Reliability of Using Radius Union Scoring System among General Practitioners, Orthopedic Residents and Orthopedic Surgeons for Distal End Radius Fracture Healing Evaluation

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Background: *Fractures of distal end of radius are common fractures in adults. They were commonly treated by general practitioners (GPs) in rural Thailand. Inadequate time for immobilization and casting may reach more complications such as failure to maintain reduction or stiffness. There has been no publication of objective tools for diagnosing of fracture union to date. Radius union scoring system (RUSS) may be a good diagnostic tool and easy to use. However, there is no study about the reliability between GPs and orthopedic surgeons.*

Objective: *To study the reliability of using RUSS score between different evaluators-GPs and orthopedic surgeons.*

Material and Method: *Anteroposterior and lateral view of plain wrist radiographs from 20 distal end radius fractured patients were used for reviewing. RUSS was used for rating of radiographs by 6 GPs, 6 orthopedic residents and 3 orthopedic surgeons. Interobserver reliability was determined and calculated.*

Results: *This study found low level of interobserver between GPs and orthopedic surgeons (ICC = 0.39, 95% CI) and low level of interobserver reliability in inexperienced groups of physicians in this study (ICC = 0.37 and 0.48 in GPs and junior residents' group). Level of interobserver reliability has been associated with rater's experience.*

Conclusion: *Level of interobserver reliability between general practitioners and orthopedic surgeons was low due to experiences of the raters. RUSS may not be a proper tool for inexperienced physicians.*

Keywords: *Distal radius fracture, Fracture union, General practitioners, Radius union scoring system*

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Fractures of distal end of the radius are common fractures in adults, especially in osteoporotic patients. In Thailand, some of patients have been treated by general practitioners (GPs) in primary hospitals. Casting and serial radiographic examination have been used for purposes of treatment and assessment. Bone union has been subjectively diagnosed by using clinical judgement and radiographic images, which are mainly based on examiner experiences. Inadequate time for immobilization may reach the complications such as loss of reduction or stiffness and complex regional pain syndrome. Previously, there was no simple and objective tool used for diagnosing the bone union in this kind of fracture. For this reason, we want to find a simple, easy, and objective tool to help GPs diagnose the distal end radius fracture union. Schnarkowski et al reported computer tomography may be useful for fracture union diagnosing, but it is not widely available in rural hospital[1,2].

In 2014, Morshed et al reported many methods for union evaluation using imaging and various biological markers, but they are still not a gold standard in diagnostic methods[3]. A radiographic scoring system was among one of the reported options[4-10].

Patel et al developed Radius Union Scoring System (RUSS), which uses bridging callus and fracture lucent line for evaluation[4]. In this report, interobserver reliability between orthopedic surgeons and radiologists was high. This may be a useful, objective tool for GPs to evaluate the distal end radius fracture union.

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For generalization of RUSS application, high level of reliability and validity must be confirmed. Therefore, the authors conducted a preliminary study to assess the interobserver reliability between two groups of physicians-GPs and orthopedic surgeons.

Material and Method

The wrist radiographs (anteroposterior and lateral view) from distal end radial fractured patients between January 2014 and December 2015 were reviewed. Twenty sets of anteroposterior and lateral view of digital plain radiographs were chosen randomly (n = 12 for 95% CI. The sample size was calculated by using a formula to estimate levels of agreement at various dates after injury; casts were not removed before taking radiographs and all images were rated using RUSS (Table 1). Fracture line and bridging callus, radio-opaque trabeculae that run across the fractured radiolucent line (Fig. 1), were used for rating.

Fifteen raters participated in this study-six general practitioners (1 year post graduate), three junior residents (1st or 2nd year orthopedic residents), three senior residents (3rd or 4th year orthopedic residents) and three orthopedic surgeons (SWUEC/E-258/2558).

