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# Relationship between pain and hesitation during movement initiation after distal radius fracture surgery: A preliminary study

## *Relation entre la douleur et l'hésitation à l'initiation du mouvement après chirurgie d'une fracture distale du radius : étude préliminaire*

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ABSTRACT

We investigated the relationship between pain and hesitation during movement initiation among 11 adult female patients who had undergone surgery for a distal radius fracture. Data on the patients' pain at rest, pain during movement and score on the Pain Catastrophizing Scale were analyzed. Movement characteristics were assessed by the administration of a finger tapping (FT) task using the thumb and index finger, with the movement repeated 10 times, recorded and analyzed to determine the patient's hesitation when opening or closing her thumb/forefinger during the task. Hesitation of movement initiation was significantly correlated with subjective factors such as pain at rest, pain during movement, and rumination. Pain was not significantly correlated with the physical range of motion. Our findings suggest that hesitation during movement initiation for the FT task may be a type of behavior that is affected by subjective pain. Movement hesitation is a novel clinical sign indicating the possible progression of acute pain into chronic pain. The kinematic evaluation described herein is a convenient clinical measurement that captures a subjective factor.


RÉSUMÉ

Nous avons cherché la relation entre la douleur et l'hésitation de l'initiation du mouvement parmi des patientes ayant subi une opération pour une fracture distale du radius. Dix patientes adultes ont subi une opération pour une fracture distale du radius. Les données concernant les patientes au repos, pendant une douleur due à un mouvement ainsi que les chiffres de l'échelle de la dramatisation face à la douleur ont été analysés. Les caractéristiques de mouvement ont été évaluées par l'administration d'une tape sur le doigt (TD), tâche effectuée en utilisant le pouce et l'index, avec un mouvement répété 10 fois, enregistré et analysé pour déterminer l'hésitation de la patiente à ouvrir ou fermer son pouce/index pendant la tâche. L'hésitation de l'initiation du mouvement a montré une corrélation significative avec les facteurs subjectifs de douleur au repos, douleur pendant un mouvement, et rumination; cependant la douleur n'a montré aucune corrélation significative avec le facteur physique de l'amplitude du mouvement. Notre étude suggère que l'hésitation de l'initiative du mouvement dans la tâche de TD peut être un type de comportement qui est affecté par une douleur subjective. L'hésitation de mouvement est un signe clinique original indiquant l'évolution possible d'une douleur en douleur chronique. L'évaluation cinématique décrite ci-dessus est une mesure clinique commode qui inclut un facteur subjectif.


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## 1. Introduction

Long-term disability and chronic pain have been reported in over 60% of limb fracture patients [1], and a wrist fracture increases the odds of functional decline [2]. Early after fracture treatment, roughly 1% to 37% of patients have been reported to demonstrate signs and symptoms of complex regional pain syndrome (CRPS) [3–5]. Some CRPS symptoms persisted for more than 1 year after the fracture event [6]. More specifically, pain after a distal radius fracture tends to become chronic and develop into CRPS more often than after other fractures [3]. Pain and its related anxiety or fear after a limb fracture are also known risk factors for the development of CRPS [7–9]. CRPS patients may suffer from not only from severe pain-related emotional problems, but also impaired motor control. Well-known movement disorders related to CRPS include dystonia and tremor [10]. While it is important to quantify an individual's impaired motor control in the acute phase after a limb fracture, few studies have measured movement impairment in patients after fracture surgery.

We focused on the impaired motor control observed in clinical practice among patients with musculoskeletal pain. It has been reported that a finger-tapping (FT) task can be used to identify other movement disorders in CRPS patients [10,11], such as slowness of movement performance (bradykinesia), reduction of the movement amplitude (hypokinesia), and difficulty with movement initiation (start hesitation). Evaluating these aspects of movement performance could also be clinically meaningful.

Pain and/or its related anxiety or fear often hinder the improvement of pain [7–12]. Thus, an evaluation of psychological factors is also required. In clinical practice, psychological factors are often evaluated with the use of a questionnaire, but the results of a psychological questionnaire may be affected by the patient's subjective bias [12]. Alternatively, movement evaluations such as the FT task can be conducted quickly and without subjective bias. Ideally, a postoperative evaluation would include an assessment of both movement and psychological factors. A previous study indicated that movement hesitation is an abnormal behavior caused by pain-related fear [13]. For example, the instance when the affected limb of CRPS patients started to move was significantly later compared to that of the non-affected limb [13].

