

A Comparison of Two Radiography Scoring Methods Used by Rheumatologists and Radiologists in Patients with Established Rheumatoid Arthritis

Ljubinka Damjanovska Krstikj^{1,*}, Elena Jordanovska² and Violeta Vasilevska-Nikodinovska²

¹University Rheumatology Clinic Skopje, University "Sts. Cyril and Methodius", Bul. Majka Tereza 17, 1000 Skopje, Macedonia

²University Surgical Clinic "St. Naum Ohridski", University "Sts. Cyril and Methodius", Bul.11 Oktomvri, 53, 1000 Skopje, Macedonia

Abstract: *Background:* There are numerous radiographic scoring methods in rheumatoid arthritis (RA). The scoring method Sharp/van der Heijde (SHS) is considered "a gold standard" for the assessment of the disease progression in RA. It is reliable but complex scoring method, which is time consuming and is used by well trained readers. The Simple Erosion Narrowing Score (SENS) was derived from the SHS method as an easier, quicker and reliable method for joint lesions scoring.

Aim: The aim of the present work is to use and to evaluate the SENS method, for the first time in Macedonia, in comparison with SHS, and to test the agreement between the readers for the two scoring methods, in a group of patients with established RA.

Materials and Methods: Evaluation of the patients included collection of demographic and clinical data, physical examination and calculation of the 28-joint Disease Activity Score (DAS-28). Laboratory tests and bilateral radiographs of the hands, wrists and feet were done in each of the patients. The radiographs were scored in pairs by two independent readers: rheumatologist and experienced radiologist.

Results: The study group consisted of 54 RA patients. The mean age of the patients was 54,4 years. The average duration of the disease was 4,74 years with the mean DAS 28 score 5,0. The average radiography scores read by the rheumatologist and radiologist were 43,7 vs. 38,6 for the total SENS and 70 vs. 72 for the total SHS score. The interobserver reliability was calculated by the intraclass correlation coefficient (ICC) which was 0,77 for SENS and 0,88 for the SHS score. The intraobserver reliability was 0,76 vs 0,74 for the rheumatologist and radiologist, respectively.

Conclusion: The performances of SENS method were good and the reading was very fast and easy. The agreement between the readers was higher for the more detailed SHS score.

Keywords: Rheumatoid arthritis (RA), Conventional radiography (CR), Sharp/van der Heijde score (SHS), Simple Erosion Narrowing Score (SENS), joint space narrowing (JSN).

INTRODUCTION

Conventional radiography (CR) has long been the standard for detection of joint damage in established rheumatoid arthritis (RA) [1].

In addition to its role in the diagnosis of RA, the conventional radiography is used for monitoring of the progression of the disease and for the assessment of the efficacy of treatment.

There are numerous radiographic scoring methods in RA. Some give a global assessment for the entire patient, whereas others assess individual joints [2].

The most commonly used scoring methods are those devised by Larsen, Sharp and Sharp/van der Heijde (SHS) [3-5].

In 1971, Sharp proposed a scoring method for the radiographies of hands and wrists. A modification of this method which was done in 1985 is now considered the standard for the Sharp method. It provides separate scores for erosions (ER) and for joint space narrowing (JSN) and considers 17 areas for ER and 18 areas for JSN in the hands and wrists [4]. Ghenant modified the Sharp scoring method in 1998 and Kaye combined the methods described by Sharp and Genant [2].

In 1989 van der Heijde modified the method described by Sharp in 1985. This method is now called Sharp/van der Heijde scoring method (SHS) and is considered as "a gold standard" for assessment of the disease progression in RA. In addition to hands and wrists, it includes feet. SHS is a reference method used in majority of clinical trials and longitudinal observational studies. SHS collects information on ER and JSN and covers a sufficiently broad spectrum of joints to provide sensitivity to change in structural damage [5, 6].

