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ORIGINAL RESEARCH

Comparison of periodic face-to-face visits and use of smartphone application during COVID-19 pandemic in clinical follow-up of range of motion in patients with distal humeral fracture

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Abstract

Objective: As the prevalence of the coronavirus increases, there is now more emphasis on reducing "face-to-face" patient visits. Therefore, the use of smartphones and their special medical applications can play an important role in following up patients. The aim of this study was to evaluate the use of smartphone in evaluating clinical outcomes and range of motion of patients after elbow operation.
Materials and Methods: Forty patients were randomly selected from patients undergoing elbow operation. Patients were divided into two groups, so that in the first group, the patients were visited and then were followed-up for 2,6, and 12 weeks as well as 6 months after first visit by smartphone connection and delivering the pictures and videos of involved organ to the physician as well as having the physical examination him. In the second group, all assessments were performed by clinical visiting at the same time points.
Results: The two groups were similar in baseline characteristics including demographics; the side of involved elbow, type of fracture, surgical approach, operation time, and mean Mepi score. Assessing the postoperative complications and also patients' satisfaction was also similar in both groups. There was no difference in different range of elbow motion degrees between the case and control groups at different times of following-up as well as the progress in motion of elbow after surgery in two groups. Moreover, there was no significant difference between the range of motion evaluated by smartphone and physical examination.
Conclusion: The use of the smartphone has a high degree of accuracy and sensitivity in assessing the status of elbow range of motion after surgical treatment, both in the short and long term after surgery.

Keywords: Smartphone, COVID-19, Pandemic, Range of motion, Elbow joint

Introduction

COVID- 19 is an acute respiratory distress disorder caused by SARS-CoV-2 that was first reported in December 2019 in Wuhan, China. (1-3) This disease causes a wide range of respiratory symptoms such as colds to more severe diseases such as pneumonia, the mode of transmission of the disease is mainly through respiratory droplets. (4) As the prevalence of COVID-19 continues to increase worldwide, governments have taken nationwide measures, such as "social distancing" and "closure of schools and offices", to protect at-risk individuals. (5) Due to the risk of coronavirus infection, there is now more emphasis on reducing "face-to-face" visits to patients in hospitals. Telecommunication portals can be a useful tool for remotely monitoring patients and advising them on how to care for them (in cases where patients are unable to stay in the hospital due to long distances or when the system does not allow face-to-face counseling such as pandemic conditions). Smartphone applications can be used as a cost-effective and convenient tool for transmitting patients' medical information to physicians, such as following up patients after orthopedic surgery. (6) Sixty percent of orthopedic surgeons in the United States use "telemedicine" as a follow-up tool for patients living in remote areas. (7) In orthopedic surgery, follow-up of patients is important and failure to follow can cause irreparable damage to the patient and the health system. The popularity of smartphone applications for clinical evaluation of patients is increasing among physicians, and many studies have evaluated the reliability and validity of smartphone applications for ROM measurement. (8-10) Fractures and dislocations of the elbow can cause many side effects. The elbow is a troche-ginglymoid joint (11, 12) but is prone to instability due to trauma. Even low instability in the elbow without a fracture can have a detrimental effect on the surrounding soft tissue. Therapeutic goals for (fracture-dislocation) of the elbow include fixing the fracture permanently and maintaining its range of motion. (13) Currently, the limitations imposed by the corona virus and to reduce the presence of patients in medical centers and the need to follow patients with elbow fractures in terms of ROM and clinical results after surgery, the use of smartphones in the orthopedic system has expanded. Therefore, the aim of this study was to compare the clinical results of periodic face-to-face visits (standard method) with a smartphone application in elbow surgery.

Materials and Methods

This was a retrospective case-control study after approval of the ethics committee of Shahid Beheshti University of Medical Sciences, in a period of 9 months between February and October 2020. One hundred and twenty six patients in the age group between 20 and 65 years, were randomly selected from patients with distal humeral fractures who underwent open reduction and internal fixation with locking plate. Study conditions were explained to all patients and written consent was signed by all members. The patients were divided into two groups of visits (face-to-face and smartphone) and then were visited at regular intervals in the second, sixth and twelfth week and sixth month by doctor. The case group underwent an online visit with a smartphone and were asked to take pictures with a healthy hand using a smartphone application (WhatsApp, etc.) (14). While the operated elbow was attached to the body, the elbow underwent flexion, extension supination and pronation. Then delivering the pictures to the physician as well as having the visual physical examination by physician. In the second group, all evaluations were performed with clinical referral in the same time period. Patients were compared with clinical outcomes and degree of motion (flexion, extension, supination and pronation). The results were presented as mean± standard deviation (SD) for quantitative variables and were summarized by absolute frequencies and percentages for categorical variables. Categorical variables were compared using chi-square test for Fishers exact test when more than 20% of cells with expected count of less than 5 were observed. Quantitative variables were also compared with t-test. For the statistical analysis the statistical software SPSS version 16.0 for windows (SPSS Inc. Chicago, IL) was used. P-values of 0.05 or less were considered statically significant.

