



Diagnostic value of the radiographic muscle-to-bone thickness ratio between the pronator quadratus and the distal radius at the same level in undisplaced distal forearm fracture



Bo Sun^{a,b,c}, Dianxing Zhang^a, Wuxian Gong^a, Shiting Huang^a, Qinhua Luan^a, Jinyong Yang^a, Dan Wang^d, Jun Tian^{a,*}

^a Shandong Medical Imaging Research Institute, Shandong University, 324 Jing Wu Road, Jinan 250021, Shandong, PR China

^b Research Center for Sectional and Imaging Anatomy, Shandong University School of Medicine, Jinan 250012, Shandong, PR China

^c Shandong Key Laboratory of Advanced Medical Imaging Technologies and Application, Jinan 250012, Shandong, PR China

^d Shandong Provincial Hospital Affiliated to Shandong University, 324 Jing Wu Road, Jinan 250021, Shandong, PR China

ARTICLE INFO

Article history:

Received 8 August 2015

Received in revised form

30 November 2015

Accepted 2 December 2015

Keywords:

Pronator quadratus

Undisplaced distal forearm fracture

Radiograph

Muscle-to-bone ratio

ABSTRACT

Purpose: To investigate the value of the muscle-to-bone ratio (MBR), which is the ratio between the maximum pronator quadratus thickness (mPQT) and the distal radial thickness (DRT) at the same level, in comparison with mPQT in the diagnosis of undisplaced fractures in distal forearm (FDF) on radiographs. **Material and methods:** This study was conducted with 210 wrists of 210 volunteers (79 male, 131 female) and 106 wrists of 106 patients with acute undisplaced FDF (53 male, 53 female). The mPQT was measured on lateral radiographs, and the MBR was calculated for each wrist.

Results: The mean mPQT (7.37 ± 1.99 mm) and MBR (0.55 ± 0.15) in the fracture group were significantly larger than those (4.70 ± 1.42 mm and 0.31 ± 0.09) in the control group respectively (all $P < 0.05$). Sexual differences of mPQT were found in both control and fracture groups (all $P < 0.05$). There were no gender differences of MBR in either control or fracture group (all $P > 0.05$). ROC analysis revealed that the discriminating efficacy of MBR was significantly superior to that of mPQT ($P < 0.01$). The most optimal diagnostic discrimination was obtained by a MBR cut-off value of 0.4.

Conclusions: The MBR can be used as a new index for the diagnosis of undisplaced FDF, as well as a complementary means to detect occult fractures. If the MBR is larger than 0.4 in a patient with suspected or occult FDF, a further MRI examination will be justifiably needed.

© 2015 Elsevier Ireland Ltd. All rights reserved.

1. Introduction

The pronator quadratus (PQ) is a small square-shaped muscle attached to the anterior aspects of the distal radius and ulna [1–4]. Overlying the PQ, there is a thin radiolucency stripe, which is called the PQ fat pad, separating the PQ from the flexor digitorum profundus muscles [2,5]. On lateral radiographs of the wrist, the PQ pad in normal subjects generally represents a straight stripe or slight anterior convexity paralleling the distal radius [2,4,6]. According to

its lateral radiological appearances, the PQ pad was also classified into 4 types ranging from straight to absent [6].

Fractures of the distal forearm (FDF) are the most common wrist trauma in clinical emergency [7]. FDF can make the PQ swollen, and the PQ pad displaced anteriorly or even obliterated, which is called the radiological “PQ sign”, due to the accumulation of fluid within the PQ muscle [4,5,8,9]. The PQ sign sometimes might be the only evidence of occult FDF. Nevertheless, the validity of the PQ sign in FDF detection has been controversial. MacEwan first reported the PQ sign as an important soft-tissue sign of fractures of distal forearm at the level of the PQ attachment with high sensitivity and specificity [4]. However, other previous findings revealed that a positive PQ sign is not a reliable predictor of occult fracture of the wrist [9,10].

Researchers also tried to find a proper value of the maximum pronator quadratus thickness (mPQT) to identify the PQ swelling for FDF detection. However, the PQ value in normal subjects varies

Abbreviations: MBR, muscle-to-bone ratio; mPQT, maximum pronator quadratus thickness; DRT, distal radial thickness; FDF, fractures in distal forearm.

* Corresponding author.

E-mail addresses: sunboy4554@163.com (B. Sun), lustar1976@163.com (D. Zhang), gw9899@163.com (W. Gong), hst996@163.com (S. Huang), leilei.5143@163.com (Q. Luan), yangjin.527@163.com (J. Yang), wangd2013@163.com (D. Wang), tian_jun1@126.com (J. Tian).

<http://dx.doi.org/10.1016/j.ejrad.2015.12.002>

0720-048X/© 2015 Elsevier Ireland Ltd. All rights reserved.