*Address correspondence to this author at the University Rheumatology Clinic Skopje, University "Sts. Cyril and Methodius", Bul. Majka Tereza 17, 1000 Skopje, Macedonia; Tel: +38978263606; E-mail: ljubinkadr@yahoo.com

An important disadvantage of the SHS scoring method lays in the fact that it requires significant training and that the scoring according to this method is very time consuming, making SHS difficult for use in clinical trials and routine clinical practice [7].

Simple Erosion Narrowing Score (SENS) assesses the same joints as the SHS method. It was derived from the SHS method in 1999, as an easier, quicker and quite reliable method for joint lesions scoring. In SENS, instead of grading, the number of joints with erosions and the number of joints with JSN are simply summed. The measurement properties of SENS are good and comparable to SHS, which makes it suitable for use in clinical practice and in large clinical studies especially in the first few years of the disease [8]. To our knowledge there are few clinical studies which compared SENS and SHS scoring methods.

The objective of the present work is to evaluate the SENS method, for the first time in Macedonia, in comparison with SHS in a group of patients with established RA, with a considerable variation in disease duration and severity. We also wanted to compare the agreement of SENS and SHS scores read by the two readers, rheumatologist and an experienced radiologist in order to get an answer to a provocative question: who should read the radiographs and perform the scoring, the treating rheumatologist or an experienced radiologist?

PATIENTS AND METHODS

Patients

The study was conducted at the University Rheumatology Clinic Skopje in collaboration with the Radiology Department of the University Surgical Hospital "St. Naum Ohridski". It was a part of a bigger PhD study which evaluated 105 patients with RA and it was approved by the Ethical Committee of the Medical Faculty in Skopje.

The patients were randomly selected for participation in the study, after they were seen by clinical rheumatologist as an outpatients. They signed an informed consent for the collection and evaluation of clinical data in accordance with the ethical standards described in the Declaration of Helsinki.

Evaluation at the time of the recruitment included collection of demographic and clinical data, physical examination and calculation of the 28-joint Disease Activity Score, (DAS-28) [9]. Laboratory tests and

bilateral radiographs of the hands, wrists and feet were done in each of the patients.

Radiographs were available for 54 patients, who fulfilled the 1987 American College of Rheumatology criteria for RA [10].

Radiographic Analysis

Radiographs of the hands, wrists and feet were made in postero-anterior view and they were separately, in random order, scored in pairs by the two independent readers: rheumatologist and experienced radiologist. The radiologist was unaware of the patient's identity and the clinical activity of the disease. We used printable scoring sheets of the joints of the hands and feet. SENS score was read independently from the radiographs and it was not derived from the SHS score [5].

The SHS method includes 16 areas for ER and 15 areas of JSN in each hand and 6 areas for ER and 6 areas for JSN in each foot. The erosion score can range from 0 to 5, per joint of the hand. The erosion score can range from 0 to 10, per joint of the foot. JSN and joint subluxation/luxation are combined in a single score with a range from 0 to 4.

The maximal erosion score for each hand is 80, and the maximal JSN subluxation/luxation score for each hand is 60. The maximal erosion score for each foot is 60, and the maximal JSN subluxation/luxation score for each foot is 24.

The maximal total erosion score of the hands and feet is 280 (160 for hands+120 for feet) and the maximal total JSN and joint subluxation/luxation of the hands and feet is 168 (120 for hands + 48 for feet) summing up to 448 units, for the total SHS score (TSS) [6, 7].

SENS assesses the same joints as SHS method. A joint is scored one (1) if it displays at least one erosion. In the same way, if there is any narrowing of the joint it is also scored one. The score for each joint can therefore range from 0 to 2. The maximal erosion score for each hand is 16 and for each foot 6 and the maximal JSN and joint subluxation/luxation score is 15 for each hand and 6 for each foot. The total SENS score ranges from 0-86 [2].

Statistical analysis was done with the SPSS statistical software version 19 (SPSS 19 Chicago, Illinois). $P < 0,05$ was considered significant.