Results

In this study 20 patients were enrolled as a case group by referring to the clinic at the first session and other sessions as the follow-up by smartphone and in person physical examination and 20 patients as the control group, referring to the clinic at same time. As shown in (Table 1) the two groups were similar in baseline characteristics including demographics, the side of involved elbow, type of fracture, surgical protocol, operation time, and mean Mepi score (Table1). Assessing the postoperative complications and also patients' satisfaction was also similar in both groups (P=0.514). As indicated in (Table 2) there was no difference in range of motion between the case and control groups at different times of following-up as well as the progress in change of range of motion during the follow ups. Also there was no difference in the range of motion evaluated by smart-phone and physician (P>0.05). In this regard, high correlation was revealed between the range of motion degrees assessed by smartphone and by clinical visiting.

Table1: Baseline characteristics and outcomes in surgery

Variable	Case group	Control group	P value
Sex Male Female	 60% 40%	 70% 30%	0.507
Mean age, (year)	43.4±7.91	43.45±10.7	0.183
Side of involvement			0.723
Left	25%	30%	
Right	75%	70%	
Type of fracture			0.591
A2	10%	5%	
A3	10%	10%	
B1	5%	10%	
B2	25%	15%	
B3	5%	10%	
C1	15%	0%	
C2	10%	20%	
C3	20%	30%	
Surgical approach			0.903
Lateral	25%	15%	
Medial	20%	10%	
Paratricipital	25%	30%	
Chevron osteotomy	30%	45%	
Mean Mepi score	83.9±4.78	81.7±5.08	0.947
Mean operation Time (minutes)	105±11	111±14.1	0.365
Complications			0.514
No union	10%	10%	
Loss of reduction	5%	0.0%	
Discharge from wound	15%	5%	

Table 2. Comparing range of motion degrees after surgery

Variable	Case group	Control group	P value
2 week after surgery			
Flexion	32.85±3.37	33.30±3.24	0.968
Extension	41.40±3.78	43.65±4.73	0.499
Pronation	32.50±3.28	33.00±3.56	0.937
Supination	34.20±4.39	32.90±4.10	0.665
6weeks after surgery			
Flexion	39.05±2.92	40±2.27	0.284
Extension	58.90±3.85	60.05±3.10	0.687
Pronation	42.05±2.70	43.00±2.59	0.891
Supination	41.70±3.61	41.30±4.56	0.267
12weeks after surgery			
Flexion	50.95±5.09	51.50±4.21	0.341
Extension	78.50±3.94	80.30±3.82	0.910
Pronation	62.50±4.45	63.05±4.11	0.614
Supination	63.80±3.75	62.8±4.62	0.145
6months after surgery			
Flexion	58.45±5.40	57.35±4.27	0.256
Extension	82.30±4.35	82.4±2.89	0.209
Pronation	72.15±3.40	72.30±3.46	0.843
Supination	71.95±4.17	73.30±4.11	0.824

Discussion

Patients undergoing orthopedic surgeries require frequent referrals to evaluate the short and long-term postoperative outcomes, especially in terms of assessing changes in the natural range of motion in the surgical site. At present, due to the spread of the coronavirus and patients' concerns about the possibility of contracting the coronavirus, as well as the restrictions imposed by the government, the attendance of patients to follow the treatment process has decreased. In this regard, the use of alternative methods such as photography, video recording and the use of smartphone applications are now offered as options for patient evaluation. In this study, the correlation between standard assessment method (periodic attendance) and absentee methods including smartphone application was investigated. Post-surgical care programs should continue to focus on providing the highest quality of patient care and a high degree of patient and service provider satisfaction, while providing greater access to surgical care. In this regard, in the short and long term, it was found that the use of smartphones is a good and accurate alternative to visiting patients, in fact, in the postoperative evaluation, including the amount of elbow movements, will be as effective as face-to-face visits. Therefore, in assessing the short and

long range of motion of the elbow after surgery, it is possible to prevent the patient from requesting a repeat face-to-face visit and instead ask the patient to send pictures of elbow movements to the physician. In this way, changes in the range of motion of the elbow can be evaluated with high accuracy without the need for repeated patient intervention. Such a conclusion has been clearly expressed in other studies. In a study by Hanneh H. Le et al., The results of new smartphone applications are promising to provide accurate and reliable measures for range of motion. (15) Study Bchnoush et al. Showed that the reliability and validity of the mobile application compared to the goniometer in evaluating all the ranges of flexion, extension, pronation and supination of the elbow with a correlation coefficient of more than 95%. The highest correlation was observed in relation to elbow supination and the lowest correlation was related to elbow flexion. (16) Study by Keijsers et al. both photography and goniometric methods based on filming have a high reputation in flexion and extension evaluation. Reliability of both photographic and goniometric methods has been reported based on video recording, but this correlation and reliability has been reported for both goniometric methods and an average mobile application. (17) In the study of Meislin et al. (18) the correlation between goniometer and smartphone application was estimated to be 88.2%. Therefore, our findings, like other studies in this field, show that mobile applications are as reliable in assessing elbow movement changes as face-to-face visits. Due to the availability of smartphones in almost every society, functional and structural changes of the elbow joint can be evaluated after surgery with the required speed and accuracy without the need for a face-to-face visit.

The use of smartphones has a high accuracy and sensitivity in assessing the status of the range of motion of the elbow after surgical treatment, both in the short and long term after surgery, and it can be used as an alternative to face-to-face patient visits.

Conflict of interest

Authors declare no conflict of interest.

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