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Original Research Article

Strong Correlation Between Disabilities of Arm, Shoulder and Hand Score and Modified Mayo Wrist Score Affected by Radius Union Scoring System and C-Reactive Protein in Patients with Conservatively Managed Distal Radius Fracture

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Abstract

Introduction:
Fractures of the distal radius are the most common fractures in the upper extremity. The conservative management of these fractures often yields favorable outcomes, which can be measured using various scoring systems, and are often associated with controlled inflammatory response. This study aims to determine whether the Modified Mayo Wrist Score (MMWS) can be an alternative to the gold standard Disabilities of Arm, Shoulder and Hand (DASH) score. Additionally, we investigate the effect of the Radius Union Scoring System (RUSS) and the C-Reactive Protein (CRP) inflammatory marker to those scores.

Material & Methods:
Patient samples were consecutively taken from a population of patients with conservatively managed distal radius fractures using a cast. The patients were treated with a cast for 6 weeks, followed by a radiographic evaluation to assess the RUSS score and blood sampling in the 9th week to measure CRP level. In the 12th week, the DASH and MMWS were assessed.

Result:
Correlative analysis showed a strong correlation between MMWS and DASH score, and a predictive correlation between RUSS and CRP level toward MMWS and DASH score.

Conclusion:
The MMWS scoring system correlates with the DASH score, making it a promising scoring system in clinical practice, while a high RUSS score and low 9th-week CRP level can cause better functional outcomes in patients with conservatively managed distal radius fracture.

Introduction

Distal radius fracture is the most common fracture of the upper extremity, Its conservative management has been proven to be effective and resulted in comparable clinical outcomes to surgical management, especially in elderly patients.[1] These clinical outcomes can be measured with various scoring systems, where Disability of Arm, Shoulder, and Hand is the most commonly used system, with high validity and reliability.[2] However, this scoring system has 30 items on its inventory, thus taking roughly 20-30 minutes to finish in clinical practice.[3] Modified Mayo Wrist Score (MMWS) is another scoring system developed to measure the outcome of wrist procedures, where it consists of only 4 items combining subjective and objective parameters.[4] Yet, this score has not been researched as much as DASH and still has varying results regarding its validity and reliability.[5]

The clinical outcome for distal radius fracture management is also correlated with several aspects. A higher degree of union, which can be measured with the Radius Union Scoring System (RUSS), is correlated with better outcomes,[6,7] similarly, controlled inflammation response also contributes to it, where prolonged inflammation of more than 9 weeks after the trauma is correlated with poor outcomes.[8]

This paper aims to determine whether MMWS can be an alternative to the gold standard DASH score and to determine the effect of inflammatory markers on clinical outcomes in patients with distal radius fractures treated conservatively.

Methods

This study is a longitudinal observational study and was conducted at Prof. Dr. Ngoerah Hospital on March 2023 until August 2023. Thirty-five consenting patients with distal radius fractures treated conservatively with cast immobilization are enrolled in this research consecutively. The inclusion criteria are patients with age more than 18 years old and consent to be enrolled in the study. The exclusion criteria are a history of ipsilateral upper extremity fracture, having an infectious disease in the course of study, having a cognitive impairment, suboptimal reduction quality after cast application, and patients with multiple fractures.

The cast is maintained for 6 weeks, with weekly visits to evaluate the cast quality and reapplication of the cast when loosening occurs. The cast was removed after 6 weeks, followed by plain radiography examination to determine the RUSS score. A 6-week physiotherapy was commenced on the patients, and was followed up weekly for the progress. On the 9th week, a blood sample was collected to determine the CRP level as the inflammatory marker, and on the 12th week, the DASH score and MMWS were measured, using a goniometer for a range of movement measurement, and hydraulics hand dynamometer for grip strength evaluation.

The correlation between the DASH score and MMWS was measured using the Spearman correlation test to determine correlation coefficient (r), while the correlation between RUSS and CRP level to the DASH score and MMWS was measured using linear regression analysis. Statistical analysis was done using SPSS Statistics version 26 (IBM Corp., Armonk, New York).

Results

A descriptive analysis of 35 patients enrolled in this study is presented in range, median, and interquartile range (IQR). The sample consists of 17 males and 18 females. The median age for male subjects was 36 year-old (IQR 38), and females is 44.5 year-old (IQR 45). Median for RUSS score is 6 (IQR 1), while for CRP is 0.75 (IQR 0.55). DASH score has a median of 2.5 (IQR 7.5), and MMWS 80 (IQR 25). Descriptive analysis for the samples is described in Table 1.

