

Scaphoid Nonunion Advanced Collapse Classifications: A Reliability Study

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Abstract Watson & Ballet and Vender staging systems are widely known for classifying SNAC wrist osteoarthritis. Despite of its day-to-day use, no assessment for its agreement was performed. To Evaluate the intra and interobserver agreement for these classification systems. Forty-eight posteroanterior wrist radiographs from patients with osteoarthritis due to scaphoid nonunion were evaluated at two occasions—in a 1 week interval—by five observers with different expertise—hand surgeons, hand surgery residents, orthopedic surgeons and orthopedic surgery residents. They rated osteoarthritis stages according to the above-cited systems. Kappa statistics were performed for measuring agreement. Unsatisfactory (Cohen's Kappa <0.5) agreement was found for all intra and inter observer measures for both systems. There was no clear correlation between expertise and kappa values. Unsatisfactory agreement was found for both classifications, despite the evaluator expertise. A rationale of a more *reliable* classification is needed.

Keywords Scaphoid non-union · Wrist osteoarthritis · Agreement · Kappa statistics · Hand surgery · Classification systems

Introduction

The natural history of untreated scaphoid nonunion is the development a pattern of progressive wrist arthritis [1–5]. This condition is known as *SNAC—scaphoid nonunion advanced collapse* [6].

This condition affects the wrist joint in an expected manner. Initially, it is limited to the radial styloid and then it affects the radius scaphoid fossa and the midcarpal joint. Radiolunar joint is usually preserved even in advanced cases, since it is relatively spherical, which contributes to its permanent congruency [1]. Pain and osteoarthritis are the cornerstone for treatment guidance, in which surgical treatment could be an option [4, 7, 8].

For the purpose of staging osteoarthritis, Watson & Ballet classification system is of widespread use [9, 10]. It describes osteoarthritis as progressive stages—formerly described for osteoarthritis secondary to scapholunate advanced collapse—*SLAC wrist* [9, 10]. It considers three stages, progressing from the radialstyloid-scaphoid interface, following to the radioscapoid fossa and then the midcarpal joint is also affected [9].

Vender and colleagues [11] established the term *SNAC*. In the *SNAC* wrist, the degenerative changes occurs in a different pattern from that seen in *SLAC—scapholunate advanced collapse*. According to Vender, arthritis progresses in three stages The first stage is: *I*—The interface between the radius scaphoid fossa and the fractured scaphoid distal fragment interface is affected. In Stage, II, the interface between the fractured scaphoid proximal fragment and capitate is also affected. In Stage III, Radius-scaphoid, scaphoid-capitate and lunate-capitate interfaces are affected. In this system, the interface between the fractured scaphoid proximal pole and radius is not included, since it is frequently

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spared. Currently, some surgeons gave preference to stage osteoarthritis by these stages [1, 12].

A classification rationale, to be considered as reliable, should permit satisfactory agreement. Additionally, it should be able to help classifying injury status and may well expect its prognosis [13–16]. In this scope, studies regarding to the assessment of these characteristics are lacking.

For this study, we hypothesized that both classifications would demonstrate unsatisfactory agreement, with a lower agreement for Watson & Ballet stages. The study’s aim is to assess intra and inter observer agreement for these classifications and to establish which classification is more *reliable* for day-to-day practice.

Methods

We have assessed Watson & Ballet [9, 10] and Vender [11] stages agreement for SNAC wrist osteoarthritis. Forty-eight posteroanterior radiographs of the wrist from patients with wrist osteoarthritis due to SNAC were selected for this purpose. *Wrist posteroanterior radiographs were performed with upper limb positioned in a 90/90° of shoulder abduction and elbow flexion.* These patients were treated for this condition from May, 2005 to August, 2010 at the institution’s outpatient clinic—Hand surgery division, Escola Paulista de Medicina—Universidade Federal de São Paulo.

Initially, researchers met with the observers to present the Watson & Ballet [9] and Vender and colleagues [11] original articles. This phase was crucial to standardize methodology and to and clarify the assessment process. *This procedure was conducted by the senior hand surgeons (JBGS and JCB), which had led classifications difficulties from its interpretation to a consensus.*

After this initial presentation, five observers analyzed the radiographs independently: two hand surgeons (EM1 and EM2), a last-year hand surgery resident (R2M), an orthopedic surgeon (ORT) and a second-year orthopedic surgery resident (R2O). All were blinded to the research data and radiographs distribution.

Table 1 Intra observer Kappa correlations for Watson & Ballet and Vender staging systems

	Observer	Classification	
		Watson & Ballet	Vender et al.
	EM1	0.437	0.241
	EM2	0.394	0.394
	R2M	0.634	0.596
	ORT	0.156	0.451
	R2O	0.185	0.168
	Mean	0.361	0.370

EM1 = Hand surgeon 1; EM2 = Hand surgeon 2; R2M = a last-year hand surgery resident, ORT = orthopedic surgeon; R2O = second-year orthopedic resident

Table 2 Mean overall inter observer Kappa correlations for Watson & Ballet and Vender and colleagues staging systems

	Classification	
	Watson & Ballet	Vender et al.
T1	0.120	0.220
T2	0.118	0.119
Mean	0.119	0.169

T1: First evaluation; T2: evaluation

The observers performed all radiographs analysis, in a 1-week interval, as follows: Week-1 (T1): Watson & Ballet classification; Week-2 (T1): Vender and colleagues classification; Week-3 (T2): Watson and Ballet classification, Week-4 (T2): Vender and colleagues classification. A random change at radiographs distribution was performed between T1 and T2.

