

Interobserver Agreement in Magnetic Resonance Imaging of Active Sacroiliitis

Aktif Sakroileitin Manyetik Rezonans Görüntülemesinde Gözlemciler Arasındaki Uyum

Ahmed Cihad Genç¹, Ahmet Burak Kara², Fevziye Türkoğlu Genç¹, Zeynep Öztürk³, Damla Karataş³, Aysel Toçoğlu¹, Ünal Erkorkmaz⁴, Yasemin Gündüz², Emel Gönüllü³

¹ Sakarya University Faculty of Medicine, Department of Internal Medicine, Sakarya, Türkiye

² Sakarya University Faculty of Medicine, Department of Radiology, Sakarya, Türkiye

³ Sakarya University Faculty of Medicine, Department of Rheumatology, Sakarya, Türkiye

⁴ Sakarya University Faculty of Medicine, Department of Biostatistic, Sakarya, Türkiye

Yazışma Adresi / Correspondence:

Ahmed Cihad Genç

Sakarya University Faculty of Medicine, Department of Internal Medicine, Sakarya, Türkiye

T: +90 543 397 65 36

E-mail: genccihad@gmail.com

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Orcid ve Mail Adresleri

Ahmed Cihad Genç <https://orcid.org/0000-0002-7725-707X>, genccihad@gmail.com
Ahmet Burak Kara <https://orcid.org/0000-0001-7247-6022>, ahmetburakkara@gmail.com
Fevziye Türkoğlu Genç <https://orcid.org/0000-0003-4674-7399>, fevziyeturkoglu@gmail.com
Zeynep Öztürk <https://orcid.org/0000-0001-6439-000X>, zeynepoztrk84@gmail.com
Damla Karataş <https://orcid.org/0000-0002-4755-0443>, dr.damla_88@hotmail.com
Aysel Toçoğlu <https://orcid.org/0000-0002-9078-6996>, agurkan@sakarya.edu.tr
Ünal Erkorkmaz <https://orcid.org/0000-0002-8497-4704>, uerkorkmaz@gmail.com
Yasemin Gündüz <https://orcid.org/0000-0002-8373-4792>, dryasemingunduz@yahoo.com
Emel Gönüllü <https://orcid.org/0000-0002-6990-4206>, emelorge@yahoo.com

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Abstract

Introduction	Axial spondyloarthritis has characteristic clinical features such as enthesitis, sacroiliitis and spondylitis, and extra-articular manifestations. Sacroiliitis (SI) occurs as a result of inflammation of the sacroiliac joint. Magnetic resonance imaging (MRI) of sacroiliac (SI) joints is used to detect early sacroiliitis. Sometimes, there can be variations in the interpretation of MRI findings of the SI joint among observers. Our aim was to investigate the inter-observer agreement among the observers.
Materials and Methods	The study included the MRI results of 1150 patients who were diagnosed with active or chronic sacroiliitis based on the findings from sacroiliac MRIs, or whose MRI was deemed indicative of sacroiliitis by the rheumatologist. 1150 MRIs were re-evaluated by a different and expert radiologist.
Results	Out of the total 1150 patients investigated within the scope of this study. A statistically significant disparity emerged between the assessments provided by the expert radiologists and those obtained from outsourced radiologist evaluations.
Conclusion	The diagnosis of spondyloarthropathy may be delayed for some reasons. If the patient's clinic and MRI report are not consistent, the patient should not be removed from follow-up.
Keywords	Ankylosing spondylitis, magnetic resonance imaging, inter-observer agreement

Öz

Amaç	Aksiyal spondilozartropatiler entezit, sakroileit ve spondilit gibi karakteristik klinik özelliklere sahiptir, ayrıca eklem dışı belirtiler de görülebilir. Sakroileit (SI), sakroiliak eklemin inflamasyonu sonucu oluşur. SI eklem manyetik rezonans görüntülemesi (MRG), erken sakroileiti tespit etmek için kullanılır. Bazen SI eklem MRG bulgularının yorumlanmasında gözlemciler arasında farklılıklar olabilir. Amacımız, gözlemciler arasındaki uyumu araştırmaktır.
Yöntem ve Gereçler	Çalışma, sakroiliak MRG bulgularına dayanarak aktif veya kronik sakroileiti teşhis konulan ve/veya MRG sonuçları romatolog tarafından sakroileiti gösterir nitelikte bulunan 1150 hastanın MRG sonuçlarını içeriyordu. 1150 MRG uzman bir radyolog tarafından yeniden değerlendirildi.
Bulgular	Bu çalışma kapsamında incelenen toplam 1150 hastadan; uzman radyoloğun değerlendirmeleri ile dış kaynaklı radyolog değerlendirmeleri arasında istatistiksel olarak anlamlı bir farklılık ortaya çıktı.
Sonuç	Spondilozartropatilerin teşhisi bazı nedenlerle gecikebilir. Eğer hastanın klinik durumu ve MRG raporu tam uyum göstermiyorsa, hastanın takipten çıkarılmaması gerekmektedir.
Anahtar Kelimeler	Ankilozan spondilit, manyetik rezonans görüntüleme, gözlemciler arası uyum