Table 1: Baseline Characteristics of the Study Population

Total patients	n=54
Females n (%)	n=42 (77, 8%)
Males n (%)	n=12 (22,2%)
Age (years)	54,4 (SD 9,6)
Disease duration (years)	4,7 (SD 5,3)
DAS28	5,0 (SD 1,6)

Presented as absolute numbers and percentages total.

Legend: SD=Standard Deviation, DAS = Disease Activity Score.

Table 2: The Mean Radiography Scores of the Hands, Wrists and Feet Read by Rheumatologist and Radiologist

Rheumatologist				
	Mean	SD	Minimum	Maximum
SHS	70,02	+/- 37,8	16	182
SENS	43,7	+/- 16,9	14	101
Erosions HF	19,4	+/- 10,7	3	54
JSN HF	24,6	+/- 8,2	8	47
Radiologist				
	Mean	SD	Minimum	Maximum
SHS	72,02	+/- 58,2	10	277
SENS	38,6	+/- 20,9	10	85
Erosions HF	20,4	+/- 12,5	2	44
JSN HF	18,2	+/- 10,2	2	41

Legend: SHS= Sharp van der Heijde RTG Score, SENS= Simple Erosion Narrowing Score, JSN= Joint Space Narrowing, H=Hands, F=Feet.

RESULTS

We performed radiographic scoring of the hands, wrists and feet in 54 RA patients, 42 females (77,8%) and 12 males (22,2%). The mean age of the patients, the average duration of the disease and the mean disease activity score DAS-28 are presented in Table 1. The mean DAS-28 score indicates moderate activity of the disease. The mean radiography scores read by the rheumatologist and radiologist are presented in Table 2.

Figure 1 presents the mean total SHS scores and Figure 2 presents the mean total SENS scores read by the rheumatologist and radiologist.

The SHS scores and the SENS scores correlated strongly with each other. There was a strong positive correlation between the SHS and SENS scores read by the rheumatologist Pearson's $r=0,91$ ($n=54$, $p < 0,0001$) and between the SHS and SENS scores read by the experienced radiologist Pearson's $r=0,92$ ($n=54$, $p < 0,0001$). Because the correlation analysis

calculates only the association and not the agreement between the scores we did an intraobserver reliability analysis which showed substantial reliability of the SENS and SHS scores in both of the readers Table 3.

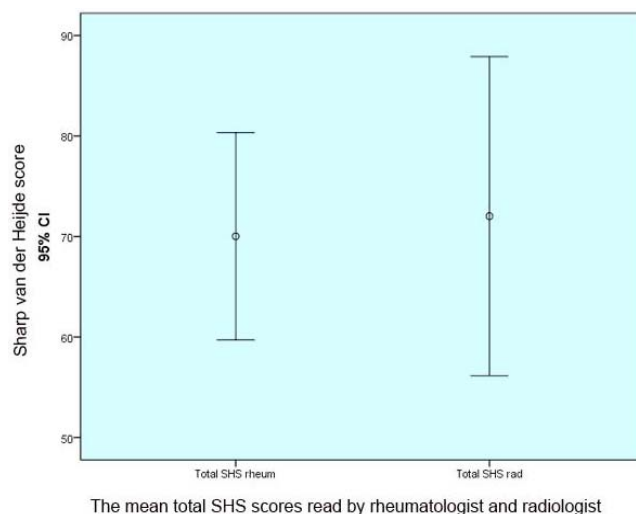


Figure 1: SHS= Sharp van der Heijde Radiography Score, Rheum=Rheumatologist, Rad= Radiologist.

