

RESEARCH ARTICLE / ARAŞTIRMA MAKALESİ

Comparative Evaluation of Magnetic Resonance Imaging Request Accuracy for Suspected Rotator Cuff Tears Across Medical Specialties

Rotator Manşet Yırtığı Ön Tanısı ile Yapılan Manyetik Rezonans Görüntülemelerinin Branşlar Arası Tanısal Etkinliğinin Araştırılması

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ABSTRACT

Objective: The diagnosis of shoulder pathologies is a multidisciplinary process that includes physical examination, anamnesis and imaging techniques such as magnetic resonance imaging (MRI). Nevertheless, the inappropriate utilization of these imaging modalities engenders an unwarranted increase in workload and financial expenditure. The objective of the present study was to compare the appropriateness and diagnostic effectiveness of shoulder MRI requests for suspected rotator cuff tears across departments.

Material and Methods: In this retrospective study, shoulder MRIs requested by five different physician groups with a preliminary diagnosis of rotator cuff pathology were analyzed: orthopedic specialists, orthopedic residents, physical therapy and rehabilitation (PTR) specialists, PTR residents, and physicians from other specialties (neurosurgery and internal medicine). MRI requests that included other preliminary diagnoses, as well as unreported or unconfirmed MRI scans, were excluded from the study.

Results: A total of 712 MRIs were analyzed. Among the MRI examinations requested by orthopedic specialists, the rate of full-thickness rotator cuff tears was 21.4%, while the rate of partial-thickness tears was 16.7%. When both partial- and full-thickness tears were considered together, the overall rotator cuff tear rate was 38.1%. A statistically significant difference was observed in the detection rates of full-thickness tears between orthopedic physicians and other specialists ($p = 0.029$). A significant difference was also found between the groups in the diagnosis of isolated partial-thickness tears ($p = 0.048$). No significant difference was observed between orthopedic specialists and PTR specialists ($p > 0.05$). Among physicians from other specialties, despite MRI requests indicating a preliminary diagnosis of rotator cuff pathology, shoulder examinations were either not performed or inadequately documented.

Conclusion: The study demonstrated that orthopedic and PTR specialists were significantly more likely to request MRIs appropriately. In the context of escalating healthcare expenditures, the implementation of restrictive regulations for non-specialist departments is recommended.

Keywords: MRI, Rotator cuff tear, sustainable healthcare

ÖZ

Amaç: Omuz patolojilerinin tanısı, fizik muayene, anamnez ve manyetik rezonans görüntüleme (MRG) gibi görüntüleme tekniklerini içeren multi disiplinler bir süreçtir. Bununla birlikte, bu görüntüleme yöntemlerinin uygunsuz kullanımı, iş yükünde ve sağlık maliyetinde önemli bir artışa neden olur. Bu çalışmanın amacı, rotator manşet yırtıkları ön tanısıyla istenmiş omuz MRG'nin işlevselliğini ve etkinliğini bölümler arasında karşılaştırmaktır.

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Gereç ve Yöntemler: Bu retrospektif çalışmada, rotator manşet patolojileri ön tanısıyla beş farklı hekim grubu tarafından istenen MR'lar analiz edildi: Ortopedi uzmanları, ortopedi asistanları, fizik tedavi ve rehabilitasyon (FTR) uzmanları, FTR asistanları ve diğer branş (nöroşirurji, dahiliye) hekimleri. Diğer ön tanıları içeren veya raporlanmamış MR taramalarını içeren MR talepleri çalışmadan hariç tutuldu.

Bulgular: Toplam 712 MRG incelendi. Ortopedi uzmanları tarafından istenen MRG değerlendirmelerinde %21,4 oranında tam kat rotator manşet yırtığı, %16,7 oranında ise kısmi yırtık saptandı. Hem kısmi hem de tam kat yırtıklar dahil edildiğinde toplam %38,1 oranında rotator manşet yırtığı patolojisi kaydedildi. Ortopedi hekimleri ile diğer uzmanlar arasında tam kat yırtıkların tanı oranlarında anlamlı fark gözlemedi ($p=0,029$). İzole kısmi yırtıkların tanısında da gruplar arasında anlamlı fark gözlemedi ($p=0,048$). Ortopedi uzmanları ile FTR uzmanları arasında anlamlı fark gözlemedi ($p>0,05$). Diğer branş hekimleri arasında, rotator manşet patolojisini gösteren MR isteklerinin ön tanısında olmasına rağmen omuz muayenelerinin ya yapılmadığı ya da yetersiz şekilde belgelendiği görüldü.

