

Evaluation of Metacarpal Compression Test for Diagnosis of Metacarpal Fracture

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Abstract

Background: There are many methods for evaluating a traumatized metacarp.

Objectives: This study sought to evaluate the accuracy of the metacarpal compression test for the diagnosis of metacarpal fracture.

Methods: All patients with metacarpal trauma were tested via placement of axial load (compression) on the metacarpal; induction or exacerbation of pain on each metacarp was recorded upon applying axial pressure. Then, an X-Ray imaging system was used to identify and record the presence of fracture. All data were entered into a 2x2 table, and then negative predictive value (NPV), positive predictive value (PPV), sensitivity and specificity of the test were calculated.

Results: After careful physical examination and application of the axial pressure on the metacarpal bone, 16(23.68%) patients did not experience any pain during axial loading (none had fracture). According to the statistical analyses of the data, the proposed method had a 69% specificity, 100% sensitivity, 86% PPV and 100% NPV.

Conclusion: Our findings showed that axial loading applied on the metacarpal bone, when it leads to pain, is a good marker for fracture. On the other hand, patients with negative test results had no fracture on radiography, which emphasized 100% NPV of the test.

Keywords: Metacarpal Bone, Fracture, Compression Test, Clinical Decision Rule, Axial Load.

Introduction

Metacarpal bone fracture is the most prevalent fracture of the hand (about 40%).^{1,2} These fractures are diagnosed by both the clinical examination and radiography.³ Pain on palpation or point tenderness is the sign of trauma in physical examination.⁴ In some cases without deformity at the trauma location, localized edema may not be helpful for diagnosis, however, in the most cases, the patient complains of severe pain at the fracture site.^{5,6}

There have been various diagnostic approaches to identify a metacarpal fracture,^{7,8} such as conventional radiography (as the standard method), computed tomography (CT) scans, hand sonography and magnetic resonance imaging (MRI).^{9,10} Numerous clinical concepts emphasized that radiographic examination is essential after physical examination for diagnosis of fracture.^{11,12} Hence, proper use of physical examination reduces the need for unnecessary radiographs without any missed diagnoses. Recognition of patients who do not require radiographic examination is important for all clinicians, especially emergency physicians.^{13,14}

Objectives

This study sought to evaluate the accuracy of the metacarpal compression test for the diagnosis of metacarpal fracture.

Materials and Methods

This study was performed in emergency department of Shahid Rahmehoon Hospital (trauma center) during the winter 2014 and summer 2015.

All the cooperative hand trauma patients with metacarpal tenderness, who had normal brain function and Glasgow Coma Scale (GCS), were included in this study. Patients with deformity in hand, wrist and finger, finger tenderness, ages <18 or > 60 years, chronic disease of bone or joint, intoxication and distracting injury were excluded.

The maneuver steps were described for the patients by a physician get their consent. After taking informed consent from patients, the physician asked the patient to fix her/his hand in prone position and extent all metacarpophalangeal (MCP), proximal inter phalangeal (PIP) and distal inter

phalangeal (DIP) joints. Then, a mild axial loading along all the patient's finger was applied by the physician according to [Figure-1](#). Induction or augmentation of pain on each metacarpals was recorded during axial pressure. In the present study, for reducing biases and errors, all of the patients were evaluated by the same physician.

Since all patients had hand trauma and needed radiography, an x-ray was performed and emergency medicine (E.M) physician or the orthopedic consultant, ordered appropriate therapy according to radiographs.

Radiographs were evaluated by a radiologist who was blinded about this study. The presence of fracture was diagnosed using X-rays. All data was entered to a 2*2 table, then negative predictive value (NPV), positive predictive value (PPV), Sensitivity and Specificity of test were established.

Ethical Consideration: According to the ethical committee of Shahid Sadoughi University of Medical Sciences, in the present study, the data were collected without any intervention and was thus exempt from ethical approval. All the patients included in this study were informed about the details of the study procedure and signed the consent form for gathering data.

Results

In this cross-sectional study, 97 patients were potentially eligible for testing. Of these patients, 67 patients had Blunt force trauma to hand and were selected in the emergency department. There were no differences between E.M physician and radiologist for reporting fracture in all radiographs.

In this study, the mean age of the patients was 29.44 ± 8.53 years (in the range 15- 55). 63 (94.02%) patients were male and 4 (5.97%) were female.