We speculated that both movement and psychological factors could be evaluated using only the FT task. We conducted the present study to determine whether performance of the FT task is related to both motor function and psychological factors. We evaluated the movement performance of patients who have undergone surgery for distal radius fracture. We did this by having the patients perform the FT task, and we recorded and analyzed their performance of the task. We then evaluated whether the movement parameters in the FT task are correlated with subjective pain ratings.

## 2. Materials and methods

### 2.1. Patients

This study was approved by the Ethics Committee of our institute and was conducted in accordance with the ethical standards of the 1964 Declaration of Helsinki (and subsequent revisions). The purpose and protocol of this study were fully explained to all patients before obtaining their written informed consent to participate. This study was registered at the UMIN Clinical Trials Registry (UMIN000026156) and included a new set of patients.

The subjects were patients who underwent surgery for distal radial fracture between September 1, 2015 and December 27, 2016. Patients were excluded if they had:

- severe chronic uncontrolled pain at a site other than the operated wrist before the surgery ($n = 0$);
- or a stroke or other central nervous system disorder ($n = 0$);
- or dementia ($n = 2$).

Eleven patients participated in the study; all were female. They were $70.4 \pm 8.1$ (mean $\pm$ SD) years of age. The affected wrist was the right wrist in eight patients and the left wrist in the other three patients. All 11 patients were operated on by a single surgeon or several surgeons. Every patient completed the Mini-Mental State Examination (MMSE) at the study baseline. Their MMSE score was $28.3 \pm 2.4$, indicating that none had dementia or another cognitive disorder. No patients had ever undergone surgery or experienced movement-related pain after surgery.

### 2.2. Procedure and outcomes

At our hospital, patients were allowed to move their operated wrist 1 day after surgery since only a bandage is used for immobilization. In addition, the surgeons requested that a physical therapist or occupational therapist move the affected hand starting 1 day after the surgery. Thus, occupational therapists performed range of motion (ROM) exercises after removing the bandage and moved the patient's wrist to check pain levels. The patients received occupational therapy for 40 min/day beginning 1 day after surgery (i.e., Day 1), including ROM exercises and icing.

The four outcome measures were pain at rest, pain during movement, score on the Pain Catastrophizing Scale (PCS) (with subcategories of rumination, magnification, and helplessness) [14], and ROM (palmar flexion, dorsal flexion). Pain at rest and during movement was evaluated using a visual analog scale (VAS). The PCS is a 13-item self-reported questionnaire in which every item is evaluated in 3 grades [14]. The grades indicate thought and perception of a pain in the background of a variety of experiences. Higher scores indicate greater levels of catastrophizing. Additionally, movement characteristics were assessed by a finger-tapping (FT) task using the thumb and index finger, with the movement repeated 10 times. In the FT task, the seated patient was instructed by a physical therapist to close (tap) her thumb and index finger together and then open them, ten times. The patients were instructed to go at their own speed (Fig. 1).

Each patient's performance of the FT task was recorded with an iPhone video camera (sampling rate: 30 Hz). The recorded movie was divided into individual frames, and we counted both the number of frames in which the patient hesitated to open her thumb/index finger and (2) the number of frames in which the patient hesitated to close her thumb/index finger, as quantifiable indicators of hesitation. We defined such stopped tapping as "hesitation during movement initiation". The FT task was repeated and recorded after rehabilitation and these outcomes were measured at 1, 3, 5, 7, 14, 21, and 30 days post-surgery.

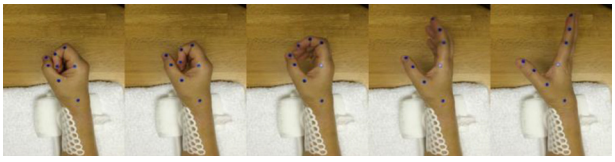

**Fig. 1.** The patient's performance of the FT task was recorded with an iPhone video camera (sampling rate: 30 Hz). The recorded movie was divided into individual frames, and we counted both the number of frames in which the patient had hesitated to open her thumb/index finger and the number of frames in which the patient had hesitated to close her thumb/index finger and used these as quantifiable indicators of hesitation.

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