INTRODUCTION

Conditions within the category of axial spondyloarthritis are classified into two distinct groups: radiographic sacroiliitis or ankylosing spondylitis, and non-radiographic axial spondyloarthritis. This division is based on the presence of radiographic sacroiliitis in conjunction with clinical manifestations.¹ Ankylosing Spondylitis (AS) primarily affects the axial skeleton and the sacroiliac joint. AS is a chronically inflammatory disease with an etiology that is not fully understood and a progressive course.² Its prevalence varies across different geographical regions. For instance, while the prevalence of AS in Turkey is around 0.49%, it is approximately 1.4% in other countries.³ In progressive cases, functional impairment accompanies joint fusion, whereas early diagnosis and appropriate treatment can lead to substantial clinical remission rates. Despite the ongoing uncertainty surrounding its etiology, it is acknowledged that inflammation plays a significant role in the pathogenesis and progression of the disease.⁴ While advancements have been made in the diagnosis of spondyloarthritis in recent times, the refinement of imaging techniques employed in diagnostic procedures remains an ongoing process.⁵ Timely identification and implementation of early therapeutic strategies for these individuals are imperative to preempt and manage associated conditions and avert potential future functional impairment. In addition to the patient's medical background, diagnostic measures encompass imaging techniques like sacroiliac joint radiography and sacroiliac magnetic resonance imaging (MRI).⁶ For disease diagnosis, prognosis estimation, and treatment response assessment, it is essential to monitor the degree of inflammation at regular intervals. However, there is no universally established standard laboratory method for this purpose.⁷ Currently, sedimentation rate (ESR) and C-reactive protein (CRP) are commonly employed inflammatory markers due to their reliability and cost-effectiveness. Despite their widespread use, these tests have limitations including low sensitivity and specificity, as well as their ability to reflect short-term inflammatory activity.⁸ Furthermore, elevated levels of these parameters have

been observed in only around 70% of individuals with active disease.⁹ MRI assumes a pivotal role in diagnosing and monitoring sacroiliitis in spondyloarthritis cases. Notably, active sacroiliitis lesions detected through MRI are crucial for both diagnosing the condition and evaluating the persistence of active inflammation. As time progresses, the significance of structural lesions grows in terms of diagnosis and ongoing monitoring.¹⁰ Due to rising demands and costs, outsourcing teleradiology services maintain their relevance and it is also utilized in the monitoring and treatment of rheumatological conditions.¹¹

We opted to assess the level of agreement among observers concerning active MRI findings of the sacroiliac (SI) joint. This evaluation pertains to both radiologists from outsourced radiology services and expert radiologists specializing in musculoskeletal diseases.

MATERIAL and METHODS

During the period from 2015 to 2019, a total of 8100 sacroiliac MRIs were conducted at our hospital. The study focused on the MRI results of 1150 patients who were either diagnosed with active or chronic sacroiliitis based on the sacroiliac MRIs or had their MRI results favoring sacroiliitis as determined by the primary physician. SI joint MRIs were reinterpreted by the expert radiologist. The MRI interpretations of the SI joint have been performed according to the Assessment of SpondyloArthritis International Society (ASAS) criteria for active sacroiliitis.

Ethics Approval

This study was conducted in accordance with the Helsinki Declaration. All procedures carried out in this study were approved by Sakarya University Local Ethics Committee on 23.03.2023 (Ethics committee approval no: E-71522473-050.01.04-194674-330). Due to the retrospective nature of the study, informed consent forms were not obtained.

Statistical Analysis

Descriptive analyses were conducted to present an overview of the general characteristics of the study population. To assess normal distribution, both visual methods (such as probability plots and histograms) and analytical tests (including the Kolmogorov-Smirnov and Shapiro-Wilk tests) were employed. For continuous variables that exhibited a normal distribution, Student t-test was employed. Conversely, for continuous variables that did not adhere to a normal distribution, Mann-Whitney U test was utilized. Furthermore, categorical data were compared using the Chi-square test. The agreement between the expert and outsourced services was evaluated using Kappa (k) coefficients. To compare evaluation outcomes between two observers, the McNemar test was employed. A p-value of less than 0.05 was deemed statistically significant. All analyses were performed using commercial software (IBM SPSS Statistics, Version 22.0. Armonk, NY: IBM Corp.).