Statistical Methods

We applied kappa statistics methodology, which allows the calculation of the expected agreement by chance, for two raters in the assessment of nominal variables [13]. The kappa values ranges from -1 to +1, the values between -1 and 0 indicate that the observed agreement was lower than that expected by chance, 0 indicates a level of fortuitous agreement and +1 indicates complete agreement. Kappa values below 0.5 are considered unsatisfactory, the values between 0.5 and 0.75 are considered satisfactory and values above 0.75 are considered excellent [17].

Table 3 Inter observer kappa correlations for Watson & Ballet and Vender staging systems: paired analysis

Observers	Watson and Ballet		Vender et al.	
	T1	T2	T1	T2
EM1-EM2	0.205	0.225	0.093	0.080
EM1-R2M	0.268	0.140	0.220	0.023
EM1-ORT	0.120	0.108	0.192	0.075
EM1-R2O	0.065	0.321	0.418	0.386
EM2-R2M	0.355	0.143	0.498	0.351
EM2-ORT	0.055	0.143	0.373	0.251
EM2-R2O	0.026	-0.039	0.020	0.098
R2M-ORT	0.137	0.405	0.376	0.292
R2M-R2O	-0.060	-0.312	0.078	0.131
ORT-R2O	0.165	0.266	0.175	-0.014

EM1 = Hand surgeon 1; EM2 = Hand surgeon 2; R2M = a last-year hand surgery resident, ORT = orthopedic surgeon; R2O = second-year orthopedic resident

This study was approved by the Ethics Committee of Universidade Federal de São Paulo (number: 1953/09).

Results

Classifications showed low kappa values for intra observer agreement (Table 1) and inter observer agreement (Table 2). These results demonstrate unsatisfactory agreement for both classifications (Tables 1 and 2). A slight higher kappa was found for Vender and colleagues classification (Tables 1 and 2). Hand surgeons and hand surgery residents had higher agreement, yet, below the satisfactory threshold (Table 1 and 2). For paired correlations, low agreement was found between the evaluation periods—for both classifications, without any correlation to the expertise status (Table 3).

Discussion

Watson & Ballet [9, 10] and Vender and colleagues [11] staging systems are of widespread use for those treating SNAC wrist. This fact motivated the conduction of this reliability study. Our results show the lack of agreement between these classifications. In addition, it did not improve considerably when comparisons were made considering hand surgery experts. The results were compatible to our hypothesis. We believe that Watson and Ballet presented even lower agreement due to the difficulty at differentiating stages I and II.

The ratings showed unsatisfactory agreement due to a arrangement of factors. First, considering that ratings the of Watson and Ballet [9] and Vender and colleagues [11] are based only on posteroanterior wrist images, there may be some difficultness at the judgment about the joint true status, especially the midcarpal joint. Thus, an accurate assessment of the midcarpal joint is not straightforward as it is for the radiocarpal status, mostly.

Dorsal intercalated segment instability (DISI) often accompanies the scaphoid nonunion. In this instability, there is an overlap with the capitatelunate unity and scaphoid proximal fragment best viewed in the lateral view. We believe that when only considering the frontal view of the wrist radiograph, this overlapping situation might cause a misinterpretation of lunocapitate and scaphoidcapitate joints status, that might be considered as with degenerative features. Frontal and lateral views might improve the assessment of this pitfall. Inclusion of CT or MRI assessment could also be an option. Regarding to Watson & Ballet classification, the difficulty for defining a precise edge between the styloid process and radiuscapitoid fossa might have contributed to the low agreement.

It is imperative to acknowledge that Watson and Ballet [10] and Vender [11] stages have poor levels of reproducibility and agreement and these are routinely utilized for deciding treatment. This should be kept in mind when planning treatment for these conditions. Since Watson and Ballet and Vender and colleagues. Stages are not reliable to determine the extent of arthritis through radiographic evaluation, we raised the need to identify the difficulties and to improve the way we assess patients with *SNAC wrist* [11].

Proximal carpectomy and partial intracarpal arthrodesis are the common surgical procedures, because they improve the pain, may increase grip strength and partially preserve the mobility of the wrist [4, 18]. Total wrist arthrodesis is considered for selected cases of advanced arthritis and failures of the previous options. Proximal carpectomy is best indicated in stages I or II of Watson and Ballet and Vender Stage I since in these stages proximal capitate and the lunate fossa are spared. Partial intracarpal arthrodesis—such as four corner and lunocapitate arthrodesis could be performed in Watson & Ballet or Vender stages I, II or III, since the radiolunate joint is preserved [4, 7, 18].

Our study's weakness relates to its underpowered sampling. Our retrospective sample size calculations resulted in a 156 images sample (using our results for its calculations—a 0.2 probability difference and 0.4 relative error). Further studies should include more images, since it will strength study's internal validity [13, 16, 19].

In conclusion, staging systems for SNAC wrist lack of agreement. The inclusion of lateral views and computadorized tomography could improve accuracy. A more simple staging rationale, such as considering broader scenarios, such as isolated radiocarpal or associated radiocarpal and midcarpal osteoarthritis could be an alternative, as these characteristics are relevant issues for treating purposes.

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