Table 1. Descriptive analysis of variables

Variable	Range	Median	IQR
Age (year)	17-71 (Male) 17-80 (Female)	36 (Male) 44.5 (Female)	38 (Male) 45 (Female)
RUSS	4-8	6	1
CRP (mg/L)	0,29-1,78	0,75	0,55
DASH	0-23,3	2,50	7,5
MMWS	50-100	80	25

Correlation analysis was done for DASH, MMWS, CRP, and RUSS as previously described, which can be seen in table 2.

Table 2. Correlation analysis of variables

Variable Pair	Correlation coefficient (r)	p-value
DASH-MMWS[a]	-0.919	0.000
RUSS-DASH[b]	-0.826	0.000
RUSS-MMWS[b]	0.904	0.000
CRP-DASH[b]	0.779	0.000
CRP-MMWS[b]	-0.837	0.000
a: Spearman correlation test; *b*: linear regression test		

Spearman correlation test for DASH and MMWS resulted in a strong very strong significant inverse correlation with r -0.919 and $p < 0.05$, showing lower DASH score is correlated with higher MMWS. Linear regression test for RUSS and DASH score resulted in a very strong significant inverse correlation with r -0.826 and $p < 0.05$, showing lower RUSS is correlated with lower DASH score. While linear regression test for RUSS and MMWS resulted in a very strong significant correlation, with r 0.904 ad $p < 0.05$, showing higher RUSS is correlated with higher MMWS. Similar results are also found in CRP and DASH score and CRP and MMWS correlation analysis using linear regression test, where CRP and DASH score is shown to have strong significant correlation with r 0.779 and $p < 0.05$, and CRP and MMWS has very strong significant inverse correlation with r -0.837 and $p < 0.05$.

Discussion

This study sample, which is taken consecutively, consisted of 17 male patients and 18 female patients.

This data is in line with the general epidemiology of distal radius fracture, where the female has a higher incidence compared to the male.[9] Meanwhile, the median age in the male group is 36 years, and for female 44.5 year. This finding is also following the epidemiology, where the female population has a higher mean age compared to males.[10]

Correlation analysis of DASH score and MMWS has shown a very strong significant inverse correlation between these two scores, with a correlation coefficient of -0.919 and $p < 0.05$. Previously, this correlation has never been studied specifically. The author made a systematic search for papers using these two variables in their analysis, and found 10 journals, which contain 26 pairs of DASH score and MMWS. From these 10 pairs, correlation analysis was made using the Pearson test, resulting in a very strong significant inverse correlation with a correlation coefficient of -0.861 and $p < 0.05$.[11–20] This analysis result is in line with the findings in this paper. DASH score has been previously researched extensively, showing good internal consistency, test-retest, and responsivity.[5]

A similar result is also found in correlation analysis between RUSS and DASH, showing a very strong significant inverse correlation between variables ($r = 0.826$, $p < 0.05$). Previously, there was no study researching this correlation. Two studies using these two parameters as its variable have shown that the group with higher RUSS, has a lower DASH score, thus supporting the finding of the current study.[7,21] Analysis of RUSS and MMWS pointed to the same direction, showing a strong significant correlation between them ($r = 0.904$, $p < 0.05$), indicating better union results in better outcomes. No previous study has researched the correlation between these scores, however, two prior studies using these two parameters as its measurement exhibit higher RUSS in groups with higher MMWS.[22] Numerous prior researches have shown a correlation between union and outcome of fracture management, although not specific to RUSS nor DASH score. This indirectly concludes that better RUSS will yield a better DASH score and MMWS.[23,24]

Linear regression analysis of CRP level to DASH score and MMWS has shown a strong significant correlation ($r = 0.779$, $p < 0.05$) to the former, and a very strong significant correlation ($r = 0.837$, $p < 0.05$) to the latter. This result signifies the effect of controlled inflammation to a better functional outcome. Previously, there is no study has researched the relationship between CRP level to DASH score and MMWS. However, it is well-researched that controlled inflammatory response is crucial for the fracture healing process.[25,26] Attenuation of the inflammation in the early phase of fracture healing leads to delayed and non-union.[27] On the other hand, prolonged inflammation process in this population is correlated with worse functional outcomes.[28] research by de Jong et al shown CRP level at week 4 in patients with distal radius fracture is correlated with pain and wrist range of motion on week 12.[29] While research by Sadighi et al. concluded that patients with higher CRP levels in fracture cases complicated with metabolic syndrome has a higher rate of nonunion, thus resulting in worse functional outcome.[30]

This study has several drawbacks. Firstly, the limited number of samples resulted in a non-normal spread of data, which can be a potential bias in the statistical analysis. Lastly, the lack of samples with high CRP levels makes the potential sampling bias.