RESULTS

Among the 1150 patients who were subjects of this investigation, 526 (45.7%) were identified as male, while 624 (54.3%) were classified as female. The overall mean age was recorded as 37.20 ± 11.65 years, with the respective mean ages for male and female being 34.98 ± 11.19 and 39.07 ± 11.71 years. Notably, a statistically significant distinction emerged between the evaluations provided by expert radiologist and those of the outsourced radiology reports. This divergence underscores a substantial lack of consensus among the assessors ($p < 0.001$). When scrutinizing the agreement between expert radiologist and outsourced radiologist reports, a noteworthy moderate level of concordance came to light, denoted by a kappa (k) coefficient of 0.589 (Table 1).

Table 1: Comparison of outsourcing and expert radiologist reports

		Outsourcing radiologist reports				
		Not active sacroiliitis	Active sacroiliitis	Total	p	k
Expert radiologist reports	Not active sacroiliitis	508	178	686	<0.001	0.589
	Active sacroiliitis	59	405	464		
Total		567	583	1150		
k: kappa value						

DISCUSSION

AS is a chronic autoimmune disease with an uncertain etiology; nevertheless, inflammation is widely acknowledged to play a significant role in its pathogenesis and progression.¹² Mortality rates in individuals with AS are higher compared to the general population. If patients access treatment late, joint fusion can lead to significant functional impairment. Since achieving clinical remission at high rates is possible with early diagnosis and appropriate treatment, avoiding delays in diagnosis is crucial for the prognosis of the patient.¹³

Teleradiology, a component of telemedicine, encompasses the analysis of diagnostic imaging tests conducted at a location distant from where the images were initially captured.¹⁴ During the 1990s, teleradiology advanced as a technology enabling radiologists to deliver urgent in-house radiology services remotely from their residences. Teleradiology was initially developed with the goal of ensuring that essential healthcare services could be provided across all geographical areas.¹⁵ Teleradiology's evolution aimed to widen healthcare access. From 1994 to 2015, emergency imaging use spiked by 660%, and certain neurovascular exams even surged by 17,000%, due to technology advances and increased clinical use. The yearly teleradiology volume is consistently increasing.^{16,17} Quality standards necessitate that radiologists hold licenses to offer teleradiology services in both the transmitting and receiving facilities in some countries.¹⁸ The utilization of teleradiology through the outsourced model has enhanced the efficiency of healthcare services and facilitated patients' access to healthcare. Subjecting teleradiology and outsourced radiology services to certification will elevate the standards of both service recipients and providers. With the increasing volume of teleradiology in recent years, the time per MRI could decrease. There might be interobserver disagreement in assessing SI joint. The combination of all these factors could negatively impact the quality of healthcare service. Accreditation could be a solution for establishing and monitoring the standards of teleradiology.

The use of artificial intelligence in healthcare and radiology is rapidly increasing. Artificial intelligence has become widespread, especially in radiological imaging with interobserver disagreement. In a study involving 1553 SI joint radiographs, an accuracy rate of over 80% was achieved in predictions.¹⁹

The secondary outcomes of a study involving 328 patients revealed a moderate agreement between two radiologists in sacroiliac joint MRI assessments. Development of sacroiliitis was observed in MRI after an average of 34.8 months. The risk model indicated that the presence of active inflammatory damage or chronic structural damage increases the risk of developing radiologic sacroiliitis in subsequent years.²⁰ The sacroiliac MRIs of 99 patients under the age of ²¹, who were following for sacroiliitis, were interpreted and analyzed by different radiologists. Moderate agreement among the radiologists was observed.²¹ These results are similar to the findings of our study.

We anticipate that in the near future, the use of artificial intelligence techniques will become more prevalent to reduce interobserver disagreement and achieve more precise and accurate results.

CONCLUSION

The diagnosis of spondyloarthropathies may be delayed for some reasons. Given the subtle progression of the disease, we underscore the significance of jointly assessing the patient's sacroiliac MRI report alongside their clinical findings. If the patient's clinic and MRI report are not consistent, the patient should not be removed from follow-up.

Limitations

The limitations of the study include its retrospective design, and the comparison of radiology interpretations solely by a single expert radiologist.

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The Author Contribution:

Study Design: ACG, ABK, FTG, YG, EG; Data Collection: ACG, ABK, FTG, ZÖ, DK, AT, ÜE, YG, EG; Statistical Analysis: ACG, ÜE; Manuscript Preparation: ACG, FTG.

Ethics Approval

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