The primary outcome (interobserver reliability between GPs and orthopedic surgeons) was then calculated using interclass correlation coefficient (ICC) using 23rd version of IBM SPSS Statistics. The secondary outcomes were interobserver reliability among each rater in the same group, and the reliability between orthopedic surgeons and residents. As per previous study by Patel et al[2], we used two-way random models and single rating for calculation of agreement between raters, and used the same levels of agreement as follows: 0 to 0.20 represents slight agreement, 0.21 to 0.40 fair agreement, 0.41 to 0.60 moderate agreement, 0.61 to 0.80 substantial agreement and value above 0.80 represents perfect agreement.

Fig. 1 Bridging callus.

Results

For the primary outcome, interobserver reliability ICC between GPs and orthopedic surgeons was 0.39 (95% CI: 0.23 to 0.60) which can be interpreted as fair agreement in using RUSS (Table 2).

For interobserver reliability of all raters, the ICC was 0.38 (95% CI: 0.24 to 0.58, $p<0.001$), which indicates fair agreement between all raters. Two highest ICCs are of senior residents' group (0.6, 95% CI: 0.35 to 0.80) and orthopedic surgeons' group (0.65, 95% CI: 0.41 to 0.83) (Table 3).

Table 1. Radius union scoring system (RUSS)

RUSS score	Bridging callus*	Fracture line
0	Absent	Present
1	Present	Present
2	Present	Absent

* Radio-opaque trabeculae that run across the fractured radiolucent line

Table 2. Interobserver reliability between groups

Observer	Interobserver (ICC)	95% confidence interval
GPs-orthopedic surgeons	0.39	0.23 to 0.60
GPs-orthopedic residents	0.35	0.20 to 056
Residents-orthopedic surgeons	0.42	0.26 to 0.63

GPs = General practitioners

Table 3. Interobserver reliability between physicians in each groups

Observer	Interobserver (ICC)	95% confidence interval
All GPs	0.37	0.19 to 0.60
All junior residents	0.48	0.21 to 0.73
All senior residents	0.60	0.35 to 0.80
All residents	0.35	0.17 to 0.58
All orthopedic surgeons	0.65	0.41 to 0.83
All 15 physicians	0.38	0.24 to 0.58

GPs = General practitioners

Discussion

Nowadays, no standard diagnostic tool was generally used for diagnosis of the distal end radius fracture. In Thailand, GPs in primary hospital use clinical data such as timing after injury, pain at rest and range of motion, and radiographs for predict the fracture union. We wanted to find an easy tool for improve their practice.

Many radiographic scores, such as the RUSS, may be useful to help the GPs for used in their practices. Previous study of Patel et al reported high level of agreement between orthopedic surgeons and radiologists (ICC 0.62, $p<0.001$) for RUSS rating[3]. If the reliability of this score is similar between GPs and orthopedists, the RUSS may be the helpful diagnostic tool for used in any rural hospital. Unfortunately, we found only a fair level of agreement for the interobserver reliability between general practitioners and orthopedic surgeons (ICC = 0.38, 95% CI = 0.24 to 0.58). As a result, we think that RUSS was not an easy and simple tool for general practitioner to use in their practice.

Furthermore, our study showed low interobserver reliability ICC in many groups of raters. Moderate to substantial agreement was found in groups of physicians who are more experienced including senior residents (ICC = 0.60, 95% CI = 0.35 to 0.80) and orthopedic surgeons (ICC = 0.65, 95% CI = 0.41 to 0.83), and yielded the similar results as per the study by Patel et al (ICC of interobserver reliability was 0.48 for orthopedic surgeons and 0.70 for radiologists). Experienced physician groups had higher level of agreement as a result. For the Reason, the authors ascribe inexperienced physicians may be could not distinguish between callus and plaster shadow, that made the low level of agreement between each group. Removed the cast before taking the radiographs may be improved the callus visualization.

Conclusion

The authors do not prefer this score to be generally used for evaluation of distal radius fracture union in inexperienced physicians, as the interobserver reliability of this score was too low. The differences in union diagnosis can be the result of the level of experiences between general practitioners and orthopedic surgeons.