Conclusion

MMWS has been shown to have a very strong correlation with DASH score, making it a comparable option to be used on daily practices, while controlled inflammation, as reflected as normal CRP level at week 9 post-trauma, and good union quality, as scored with RUSS, is correlated with strongly with DASH score and MMWS, making it a promising predictor of functional outcome in patients with distal radius fracture treated conservatively.

Conflict of Interests

The authors have no conflict of interest. All resources used in this research are funded by the authors.

References

1. Gutiérrez-Espinoza H, Araya-Quintanilla F, Olguín-Huerta C, Gutiérrez-Monclus R, Valenzuela-Fuenzalida J, Román-Veas J, et al. Effectiveness of surgical versus conservative treatment of distal radius fractures in elderly patients: A systematic review and meta-analysis. Orthop Traumatol Surg Res. 2022 Sep;108(5):103323.
2. Sigirtmac IC, Oksuz C. Systematic review of the quality of the cross-cultural adaptations of Disabilities of the Arm, Shoulder and Hand (DASH): Systematic Review of the Cross-Cultural Adaptations of DASH. Med Lav Work Environ Health. 2021 Aug 26;112(4):279–91.
3. Atroshi I, Gummesson C, Andersson B, Dahlgren E, Johansson A. The disabilities of the arm, shoulder and hand (DASH) outcome questionnaire: Reliability and validity of the Swedish version evaluated in 176 patients. Acta Orthop Scand. 2000 Jan 1;71(6):613–8.
4. Cooney WP, Linscheid RL, Dobyns JH. Triangular fibrocartilage tears. J Hand Surg. 1994 Jan;19(1):143–54.
5. Dacombe PJ, Amirfeyz R, Davis T. Patient-Reported Outcome Measures for Hand and Wrist Trauma: Is There Sufficient Evidence of Reliability, Validity, and Responsiveness? HAND. 2016 Mar;11(1):11–21.
6. Patel SP, Anthony SG, Zurakowski D, Didolkar MM, Kim PS, Wu JS, et al. Radiographic Scoring System to Evaluate