Sonuç: Çalışma, ortopedi ve FTR uzmanlarının uygun şekilde MRG talep etme olasılıklarının önemli ölçüde daha yüksek olduğunu göstermiştir. Artan sağlık harcamaları bağlamında, uzman olmayan bölümler için kısıtlayıcı düzenlemelerin uygulanması önerilir.

Anahtar Sözcükler: MRG, rotator manşet yırtığı, sürdürülebilir sağlık hizmeti

INTRODUCTION

Shoulder pain can result in a number of significant symptoms, including restricted joint mobility and discomfort, which may have a consequential effect on the quality of life in a variety of daily activities. Shoulder pathologies are the third most prevalent reason for musculoskeletal consultations, with a prevalence of 16-26% [1]. In the field of shoulder pathologies, rotator cuff tears are a particularly prevalent etiology of shoulder discomfort [2]. The initial and primary steps in the diagnostic process are anamnesis and physical examination [3]. Post-physical assessment imaging techniques are as both diagnostic and therapeutic guiding tools. Among the imaging technologies under discussion, magnetic resonance imaging (MRI) has been particularly instrumental in revolutionizing the diagnosis of shoulder diseases. MRI has been proven to be a reliable, accurate, precise, cost-effective, and non-invasive modality for the evaluation of shoulder pathologies [4]. Conversely, MRIs performed without prior clinical evaluation may lead to decreased time efficiency, increased patient volume, and a reduced contribution to guiding patient management. This situation also imposes an additional expense on healthcare systems and adversely impacts the sustainability of effective health system operations, particularly in developing and heavily populated nations [5]. The consequences are exacerbated in the absence of constraints on requests for MRI and other radiological and laboratory investigations within medical disciplines. Within the prevailing healthcare system, physi-

cians from a wide range of specialties, excluding those pertaining to musculoskeletal disorders, are at liberty to request MRI imaging of the locomotor system without encountering any restrictions.

When shoulder MRIs are requested without a proper preliminary examination and by physicians lacking expertise in the musculoskeletal system, they can lead to misdiagnosis, unnecessary procedures, delayed treatment, and ultimately, poorer outcomes.

Therefore, the purpose of this study was to evaluate the diagnostic accuracy of shoulder MRI in patients with a preliminary diagnosis of rotator cuff tear by comparing evaluations performed by specialist physicians with those performed by lay physicians.

MATERIAL AND METHODS

This study was designed as a retrospective study with no direct patient participation. Following approval from the local ethics committee (registration number: E-46059653-050.99-251432198, registration number 2024/231, dated 19/08/2024), shoulder MRI scans requested for preliminary diagnoses of rotator cuff impairment, rupture, or injury between April and July 2023 were evaluated from hospital information management system records, regardless of medical specialty. This data screening was conducted in a health complex comprising three hospitals across two districts and serving approximately 800,000 residents. The study comprised MRI images of patients who were initially pre-diagnosed with rotator cuff pathology and subsequently reported

by a radiologist. Unreported MRI images and scans taken postoperatively were excluded from the study. MRI scans of the shoulder requested for a preliminary diagnosis other than rotator cuff pathology were also excluded. Following the application of inclusion and exclusion criteria, 712 shoulder MRI scans were evaluated. To minimize variability among physicians within the same specialties and to encompass articles addressing similar subjects in the literature, the time interval of April-June 2023 was chosen for comparison.

