



## Scientific/Clinical Article

# Clinical relevance commentary in response to “The validity and reliability of DrGoniometer, a smartphone application, for measuring forearm supination”



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## What question did this manuscript answer?

Measurement of joint range of motion (ROM) is one of the most common evaluations performed while managing individuals with diagnoses that affect joint mobility. Impaired ROM in the wrist and forearm can lead to difficulties in performing many activities of daily living and can reduce participation in social or occupational tasks. Initial assessment and ongoing tracking of ROM measurement of the affected wrist/forearm enables clinicians to monitor recovery and provide recommendations for safe resumption of functional tasks. Using a universal goniometer has traditionally been the method of choice while assessing ROM of the wrist and forearm in clinical practice. Smartphone applications are transforming how we accomplish many daily functions, and assessment of joint ROM is no exception.

This article provides preliminary insights into the measurement properties and clinical use of the DrGoniometer (DrG), a smartphone-based goniometer application, in assessing forearm supination. Specifically, results of this manuscript provide a comparative summary of interrater and intrarater reliability, as well as concurrent validity between DrG and the universal goniometer in assessing forearm supination in healthy individuals and those with impaired forearm movement as a result of a distal radius fracture (DRF). Finally, the authors also provide indices of standard error of measurement (SEM) and minimal detectable change for the DrG in assessing forearm supination and compare these to the current literature.

## Are these study findings ready to be used in practice?

The most important question that clinicians strive to answer while reading a research article is whether the results of the article are valid and ready to be applied in clinical practice or if they should be applied with caution. Reliable and valid measurement tools are unquestionably great assets for clinicians while conducting patient assessments. With the shift in how we have

integrated the use of smartphone applications in our daily life, DrG has the potential to be an addition to clinicians' toolkit. A quick read of the results would endorse the view that DrG is a reliable and valid tool for assessing forearm supination in individuals with DRF. Specifically, the finding that the interrater and intrarater reliabilities of DrG were comparable to those of the universal goniometer in assessing supination in individuals with DRF supports the use of DrG as an alternate tool for hand therapists for this purpose. In addition, the DrG captures an image of patient's forearm, which is analyzed later within the application to compute the supination angle. The image is captured very quickly, which significantly shortens the time for which the patient needs to hold the end position for supination compared with using the universal goniometer for which the patient might have to hold the position longer to allow the examiner to read the angle off of the goniometer, likely exacerbating pain and discomfort.

A closer read of the article reveals some important details that are worth exploring to fully understand the strengths and limitations of the results of this study. These are directly linked to the decision to use DrG in hand therapy practice. First, results of this study are based on a small (by authors' own admission in study limitations) and exclusive sample of those with DRF. The unit of sample was “forearm” and not “individuals with DRF.” Some of the individuals with DRF were assessed at different time points, with each time point serving as a “separate forearm” and unique contributor to the sample. This effectively reduced the number of unique individuals with DRF recruited and does not satisfy the convention of “30 heterogeneous samples.”<sup>1</sup> Second, although the values for the intraclass correlation coefficients (ICCs) to suggest intrarater (0.87; 95% confidence interval [CI]: 0.748-0.936) and interrater reliabilities (0.76; 95% CI: 0.559-0.878) of the DrG in patients with DRF was good, the lower bound for the 95% CI was at or below the threshold for good reliability (ICC < 0.75).<sup>1</sup> For the clinical use of a measure, it is usually suggested that reliability of the measure is as good as the lower bound of the ICC and should be interpreted as such.<sup>2</sup> So, there is a chance that the reliability of the DrG can be below this threshold (ICC < 0.75) if the experiment is repeated. Finally, the authors recognize that they do not provide any standardized guidelines regarding the distance between the smartphone camera and the affected forearm while capturing the

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image to assess supination. This can be a concern while translating DrG in clinical practice as it may lead to assessing supination in a nonstandardized and inconsistent manner, rendering data that may not be comparable between two raters who may have used different distances between the smartphone and forearm. In addition, this research did not examine the interrater or intrarater reliability of DrG in assessing the ROM for pronation, which is critical to fully understand the use of DrG for the purpose of measuring the arc of supination to/from pronation.

### **What aspects of clinical decision-making does this research inform and how can I apply the results of this study in my practice?**

Making a clinical decision to use DrG should be based on its perceived benefits relative to the universal goniometer in capturing supination. There have been numerous publications over the past few years advocating the use of different smartphone goniometer applications for assessing joint ROM. DrG is one of the most common applications used for this purpose.<sup>3</sup> This article provides an important preliminary evidence for the reliability and validity of the DrG in assessing supination in individuals with DRF. The study is a useful resource for clinicians or hand therapists wishing to switch to using smartphone applications in assessing supination. In particular, the study provides a stepwise outline of the precise methodology for operating DrG, notwithstanding the missing details on the distance between the smartphone and forearm. In addition, the study also provides a comparative summary of reliability of DrG against the universal goniometer. As mentioned earlier, the interrater and intrarater reliabilities of the DrG were comparable to those of the universal goniometer. This comparison helps to facilitate the clinical decision of whether to implement the use of DrG in the clinic.