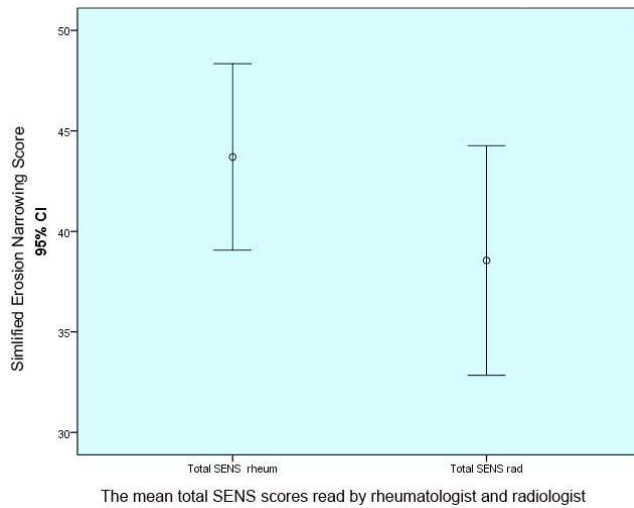


Figure 2: SENS= Simple Erosion Narrowing Score, Rheum=Rheumatologist, Rad= Radiologist.

There was a strong positive correlation between the SHS scores (rheumatologist versus radiologist scores) as well as between the SENS scores $r=0,77$ ($n=54$, $p<0,0005$) and $0,64$ ($n=54$, $p<0,0005$), respectively. Interobserver reliability was determined by intraclass correlation coefficient (ICC) Table 4.

The ICC demonstrated almost perfect inter reader agreement for the SHS scores and substantial agreement between the SENS, erosion and JSN scores. The ICC score was higher for SHS than for the SENS score. The ICC was lowest for the erosion score.

DISCUSSION

We have performed an evaluation of the SENS radiography scoring method, in comparison with the

SHS method, as a reference, in patients with established RA, in which radiographies of the hands, wrists and feet were done.

The SHS method is a sensitive scoring method for changes in structural damage, but it is complex, technically demanding, requires training and time consuming. Scoring with the SENS method requires less training and is less time consuming. It has shown reliability and sensitivity to change which are similar to SHS [11, 12].

In our study, we have found a substantial intraobserver agreement between the SENS and SHS status scores in both readers, rheumatologist and experienced rheumatologist, which means that the SENS score can be used in everyday clinical practice along with or instead of the SHS score.

We have also shown very good interobserver agreement between the SHS and SENS scores. The agreement between the readers was higher for the more detailed SHS score.

The differences between the readers were less for joint space narrowing then for the erosion scores, which implies the need of further education of the rheumatologist who have read the radiographs, because of the importance of the erosion scores as a part of the radiography scores in RA.

Our results are consistent with the results of the study of Guillemin and coworkers, who have compared 5 different radiography scoring methods (Sharp, SHS, Larsen, Larsen-Rau and SENS) in 20 patients with

Table 3: Intraclass Correlation Coefficient between the SENS and SHS Scores

Scores	ICC	95% CI	F - test	Sig.
SENS vs. SHS rheum	0,76	0,58 – 0,86	26,8	<0,0001
SENS vs. SHS rad	0,74	0,55 - 0,85	22,7	<0,0001

Table 4: Intraclass Correlation Coefficient between the Readers (Rheumatologist vs. Radiologist)

Scores	ICC	95% CI	F - test	Sig.
Total SHS rheum/rad	0,875	0,78 – 0,86	8,0	<0,0001
Total SENS rheum/rad	0,77	0,6 - 0,87	4,4	<0,0001
Erosions HF rheum/rad	0,62	0,35 – 0,77	2,63	<0,0001
JSN HF rheum/rad	0,77	0,6 – 0,86	4,3	<0,0001

Legend: SHS= Sharp van der Heijde RTG Score, SENS= Simple Erosion Narrowing Score, Rheum=Rheumatologist, Rad= Radiologist, JSN= Joint Space Narrowing.

early RA. In this study, both methods had high intraobserver and interobserver reliability. Interobserver reproducibility was the highest for Sharp and SHS scores. JSN score showed less differences between the readers [13].

In SENS validation study of Dias *et al.*, the between the reader ICC was 0,81 for the SHS and 0,91 for the SENS status scores, respectively, which was slightly different from the results of our study. The performances of the SENS score were good and SENS score was recommended for use in clinical practice [14].

