this might be related to better exercise compliance.

Pain is an important factor in the functional results of DRFs repaired with a volar plate.[31] This study found a significant superiority in the FFG in the PRWE scores at 12 weeks of follow-up. On the other hand, no significant difference was found in the Quick-DASH scale, which is another question that evaluates functionality. In the PRWE questionnaire, the pain subscale allows detailed analysis of pain, while Quick-DASH does not evaluate pain.[19,32] We attributed the improvement in PRWE and the lack of improvement in Quick-DASH in the patients' follow-up results at 12 weeks to the PRWE's assessment of pain and functionality.[33,34] In this study, none of the patients, including the FFG, received physical therapy agents such as electrotherapy and did not use oral analgesics after the postoperative second week. Therefore, we interpreted the results of this study as the exercise protocol applied with face-to-face rehabilitation was more effective on pain. These results may be due to the fact that the patient in the FFG worked with the physiotherapist every day, and the pain might have been considered more when individualizing the exercise.

Review of the literature reveals that the treatment compliance of telerehabilitation is higher and, therefore, the effectiveness of telerehabilitation is equivalent to face-to-face rehabilitation.[10,35] Treatment adherence in this group was explicitly investigated and it was concluded that there was no significant difference in treatment adherence between the two groups. The rehabilitation of both groups is similar in terms of session duration. Compliance and participation are as important as the duration of rehabilitation. Unlike the studies in the literature, the fact that face-to-face rehabilitation is more effective on functionality and muscle strength may be due to the excellent treatment compliance of the FFG. Additionally, face-to-face rehabilitation in this study may have increased participation in rehabilitation by allowing patients to assess pain at each session and encouraging activities. This is how the authors described the effectiveness of face-to-face rehabilitation on pain and functioning in this study.

Nonetheless, there are some limitations to this study. The first limitation is that a group that was given no treatment or only home-based exercises was not planned as the third group in the study. In addition, the positive effects of virtual-reality-based telerehabilitation applications in patients undergoing orthopedic surgery have been shown recently.[36] In these studies, special hardware and software infrastructures were used in the follow-up and rehabilitation of patients. However, this study applied telerehabilitation only with the HBRTVC method. Therefore, this should be considered while evaluating the results of the study. On the other hand, the main strengths of this study are that the patients in the study were operated with the same technique by the same orthopedic surgeon, a standardized exercise protocol was applied, a single-blind design, and a relatively long (12 weeks) follow-up period.

In conclusion, the telerehabilitation program applied with the HBRTVC method seems to be as effective as face-to-face rehabilitation on joint ROM and edema in patients undergoing volar plate due to DRF. However, the telerehabilitation method on functionality and muscle strength is less effective than face-to-face rehabilitation. Further multi-center, larger-scale, double-blind, randomized-controlled studies are needed to draw more reliable conclusions on this subject.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Idea/concept: L.H., B.C.K.; Design: L.H., B.C.K., I.C.; Control/supervision: L.H.; Data collection and/or processing: I.C., M.F.C., B.C.K.; Analysis and/or interpretation: M.F.C., L.H.; Literature review: L.H., I.C.; Writing the article: L.H., M.F.C.; Critical review: B.C.K.

Conflict of Interest: The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding: The authors received no financial support for the research and/or authorship of this article.

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