Patient files were reviewed to ascertain whether any physical examination findings had been documented when the MRI request was submitted. The specialty of the physician who requested the MRI scan, and whether they were a resident or a specialist, was recorded. The MRI tests were categorized based on specialty and allocation of resident or specialist physicians. Specialties addressing musculoskeletal disorders were categorized as follows: orthopedic specialists (Group 1); orthopedic residents (Group 2); PTR specialists (Group 3); and PTR residents (Group 4). Physicians from specialties not involved in musculoskeletal disorders were included in the 'other branch physician' group (group 5). All MRI examination images and radiology reports were reviewed, and the results were categorized into three groups based on rotator cuff condition: intact, slightly torn, or full-thickness tear. All patient files and MRI reports were evaluated by two senior authors.

Statistical analyses were conducted using IBM® SPSS® software, version 26. Given the categorical structure of the data, such as for medical specialties and diagnoses, descriptive statistics were presented as percentage frequencies. The chi-squared test was used to compare categorical variables, while Fisher's exact test was used when the assumptions of the chi-squared test were not

met. A p-value of less than 0.05 was considered to be statistically significant.

RESULTS

Of the 712 MRI scans, 425 were requested by orthopedic specialists (Group 1), and 111 by orthopedic residents (Group 2). Additionally, 105 MRI requests were determined to be from PTR specialists (Group 3), while 30 were made by PTR residents (Group 4). Furthermore, 41 requests were found to originate from specialists in 'other specialties' (such as neurosurgery or internal medicine) (Group 5), whose primary focus is not musculoskeletal disorders.

MRI assessments requested by orthopedic specialists revealed a rate of 21.4% for full-thickness rotator cuff tears and 16.7% for partial tears. Including both partial and full-thickness tears, a total of 38.1% of rotator cuff tear pathology was recorded. MRI imaging requested by orthopedic residents revealed full-thickness rotator cuff tears in 19.8% of cases and partial tears in 12.6% of cases. PTR specialists' MRI scans showed a full-thickness rotator cuff tear rate of 22.9% and a partial tear rate of 12.4%. MRI investigations requested by PTR residents revealed a full-thickness rotator cuff tear rate of 16.7% and a partial tear rate of 10% (Figure 1). MRI scans requested by other specialties (neurosurgery and internal medicine) showed a full-thickness tear rate of 14.6% and a partial tear rate of 4.9%. A significant difference in the diagnosis rate of full-thickness tears was observed between orthopedic physicians (Group 1) and other specialists (neurosurgeons and internists) (Group 5), with a p-value of 0.029. There was also a significant difference between these two groups in the diagnosis of isolated partial tears ($p = 0.048$). No significant difference was observed between orthopedic specialists and PTR specialists ($p > 0.05$) (Table 1).