In some other clinical trials, SENS score was also considered adequate for clinical use.

In the post hoc analysis from the BeSt study (Behandeln Strategien), SENS and SHS scores were compared in a cohort of patient treated with anti-TNF therapy. They found high probability of agreement between both of the methods [15].

Forslind and his colleagues from the BARFOT study group also showed a good agreement between the SENS and SHS scores with the ICC for the status score which was almost equal with our results [16].

In the study of Barnabe *et al.*, SENS score had good cross sectional and longitudinal interrater reliability but it was less sensitive to change. SENS score was recommended for use in observational studies but also for use in clinical practice. This study was similar with our study because the SENS score was performed by a clinical rheumatologist with no formal radiography scoring training [17].

In the paper of Bruynesteyn *et al.*, the progression of RA on plain radiographs was judged differently by expert radiologists and rheumatologists. Changes that were not regarded as substantial by the radiologist were judged clinically important by the rheumatologist [18].

Our study is interesting because of the comparison between the radiography scores read by the rheumatologist and experienced radiologist. It addresses the question who should read the radiographs and perform the scoring, the treating rheumatologist or experienced radiologist, in a way that radiography scoring can help the rheumatologist to have immediate insight to the patient condition, disease progression and the effects of the treatment. Radiography scoring is very important for the clinical

rheumatologists, who should know the radiography scoring methods and their history in order to understand the scores and perform them [16, 19, 20].

The results from our clinical study will be a valuable addition to the current literature. The major limitation of our study is that we have not included the second reading because of which we only have radiography status scores and we do not have change scores and we were not able to calculate sensitivity to change of the radiography scores.

In conclusion, the results from our study have shown that SENS radiography scoring method is simple, reliable, easy to use, readable by the practicing rheumatologist and it should be considered for use in the rheumatology clinical practice. The close cooperation between the rheumatologists and experienced radiologist is highly appreciated and very helpful.

DISCLOSURE

The authors report no conflict of interest in this work.

ACKNOWLEDGEMENT

This study was a part of a PhD study which was partially funded from an ILAR project which began in 2009 in Macedonia. We want to say thank you to Vladimir Ognenovski MD, University of Michigan, Ann Arbor, USA.

REFERENCES

- [1] Ory PA. Radiography in the assessment of musculoskeletal conditions. *Best Practice Clinical Rheumatology* 2003; 17(3): 495-512.
[http://dx.doi.org/10.1016/S1521-6942\(03\)00022-6](http://dx.doi.org/10.1016/S1521-6942(03)00022-6)
- [2] Boini S, Guillemin F. Radiographic scoring methods as outcome measures in rheumatoid arthritis: properties and advantages. *Annals of Rheumatic Diseases* 2001; 60: 817-827.
- [3] Larsen A, Dale K, Eck M. Radiographic evaluation of rheumatoid arthritis and related conditions by standard reference films. *Acta Radiol Diag* 1977; 18: 481-491.
- [4] Sharp JT, Young DY, Bluhm GB, *et al.* How many joints in the hand and wrist should be included in a score of radiologic abnormalities used to assess rheumatoid arthritis. *Arthritis Rheumatism* 1985; 28: 1326-1335.
<http://dx.doi.org/10.1002/art.1780281203>
- [5] van der Heijde DMFM. How to read radiographs according to the Sharp /van der Heijde method. *Journal of Rheumatology* 2000; 27: 261-263.
- [6] van der Heijde DMFM. Radiographic imaging: the gold standard for assessment of disease progression in rheumatoid arthritis. *Rheumatology* 2000; 39 (1): 9-16.
<http://dx.doi.org/10.1093/oxfordjournals.rheumatology.a031496>