Table 1
Characteristics of subjects.

	Control group			Fracture group			<i>t</i>	<i>P</i> ^a
	<i>n</i>	Age	Range	<i>n</i>	Age	Range		
Male	79	41.5 ± 14.6	18–86	53	44.7 ± 18.2	21–86	0.719	0.474
Female	131	43.3 ± 13.5	17–78	53	45.4 ± 19.9	20–81	1.084	0.281
Total	210	42.6 ± 13.9	17–86	106	45.1 ± 19.0	20–86	0.602	0.548

Note: Data are presented as mean ± SD.

^a Significant differences of mean age were compared between control and fracture groups for males, females and the entire sample by 2-tailed Student's *t*-test.

widely. Sasaki and Sugioka reported that the PQ distance was less than 7 mm in 92% of 72 healthy subjects and larger than 7 mm in 93% of 29 patients with recent distal radius fractures. Fallahi et al. held that a PQ value greater than 8 mm in females and 9 mm in males should be regarded as raised [9]. Nevertheless, Zammit-Maempel et al. argued that PQ values greater than 7 mm in females and 10 mm in males should be considered with suspicion [11]. Besides Sato et al. found significant differences of the mPQT between dominant (4.7 ± 1.2 mm) and nondominant (4.4 ± 1.1 mm) hands in healthy volunteers through sagittal sonographic images [1]. Much of the variability may be attributed to differences in the populations studied and measurement techniques.

Given the fact that mPQT could be affected by a variety of factors such as gender and age [11], simple measurements of mPQT may not represent an optimal radiologic parameter in the diagnosis of FDF. For example, the PQ muscle can be swollen-like in strong and healthy men, so it is not that easy to identify whether or not the swelling is caused by trauma based only on its radiologic appearance. And a single measurement of mPQT may also lead to a false positive diagnosis. As such, we hypothesize that the muscle-to-bone ratio (MBR), which is defined as the ratio between the mPQT and the distal radial thickness (DRT) at the same level, may make an alternative method of diagnosis accessible. With PQ thickening at the wrist, as in FDF, a larger MBR is expected. This ratio might be less affected by the effects of variable factors (such as gender and body size). Moreover, the ratio might also be less affected by differences in measurement method. The purpose of this study was to assess the efficacy of MBR in comparison with mPQT in the detection of undisplaced FDF (especially occult fractures) by radiographs. We also aimed to find an optimal cut-off value of the MBR for the diagnosis.

2. Materials and methods

2.1. Subjects

From 2011 through 2013, 210 wrists of 210 volunteers (79 male, 131 female, mean age, 42.6 ± 13.9 years old; range, 17–86 years) and 106 wrists of 106 patients (53 male, 53 female, mean age, 45.1 ± 19.0 years old; range, 20–86 years) were retrospectively examined in this study (Table 1). All of the volunteers, as in the control group, were completely asymptomatic with no history of osteoarthritis, inflammatory arthritis or osteomyelitis of the wrist. And all of the patients, as in the fracture group, had acute (within 24 h) undisplaced FDF. The study protocol was approved by the Ethics Committee of Shandong Medical Imaging Research Institute. Informed written consent was obtained from each patient and healthy volunteer.

2.2. Imaging acquisition and measurements

Standard plain films in postero-antero (PA) and lateral projection were collected from all participants by Kodak DR7500

Digital Radiology System (Eastman Kodak Company, USA). The radiographic parameters: PA: 58 kV, 160 mA, 0.08 s; Lateral: 60 kV, 160 mA, 0.1 s. Among three patients with suspected or occult undisplaced FDF, one patient had a 45° oblique radiograph and two patients underwent MR scanning via GE (General Electric, Milwaukee, USA) 3.0-T MRI Scanner. A standard protocol with coronal T1, coronal T2-fat suppression (FS), sagittal T1 and sagittal T2-FS sequences was performed with the following parameters: T1: TR 400, TE 7.3, 3.5 mm slice thickness, 15 cm field of view; T2-FS: TR 3500, TE 35.7, 3.5 mm slice thickness, 15 cm field of view. The three patients all had a clinical sign of pronator disorder.

At the same level of PQ attachment, the mPQT and the DRT were measured on the lateral radiographs respectively (Fig. 1). The MBR was then calculated as the ratio between mPQT and DRT. One musculoskeletal radiologist, who was blinded to the personal information of participants, examined all the radiographs. The parameters were measured twice, and the average value was subjected for statistical analysis.



Fig. 1. Measurements of PQ parameters. On the lateral radiograph, the mPQT (5.25 mm) and the DRT (15.33 mm) were measured at the same level. The MBR (0.342) was then calculated.

Download English Version:

<https://daneshyari.com/en/article/4225080>

Download Persian Version:

<https://daneshyari.com/article/4225080>

[Daneshyari.com](https://daneshyari.com)