The article also provides values for SEM and minimal detectable change at 90% CI (MDC<sub>90</sub>) for supination assessed using the DrG and universal goniometer, which should facilitate clinical decision-making. One of the foundational goals of outcome measurement is to track the recovery in scores of the measure and compare it with the baseline to determine whether a true change in status has occurred. MDC<sub>90</sub> is the widely accepted index of a true change. Depending on the results of this study, therapists using the DrG should look for any change in supination that exceeds 15° if the follow-up measurement is performed by the same therapist who performed the initial assessment and 20° if the follow-up measurement is performed by a different therapist as an indication of a change in the supination ROM. The substantial change needed to confidently detect a difference is not likely clinically useful, and a larger study sample is needed to determine if the MDC<sub>90</sub> can be reduced to a reasonable level. Clinicians wishing to integrate DrG into their practice should look for further research that demonstrates superior reliability indices with a larger sample that also describes a precise methodology for using DrG while assessing supination.

### **What limitations in this research should I consider when applying this information?**

Most studies have some methodological limitations that restrict their generalizability, and this study is no exception. The authors have been forthcoming in recognizing these limitations as they have some implications for using DrG in hand therapy practice to assess supination. The important limitations that authors have identified are as follows: (1) the short retest span between two measurements for assessing intrarater reliability such that there is a possibility of a rater remembering his/her reading from the first measurement; (2) smaller sample size ( $N = 30$ ) with even smaller

number of exclusive participants, and among them, some were considered more than once in the sample pool if they participated more than once in data acquisition during their recovery from DRF; (3) finally, but most importantly, the lack of standardization of distance between the smartphone and forearm to be measured while operating the DrG application for assessing supination.

In addition to these limitations, there are other limitations that authors have not addressed but are important for considering the use of DrG in clinical practice. Most importantly, the reliability statistics of the DrG, especially the interrater reliability (ICC = 0.76; 95% CI: 0.559–0.878), are not robust. The SEM, which is calculated using this ICC value, is therefore large (8.7°), and changes required before the recovery in the supination ROM can be ascertained to also be large (20°). An MDC<sub>90</sub> of 20° in supination ROM is a large change required before hand therapists can be confident that a true change has occurred. Although these values are useful to guide the practice, they still need to be refined using a large sample (as also admitted by authors) and standardized techniques for using DrG, which will likely improve the ICC values and thereby reduce the magnitude of measurement error. Another important consideration is that the psychometric properties are dependent on the context and can only be interpreted in view of the patient population they were tested in. In other words, results of this research are limited to assessing the supination ROM using the DrG application in individuals with DRF and healthy subjects and should not be extrapolated to other population without further evidence.

### **What would be the next step in making this research relevant to practice?**

The science of reliability and validity of using smartphone applications for assessing the joint ROM, especially wrist and forearm movements,<sup>4,5</sup> is beginning to be understood. The present study definitely adds to this growing literature, but there are still questions that remain unanswered before the use of smartphone applications is fully integrated into hand therapy practice for capturing joint motion. Authors have provided one key research question that needs to be answered to fully realize the potential of using such applications in practice. They propose a qualitative study to understand the barriers of using smartphone applications for assessing the joint ROM in clinics, especially because the DrG application has higher administrative time than the universal goniometer in obtaining supination ROM. Lack of time is the biggest barrier to using outcome measures in rehabilitation practice.<sup>6</sup> A qualitative study that examines such barriers will understandably be useful in forming strategies to overcome such barriers and integrate the use of applications such as DrG for obtaining joint ROM in clinical practice. There are other future research directions that authors have not identified but are extremely critical. Most importantly, the interrater and intrarater reliabilities of the DrG in assessing ROM for supination needs to be examined in a much larger cohort using standardized measurement techniques (e.g., predefined distance from the smartphone to the forearm) and recruiting clinicians as raters or examiners to improve the generalizability of the results. The future research should also integrate assessment of reliability for measuring ROM for pronation. Furthermore, the retest interval for assessing intrarater reliability of DrG in assessing supination or pronation should be longer to avoid any recall bias. Especially, the DrG offers an option to capture photos in time, but ROM estimation based on that picture can be performed at a later time to avoid such bias. As in this study, future research should compare the interrater and intrarater reliabilities of smartphone applications with those of the universal goniometer in assessing joint ROM. This is critical because if smartphone applications have comparable reliability and measurement errors to

those of a universal goniometer, but also have a higher administrative burden, there would be no logical reason to transition to smartphone applications for assessing joint ROM.

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