- [7] Landewe R, van der Heijde DMFM. Radiographic progression in rheumatoid arthritis. *Clinical and Experimental Rheumatology* 2005; S63-S68.
- [8] van der Heijde D, Dankert T, Nieman F, Rau R, Boers M. Reliability and sensitivity to change of a simplification of the Sharp/van der Heijde radiological assessment in rheumatoid arthritis. *Rheumatology* 1999; 38: 941-947. <http://dx.doi.org/10.1093/rheumatology/38.10.941>
- [9] Fransen J, Stucki G, van Riel P. Rheumatoid arthritis measures: Disease Activity Score (DAS), Disease Activity Score-28 (DAS28), Rapid Assessment of Disease Activity in Rheumatology (RADAR), and Rheumatoid Arthritis Disease Activity Index (RADAI). *Arthritis Care and Research* 2003; 49 (S5): S214-224.
- [10] Arnett FC, Edworthy SM, Bloch DA, *et al.* The American Rheumatism Association 1987 revised criteria for the classification of rheumatoid arthritis. *Arthritis Rheum* 1988; 31: 315-324. <http://dx.doi.org/10.1002/art.1780310302>
- [11] Vasanth LC, Pavlov H, Bykerk V. Imaging of rheumatoid arthritis *Rheumatic Diseases Clinic of North America* 2013; 39(3): 547-566.
- [12] Ravindran V, Rachapalli S. An overview of commonly used radiographic scoring methods in rheumatoid arthritis clinical trials. *Clinical Rheumatology* 2011; 30(1): 1-6. <http://dx.doi.org/10.1007/s10067-010-1554-8>
- [13] Guillemin F, Billot L, Boini S, Gerard N, Odegaard S, Kvien TK. Reproducibility and sensitivity to change of 5 methods for scoring hand radiographic damage in patients with rheumatoid arthritis. *J Rheum* 2005; 32: 778-786.
- [14] Dias EM, Lukas C, Landewe R, *et al.* Reliability and sensitivity to change of the Simple Erosion Narrowing Score compared with the Sharp-van der Heijde method for scoring radiographs in rheumatoid arthritis. *Annals Rheumatic Diseases* 2008; 67: 375-379. <http://dx.doi.org/10.1136/ard.2007.072785>
- [15] Klarenbeek NB, Guler-Yuksel M, van der Heijde D, Kerstens P, Malee C, Wested M, Huizinga T, Dijkmans B, Allaart C. A comparison between the simplified erosion and narrowing score and the Sharp-van der Heijde score: post hoc analysis from the Best study. *Ann Rheum Dis* 2011; 70(4): 714-716. <http://dx.doi.org/10.1136/ard.2010.134346>
- [16] Forslind K and the BARFOT study group. The usefulness of the Simplified Erosion Narrowing Score (SENS) in clinical practice for estimating joint damage in early rheumatoid arthritis. *Scandinavian Journal of Rheumatology* 2011; 40(6): 497-498. <http://dx.doi.org/10.3109/03009742.2011.617313>
- [17] Barnabe C, Hazlewood G, Barr S, Martin L. Comparison of radiographic scoring methods in a cohort of RA patients treated with anti-TNF therapy. *Rheumatology* 2012; 51:878-881. <http://dx.doi.org/10.1093/rheumatology/ker418>
- [18] Brynestejn K, Van der Linden S, Landewe R, Gubier F, Weijers R, Van der Heijde DMFM. Progression of rheumatoid arthritis on plain radiographs judged differently by expert radiologist and rheumatologists. *Journal of Rheumatology* 2004; 31(6): 1088-1094.
- [19] Sokka T. Radiographic scoring in rheumatoid arthritis: A short introduction to the methods. *Bulletin of the NYU Hospital for Joint Diseases* 2008; 66(2): 166-168.
- [20] Yazici Y, Sokka T, Pincus T. Radiographic measures to assess patients with rheumatoid arthritis: Advantages and limitations. *Rheum Dis Clin N Am* 2009; 35: 723-729. <http://dx.doi.org/10.1016/j.rdc.2009.10.005>

Received on 13-03-2015

Accepted on 23-03-2015

Published on 29-04-2015

DOI: <http://dx.doi.org/10.12970/2310-9874.2015.03.01.4>