What is already known on this topic?

As same as the previous literature, this study result showed high level of agreement between raters in experience physicians such as senior residents and orthopedists.

What this study adds?

From subgroup analysis, fair level of agreement was found in low experience physicians, GPs and junior residents. This knowledge did not explain in the previous study. For this reason, RUSS may not be used in inexperience physicians' practice.

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Potential conflicts of interest

None.

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ความเชื่อมั่นของ Radius union scoring system ระหว่างแพทย์เวชปฏิบัติทั่วไป แพทย์ประจำบ้าน สาขาออร์โธปิดิกส์ และศัลยแพทย์กระดูกและข้อในการประเมินการสมานของกระดูกเรเดียสส่วนปลาย

ณัฐกร มหสุภาชัย, ฐิติณัฐ ดิลกหัตถการ

ภูมิหลัง: *กระดูกเรเดียสส่วนปลายหักเป็นการหักของกระดูกที่พบได้มากในผู้ใหญ่ในประเทศไทยผู้ป่วยส่วนมาก ได้รับการรักษาโดยแพทย์เวชปฏิบัติทั่วไปในโรงพยาบาลชุมชน โดยใช้อาการและภาพถ่ายรังสีข้อมือในการวินิจฉัยการสมานของกระดูก ซึ่งการเข้าเฝือกสั้นไปหรือนานไปจะก่อให้เกิดผลข้างเคียงแก่ผู้ป่วย เช่น สูญเสียแนวกระดูกที่ดีหรือข้อติดเป็นต้น การหาเครื่องมือที่เป็นการวัดแบบอัตนัยมาใช้ในการวินิจฉัยจึงเป็นประโยชน์ในการช่วยเหลือแพทย์เวชปฏิบัติในการรักษาผู้ป่วยกลุ่มนี้ ซึ่ง RUSS score เป็นการวัดแบบอัตนัยจึงอาจเป็นเครื่องมือที่นำมาใช้ได้*

วัตถุประสงค์: *เพื่อหาความเชื่อมั่น (Interobserver reliability) ระหว่างแพทย์เวชปฏิบัติทั่วไปและศัลยแพทย์กระดูกและข้อในการประเมิน RUSS Score*

วัสดุและวิธีการ: *ภาพถ่ายรังสีข้อมือหน้าหลังและด้านข้างจำนวน 20 คู่ของผู้ป่วยกระดูกข้อมือเรเดียสส่วนปลายหัก ถูกประเมินโดยใช้ RUSS Score โดยแพทย์เวชปฏิบัติทั่วไป 6 คน แพทย์ประจำบ้านศัลยศาสตร์กระดูกและข้อ 6 คน และศัลยแพทย์กระดูกและข้อ 3 คน แล้วจึงคำนวณหาค่าความเที่ยงระหว่างกลุ่มผู้ประเมิน*

ผลการศึกษา: *ค่าความเชื่อมั่นในการศึกษานี้ระหว่างแพทย์เวชปฏิบัติทั่วไปและศัลยแพทย์กระดูกและข้อได้ผลต่ำ (ICC = 0.39, 95% CI) และยังพบว่าค่าความเชื่อมั่นยังได้ผลต่ำในกลุ่มผู้ประเมินที่มีประสบการณ์น้อย เช่น แพทย์เวชปฏิบัติทั่วไป (ICC = 0.37) และแพทย์ประจำบ้านชั้นต้น (ICC = 0.48) และแปรตามประสบการณ์ของผู้ประเมิน*

สรุป: *ค่าความเชื่อมั่นระหว่างแพทย์เวชปฏิบัติทั่วไปและศัลยแพทย์กระดูกและข้อมีค่าต่ำและแปรตามประสบการณ์ของผู้ประเมินเฉพาะนั้น RUSS score เป็นเครื่องมือที่ไม่เหมาะสมกับการใช้รักษาผู้ป่วยโดยแพทย์ที่ประสบการณ์ต่ำ*