After careful physical examination and application of the axial pressure on metacarpal bone, 16(23.68%) patients didn't report any pain during axial loading of which none had fracture.

In [Figure-2](#) shows the STARD flow diagram of the enrolled patients.

In the past, metacarpal fracture was more frequent in older people due to osteoporosis,¹⁹ while the average age of patients in our study was 29.44 years old, and motor or car accident were more than falling in etiology of trauma ([Figure-3](#)).

Among our study participants, the most metacarpal fracture was observed in young men that was caused by car accident (63%).



Figure-1. A mild axial loading along all the patient's finger was applied by the physician

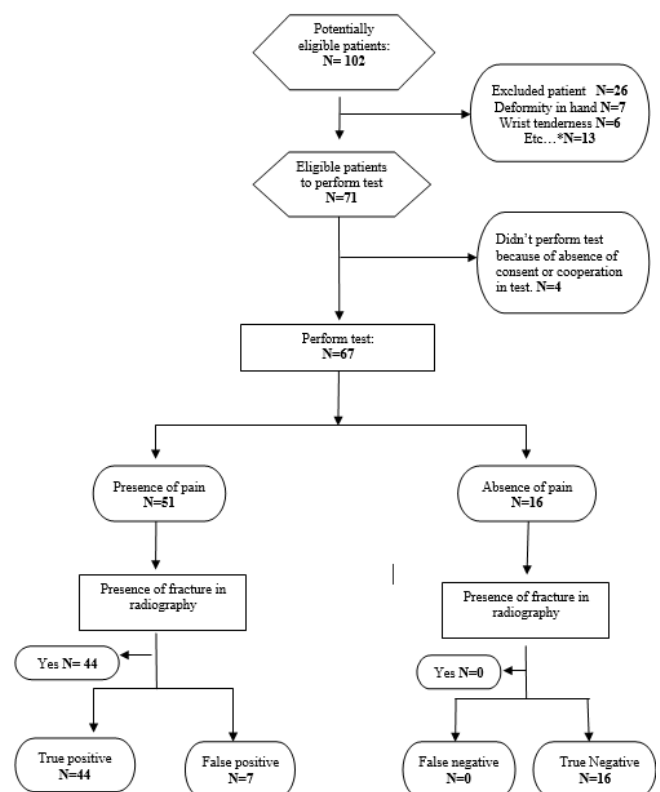


Figure-2. STARD flow diagram of patients enrolled to study.

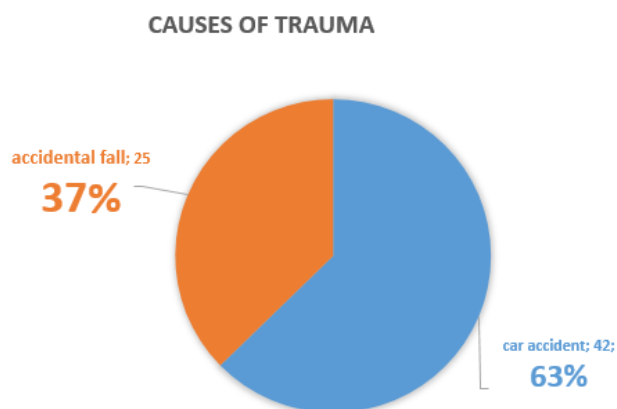


Figure-3. Causes of trauma

According to Figure-4, the most common site of metacarpal fracture was the fifth metacarpal bone, which is consistent with the findings of other studies.²⁰

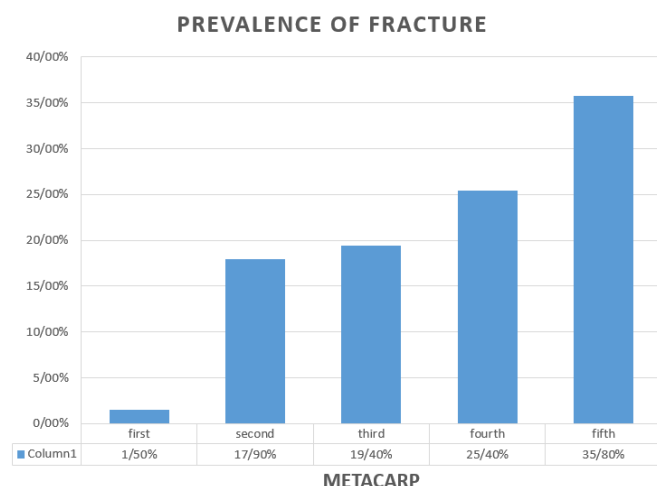


Figure-4. Prevalence of fracture in each metacarp

Table-1 summarizes the gathered data, and the statistical analyses of the data showed a specificity of 69%, sensitivity 100%, PPV 86% and NPV 100%.

