



**9th INDES 2020**  
**LIMITLESS MIND:**  
EMPOWERING INNOVATION THROUGH VISUALIZATION



الجامعة  
UNIVERSITI  
TEKNOLOGI  
MARA

Cawangan Perak

PROGRAM  
PROCEEDINGS  
ABSTRACTS BOOK

The 9th International Innovation, Invention  
& Design Competition  
INDES2020

17th May – 10th October 2020

# **DIAGNOSTIC ACCURACY BETWEEN ULTRASOUND AND RADIOGRAPHY IN DETECTING GREENSTICK FRACTURE WITH VARIOUS ANGULATIONS ON PEDIATRIC BY USING HOMEMADE DISTAL RADIUS PHANTOM**

Nurul Aisyah Mohammad Noor, Lyana Shahirah Mohamad Yamin  
*Centre of Medical Imaging, Universiti Teknologi MARA, MALAYSIA*  
*E-mail: nrlasyh97@gmail.com*

## **ABSTRACT**

The aim of this study is to compare the effectiveness of the ultrasound and radiography in detecting greenstick fracture with different angulations on pediatric by using homemade distal radius phantom. Ten homemade phantoms consist of chicken leg bones and gelatine had been prepared to represent the pediatric distal radius. There are two sets of phantoms where each contain two normal chicken leg bones and three chicken leg bones with different angulations of greenstick fracture start with 10°, 20° and 30°. Three emergency physicians were then evaluated all of the phantoms through ultrasound images and radiographic images to obtain diagnostic accuracy results. Based on the result, ultrasound has high specificity (100%) with low sensitivity (55.6%) while the radiography has low specificity (50.0%) and sensitivity (44.4%). From this study, the ultrasound is more effective in detecting greenstick fracture with different angulations on pediatric distal radius by using the phantoms as compared to radiography test.

**Keywords:** ultrasound, radiography, greenstick fracture, diagnostic accuracy, pediatric, angulations

## **1. INTRODUCTION**

A forearm fracture is the third most common pediatric fracture and 82.5% of forearm fractures are greenstick fractures [1]. The gold standard for examining suspected fracture is conventional radiography however, ultrasound has been recommended as the alternative method [2]. A few reports showed that radiology studies have high frequency of negative results which indicates that an alternative diagnosis is necessary to reduce unnecessary exposure to the pediatric [3]. Hence, ultrasound is suggested due to the absence of ionizing radiation [4]. The research aims to compare the effectiveness of ultrasound and radiography in detecting the greenstick fracture with different angulations on pediatric distal radius by using phantom. In order to meet the research goal, it is pertinent to measure the diagnostic accuracy of ultrasound and radiography in detecting the greenstick fracture with various angulations.

## **2. METHOD**

Figure 1 showed the process on making the homemade distal radius phantom to mimic the pediatric distal radius.



Step 1: Soaked ten chicken leg bones into white vinegar for three weeks.

Step 2: Six chicken leg bones were broken into greenstick fracture with angulations of 10°, 20° and 30°.

Step 3: Place the chicken leg bones into plastic ice cream tube filled with gelatine and then label each phantom

**Figure 1.** The process of making homemade distal radius

As for the data collection, three emergency physicians need to detect the greenstick fracture based on the angulations presented by analysing the radiographic and ultrasound images of each phantom. Mann-Whitney test was used to compare the diagnostic accuracy between ultrasound and radiography in detecting greenstick fracture with different angulations.

### 3. FINDINGS AND ARGUMENTS

According to the result, ultrasound has high specificity (100%) and low sensitivity (55.6%) which means that it able to correctly rule out negative cases and get fewer false positive results whereas radiography has low specificity (50.0%) and sensitivity (44.4%) which showed that it unable to obtain more positive cases of the fracture as well as getting high rate of false positives. The ultrasound appeared to have higher accuracy as the images obtained showed clear view the outline of the bones. This is because by using the ultrasound, the dense nature of bone causes reflection of the ultrasound waves, allowing a clear distinction from the soft-tissue envelope and creating a hyperechoic (bright) reflection from the cortical surface. This makes it easier for making a diagnosis when trying to identify the greenstick fracture when the fractures can be visualized as a break in the smooth cortical contour. Based on Mann-Whitney test, the p-value is 0.037 which showed that there is significant different of diagnostic accuracy between ultrasound and radiography in detecting greenstick fracture with various angulations.

### 4. CONCLUSION AND SUGGESTIONS

In conclusion from this study, ultrasound is more effective in detecting greenstick fracture with different angulations on pediatric distal radius by using the phantoms compared to the radiography. For suggestion, future researcher should use human patient as a subject as there might be some differences from human bones in radiographic and ultrasound images compare to the animal mode.

## REFERENCES

1. Komatsu, J., Nagura, N., Mogami, A., Iwase, H., & Kaneko, K. (2019). Seven- year follow- up for malrotation of a radial diaphysis fracture in a child corrected by osteotomy for loss of motion: A case report. *Experimental and Therapeutic Medicine*, 18(4), 3009-2013. Retrieved from <https://pubmed.ncbi.nlm.nih.gov/31572542/>
2. Pietsch, E. (2018). EC ORTHOPAEDICS Case Series the Significance of Ultrasound in Juvenile Distal Forearm Fractures, 10, 762–768. Retrieved from <https://www.econicon.com/ecor/pdf/ECOR-09-00357.pdf>
3. Bolandparvaz, S., Moharamzadeh, P., Jamali, K., Pouraghaei, M., Fadaie, M., Sefidbakht, S., & Shahsavari, K. (2013). Comparing diagnostic accuracy of bedside ultrasound and radiography for bone fracture screening in multiple trauma patients at the ED. *American Journal of Emergency Medicine*, 31(11), 1583–1585. Retrieved from <https://doi.org/10.1016/j.ajem.2013.08.005>
4. Herren, C., Sobottke, R., Ringe, M. J., Visel, D., Graf, M., Müller, D., & Siewe, J. (2015). Ultrasound-guided diagnosis of fractures of the distal forearm in children. *Orthopaedics and Traumatology: Surgery and Research*, 101(4), 501–505. Retrieved from <https://doi.org/10.1016/j.otsr.2015.02.010>



Surat kami : 700-KPK (PRP.UP.1/20/1)  
Tarikh : 30 Ogos 2022

YBhg. Profesor Ts Sr Dr Md Yusof Hamid, PMP, AMP  
Rektor  
Universiti Teknologi MARA  
Cawangan Perak



YBhg. Profesor

**PERMOHONAN KELULUSAN MEMUAT NAIK PENERBITAN UiTM CAWANGAN PERAK  
MELALUI REPOSITORI INSTITUSI UiTM (IR)**

Perkara di atas adalah dirujuk.

2. Pihak Perpustakaan ingin memohon kelulusan YBhg. Profesor untuk membuat imbasan (*digitize*) dan memuat naik semua jenis penerbitan di bawah UiTM Cawangan Perak melalui Repositori Institusi UiTM, PTAR.
3. Tujuan permohonan ini adalah bagi membolehkan akses yang lebih meluas oleh pengguna Perpustakaan terhadap semua bahan penerbitan UiTM melalui laman Web PTAR UiTM Cawangan Perak.

Kelulusan daripada pihak YBhg. Profesor dalam perkara ini amat dihargai.

Sekian, terima kasih.

**“WAWASAN KEMAKMURAN BERSAMA 2030”**

**“BERKHIDMAT UNTUK NEGARA”**

Yang benar