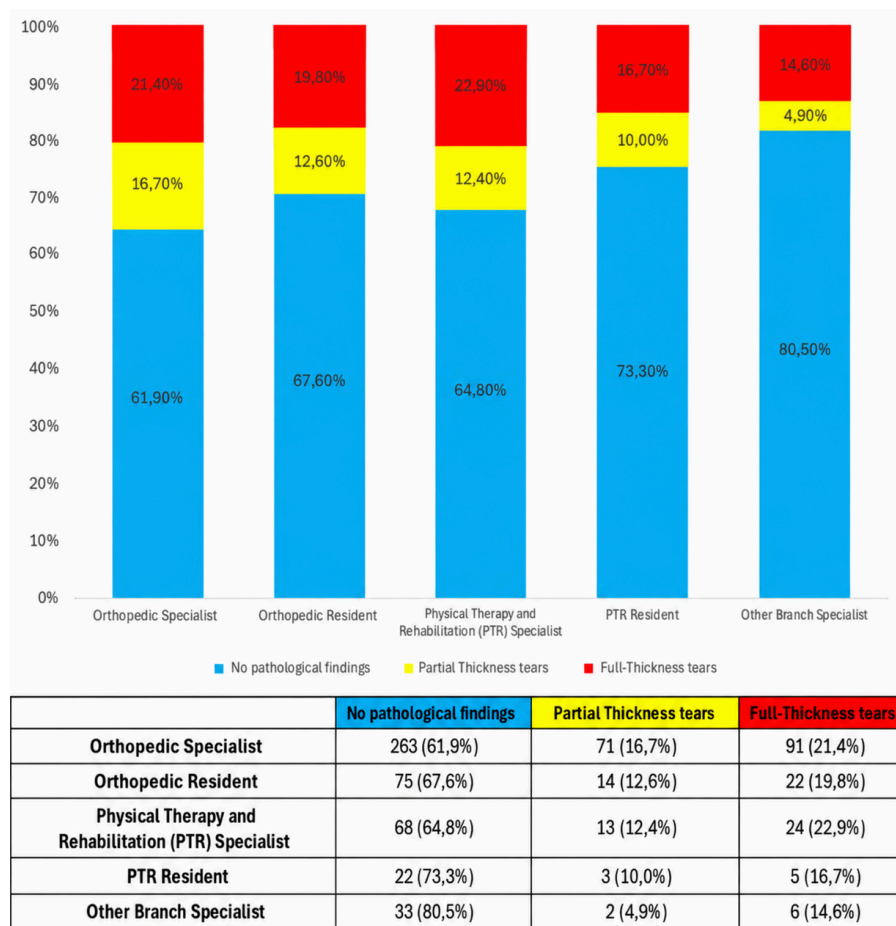


Figure 1. Branch-based rotator cuff pathology rates of requested MRI's.

Table 1. Comparison of rotator cuff pathology rates in requested MRI's by orthopedics, PTR and other branches.

	DIAGNOSIS			P
	Full-Thickness	Partial	Normal	
Orthopedic specialist	91	71	263	p=0,475
Orthopedic resident	22	14	75	
	DIAGNOSIS			P
	Full-Thickness	Partial	Normal	
PTR specialist	24	13	68	p=0,675
PTR resident	5	3	22	
	DIAGNOSIS			P
	Full-Thickness	Partial	Normal	
Other specialties	6	2	33	p=0,029

DISCUSSION

In disciplines related to the locomotor system, a thorough case history and physical examination before imaging is crucial for an accurate diagnosis and to guide therapy. Furthermore, imaging techniques impose a sig-

nificant financial burden on the healthcare system. Unnecessary imaging requests not only impose economic strain, but also lead to the misallocation of resources, thereby compromising the delivery of beneficial health services. This study focused on this issue, assessing MRI images requested for the preliminary diagnosis of rotator cuff tear/pathology in outpatient clinics within a health complex comprising three hospitals across two districts with a total population of around 800,000. To our knowledge, this is the only study in the literature to investigate this issue in such a large patient group. Devlin et al. demonstrated in their research that fewer than 25% of shoulder MRI scans ordered by primary care physicians (PCP) influence the management of various shoulder pathologies [6]. While PCP-ordered MRIs were primarily significant for full-thickness rotator cuff injuries, our study focused solely on rotator cuff abnormalities, identified in 19.5% of MRI scans with preliminary diagnoses requested by non-specialist departments. No rotator cuff pathology was observed in 80.5%

of patients. When requests are analyzed by department, orthopedic specialists exhibit the highest rate of diagnosing rotator cuff disease, with a total rotator cuff tear rate of 38.1% in preliminary diagnoses of shoulder MRIs. This is significantly different from other divisions ($p = 0.029$). In a separate department focused on the locomotor system (PTR), the rate was 35.3%, which was found to be higher than that of physicians in other non-specialist departments. Additionally, there is no statistically significant difference between orthopedic specialists and PTR specialists ($p > 0.05$), both of which specialize in the locomotor system.

In a national context, Turkey has the highest number of MRI units and the highest frequency of procedures per 100,000 people. The number of procedures increased from 8,592,072 in 2012 to 10,259,508 in 2014. While the EU average increased by 38%, this figure was 134% for Turkey [5]. In our country, the lack of specialty-specific restrictions on most imaging modalities has led to an increase in unnecessary MRI scans, largely due to inadequate physical examinations and patient pressure on physicians to request MRI studies. These factors contribute to increased patient overcrowding and place an additional financial burden on the healthcare system. Eubank et al. showed in their variance study that the average waiting time for magnetic resonance imaging (MRI) is 103 days (SD: 100, mean: 82, range: 2-611), even in developed countries such as Canada [7]. Therefore, we recommend limiting the use of expensive imaging techniques, such as MRI, through specialty-specific regulations for certain patient populations. The physical examination is a fundamental initial step. In our analysis, hospital records reviewed by physicians from non-locomotor system specialties lacked documentation of physical examination findings and specific test results. Devlin et al. demonstrated in their study that over 50% of referrals lacked a documented physical examination, indicating a reliance on MRI scans for assessment [6]. Moreover, the literature indicates that the physical examination is a reliable diagnostic tool. The Jobe test and the full can test exhibited excellent sensitivity and specificity for supraspinatus tears, while the Hornblower sign demonstrated efficacy for infraspinatus