Table-1. 2x2 table of results

		Fracture	
		+	-
Pain in axial pressure	Presence	44	7
	Absence	0	16

In this study, we applied pressure by hand over finger axial axis (axial loading) according to Figure-1, as a new method on hand physical exam. Our finding implied that axial loading applied on the metacarpal bone, when leads to pain, can be determined as a good marker for fracture.

Axial loading as a new maneuver can be considered as a novel hand physical exam. The proposed test showed a sensitivity of 100% in this maneuver. This method can be used as a simple diagnostic method for any type of fracture without the need for radiography.

On the other hand, patients with negative test results had no fracture in radiography, which emphasized 100% NPV of test.

Our study showed that this maneuver can eliminate about 23% of hand radiographies potentially, that leads to reduction in cost and radiation exposure. This test confirmed the effectiveness of physical examination.

Discussion

In the past, metacarpal fracture was more frequent in older people due to osteoporosis,¹⁹ while the average age of patients in our study are 29.44 years old.

According to De Jonge et al., study, the most frequent metacarpal fractures occur among male genders, which is consistent with our results.¹⁷ Moreover, in Anakwe et al study, falling was the most probable etiology of metacarpal fracture.¹⁸ Among our study population, the most metacarpal fracture was observed in young men, which was caused by car accident (63%). It can attribute to the different driving culture. The higher fracture rate in men may be due to the most prevalence of work-related trauma or motorcycle accident in this gender. In addition, women have a safer life style and their hand fracture is more common, because of fall and osteoporosis. Our findings implied that the most common site of metacarpal fracture was the fifth metacarpal bone, which is in agreement with other studies.²⁰ Generally, most of the trauma patients in ED prefer to undergo an X-Ray, because they are worried that something may go wrongly. Therefore, clinical decision rules such as Ottawa rules (knee and ankle), Canadian C-spine rule, and NEXUS (national emergency X-ray utilization study) low risk criteria for C-spine, were designed and now are administered. The clinical decision rules can reduce unnecessary radiographies and ED detainment time, while patient management is done carefully. These evidences prove that these methods are cost-effective.

It is emphasized in references that an obvious tenderness of a palm, during simple pressure on metacarpal bone increases the possibility of a metacarpal fracture.¹⁵

In a similar study, it has been reported that scaphoid

compression test as a novel method in physical examination of thumb in which an axial pressure is loaded to the finger. In this case, induction or enhancement of pain considered a positive result.¹⁶ In the present study, the same procedure was used but on other fingers to evaluate its diagnostic value on metacarpals.

The proposed test offered a sensitivity of 100% in this maneuver. On the other hand, patients with negative test results had no fracture in radiography, which emphasized 100% NPV of the test. Therefore, if there is no pain during axially loading test, the possibility of a significant fracture is low and radiography can be excluded. It can be concluded that axially loading test can be used as an excellent screening test for metacarpal fracture, resulting in less negative radiographs, reduced radiation exposure and decreased costs for the patients.

In the present study, we couldn't follow the patients after discharge, because they were referred to orthopedic department, and hence it is recommended that further research be undertaken to follow the patients after discharge and evaluate their prognosis.

Most of patients in the ED were not cooperative because of previous belief that radiography should be done inevitably. In most of the patients, wound or tenderness of finger was the major limiting factor for examination.

Conclusions

Current findings showed that axial loading applied on the metacarpal bone, when it leads to pain, is a good marker for fracture. On the other hand, patients with negative test results had no fracture on radiography, which emphasized 100% NPV of the test.

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Not applicable.

Authors' Contribution

All authors pass the four criteria for authorship contribution based on the International Committee of Medical Journal Editors (ICMJE) recommendations.

Conflict of Interests

None.

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