Union of Distal Radius Fractures. J Hand Surg. 2014 Aug;39(8):1471–9.
7. Wisesa KIT, Kawiyana IKS, Suyasa IK. Cast immobilization and addition of platelet rich plasma in intraarticular distal radius fracture resulting a better functional outcome to the internal fixation and radius union scorings system. Intisari Sains Medis. 2021 Jul 23;12(2):500–3.
8. Girard D, Wagner PP, Whittier DE, Boyd SK, Chapurlat R, Szulc P. C-reactive protein predicts endocortical expansion but not fracture in older men: the prospective STRAMBO study. Osteoporos Int. 2023 Mar;34(3):539–50.
9. Candela V, Di Lucia P, Carnevali C, Milanese A, Spagnoli A, Villani C, et al. Epidemiology of distal radius fractures: a detailed survey on a large sample of patients in a suburban area. J Orthop Traumatol. 2022 Dec;23(1):43.
10. Zugasti-Marquínez J, García-Reza A, Domínguez-Prado DM, Cela-López M, Oiartzábal-Alberdi I, Castro-Menéndez M. Epidemiological study of distal radius fractures in the sanitary area of Vigo. Rev Esp Cir Ortopédica Traumatol. 2022 Jan;66(1):T38–46.
11. Nam SH, Kim J, Lee JH, Ahn J, Kim YJ, Park Y. Palpation versus ultrasound-guided corticosteroid injections and short-term effect in the distal radioulnar joint disorder: a randomized, prospective single-blinded study. Clin Rheumatol. 2014 Dec;33(12):1807–14.
12. Kim JM, Seo HJ, Jeon YD, Lee HM, Son JH. Comparative Study of Outcomes between Operative and Non-Operative Treatment of Unstable Distal Radius Fracture in the Elderly Patients. J Korean Soc Surg Hand. 2015;20(2):43.
13. Kim SJ, Lee BG, Lee CH, Choi WS, Kim JH, Lee KH. Comparison of ceiling effects between two patient-rating scores and a physician-rating score in the assessment of outcome after the surgical treatment of distal radial fractures. Bone Jt J. 2015 Dec;97-B(12):1651–6.
14. Stahl S, Hentschel PJH, Santos Stahl A, Meisner C, Schaller HE, Manoli T. Comparison of clinical and radiologic treatment outcomes of Kienböck's disease. J Orthop Surg. 2015 Dec;10(1):133.
15. Abid SM, Mohan KJ. A Comparison of Open Reduction & Internal Fixation Versus Closed Reduction and Casting in Distal Radius Fractures. Ann Int Med Dent Res. 2016 Aug;2(5):60–2.
16. Wu CC. A novel surgical approach for treating distal radial extraarticular malunion: Oblique osteotomy with buttress plate stabilization. J Orthop Surg. 2017 May;25(2):230949901771408.
17. Farr S, Schüller M, Ganger R, Girsch W. Outcomes after Arthroscopic Debridement of the Triangular Fibrocartilage Complex in Adolescents. J Wrist Surg. 2018 Feb;07(01):043–50.
18. Chen M, Gittings DJ, Yang S, Liu G, Xia T. Variable-Angle Locking Compression Plate Fixation of Distal Radius Volar Rim Fractures. Iowa Orthop J. 2019;39(2):55–61.
19. Testa G, Vescio A, Di Masi P, Bruno G, Sessa G, Pavone V. Comparison between Surgical and Conservative Treatment for Distal Radius Fractures in Patients over 65 Years. J Funct Morphol Kinesiol. 2019 May 17;4(2):26.
20. Sander AL, Sommer K, Kaiser AK, Marzi I, Frank J. Outcome of conservative treatment for triangular fibrocartilage complex lesions with stable distal radioulnar joint. Eur J Trauma Emerg Surg. 2021 Oct;47(5):1621–5.
21. Shoji KE, Earp BE, Rozental TD. The Effect of Bisphosphonates on the Clinical and Radiographic Outcomes of Distal Radius Fractures in Women. J Hand Surg. 2018 Feb;43(2):115–22.
22. Di Giacinto S, Pica G, Stasi A, Scialpi L, Tomarchio A, Galeotti A, et al. The challenge of the surgical treatment of paediatric distal radius/ forearm fracture: K wire vs plate fixation -outcomes assessment. Med Glas (Zenica). 2021;18(1):208–15.
23. Park I, Shin SJ. Arthroscopic double-row bridge fixation provided satisfactory shoulder functional restoration with high union rate for acute anterior glenoid fracture. Knee Surg Sports Traumatol Arthrosc. 2023 Jul;31(7):2681–7.
24. Srinivasan A, Haque A, Kheiran A, Singh HP. Radiological and Long-Term Functional Outcomes of Displaced Distal Clavicle Fractures. J Orthop Trauma. 2023 Feb;37(2):89–95.
25. ElHawary H, Baradaran A, Abi-Rafeh J, Vorstenbosch J, Xu L, Efanov JI. Bone Healing and Inflammation: Principles of Fracture and Repair. Semin Plast Surg. 2021 Aug;35(03):198–203.
26. Maruyama M, Rhee C, Utsunomiya T, Zhang N, Ueno M, Yao Z, et al. Modulation of the Inflammatory Response and Bone Healing. Front Endocrinol. 2020 Jun 11;11:386.
27. Makaram NS, Leow JM, Clement ND, Oliver WM, Ng ZH, Simpson C, et al. Risk factors associated with delayed and aseptic nonunion following tibial diaphyseal fractures managed with intramedullary nailing. Bone Jt Open. 2021 Apr 1;2(4):227–35.
28. Meyer U, De Jong JJ, Bours SG, Keszei AP, Arts JJ, Brink PR, et al. Early Changes in Bone Density, Microarchitecture, Bone Resorption, and Inflammation Predict the Clinical Outcome 12 Weeks After Conservatively Treated Distal Radius Fractures: An Exploratory Study. Journal of Bone and Mineral Research. 2014 Aug 20;29(9):2065–73.
29. de Jong JJA. A closer look at fracture healing: fracture healing at the distal assessed using high-resolution peripheral quantitative computed tomography [thesis]. Maastricht: Maastricht University; 2017.
30. Sadighi A, Bazavar M, Niafar M, Tabrizi A. Effect of metabolic syndrome on union rate of fractures. J Anal Res Clin Med. 2015 Mar 12;3(1):37–42.