tears. A diagnosis of a full-thickness rotator cuff tear can be confirmed through specific shoulder tests during a physical examination, enabling differentiation of the affected muscle without the need for imaging techniques [8]. On the other hand, partial-thickness (approximately 21.1%) and full-thickness (approximately 4.5%) tears of the rotator cuff tendons were also identified in asymptomatic shoulders [9].

In a survey conducted by the Canadian Shoulder and Elbow Society with orthopedic surgeons, MRI scans were found to be most effective in surgical decision-making, following patient history (45-55%) and physical examination (23-42%). In the same study, 50% of patients with potential shoulder pathology were referred with an MRI scan completed before the initial orthopedic consultation. Tear pathology detected on MRI alone will not be effective in treatment management [10].

In a study examining the diagnostic accuracy of shoulder imaging, Sheehan et al. found a higher rate of inappropriate MRI requests among non-orthopedic surgeons (44%) than among orthopedic surgeons (17%) [11].

Our recommendation to restrict MRI requests can be illustrated by similar interventions targeting unnecessary laboratory testing. Numerous studies from different countries have examined the overuse of vitamin D testing. In Canada, for example, approximately 40% of vitamin D tests were reported to be inconsistent with established guidelines [12]. In response to this issue, national health authorities have implemented various strategies aimed at reducing unnecessary testing. A Danish study demonstrated that the introduction of a mandatory pop-up notification reduced vitamin D test requests by 25% among general practitioners [13]. Similarly, to prevent unnecessary vitamin D testing, the Turkish Ministry of Health introduced regulations in late 2019 through a directive issued by the General Directorate of Health Information Systems on 24 December 2019 (E.9366). These regulations imposed time- and specialty-based restrictions. Consequently, vitamin D testing was discontinued in primary healthcare institutions, and limitations were introduced in hospitals. In 2020, the effective implementation of these restrictions, together with the

decline in patient admissions during the Coronavirus Disease 2019 (COVID-19) pandemic, resulted in a 56% reduction in vitamin D test requests [14]. The findings of the present study suggest that implementing specialty-based restrictions or pop-up warning notifications during MRI ordering may help reduce unnecessary MRI requests.

Our study is not without limitations. The patient cohort was heterogeneous with respect to age, sex, and activity level. Although the sample size was adequate, the number of MRI requests originating from other departments was lower than that from departments specializing in the locomotor system. Rotator cuff disorders were categorized into two groups: full-thickness and partial-thick-

ness tears. However, no tendon-specific differentiation was performed within these categories. Furthermore, the clinical course and treatment outcomes of the identified rotator cuff disorders have not yet been investigated across departments.

CONCLUSION

The study demonstrated that orthopedic and physical therapy and rehabilitation (PTR) specialists were significantly more likely to request MRIs appropriately. Given the rising costs of healthcare, implementing restrictive regulations for non-specialist departments is recommended.

Ethics Committee Approval / Etik Komite Onayı

The approval for this study was obtained from University of Health Sciences, Sancaktepe , Şehit Prof. Dr. İlhan Varank Training and Research Hospital Clinical Research Ethics Committee, E-46059653-050.99-251432198 (Decision no: 2024/231, Date: 14/08/2024).

Conflict of Interest / Çıkar Çatışması

The authors declared no conflicts of interest with respect to authorship and/or publication of the article.

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Author Contributions / Yazar Katkıları

Concept: TA,AŞK; design: TA,TCK; supervision: BG; materials: TA,TCK; data collection and/or processing: TA,HE; analysis and interpretation: BG; literature review: TA,AŞK; writing manuscript: TA; critical reviews: HE. All authors contributed to the final version of the manuscript and discussed the results and contributed to the final manuscript.

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