Protocol for the Request of Knee Magnetic Resonance Imaging in Elderly Patients with Suspected Osteoarthritis: Reduction in Test Requests and Impact on Management and Diagnosis*

Protocolo de solicitação de ressonância magnética do joelho em pacientes idosos com suspeita de osteoartrose: Redução da solicitação de exames e o impacto na conduta e no diagnóstico

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Abstract

Objective To develop an evidence-based protocol to guide magnetic resonance imaging (MRI) requests in elderly patients with suspected knee osteoarthrosis and to evaluate its effectiveness after implementation.

Methods The institutional protocol was developed after reviewing the literature during the first semester of 2018. The control group was defined as patients cared for in the first semester of 2018, before the implementation/dissemination of the institutional protocol, and the study group was composed by patients cared for during the second semester of 2018 after the standardization of MRI requests for suspected knee osteoarthrosis.

Results Our sample included 826 patients undergoing knee MRI, with a mean age of 69.3 years. Protocol implementation decreased MRI requests and increased radiograph requests ($p < 0.001$). After the implementation of the protocol, the MRI changed the diagnosis or treatment in only 11.2% of the cases.

Conclusion Protocol implementation resulted in a 47.5% reduction in the number of requests for knee MRI, with most (89%) patients with alteration in diagnosis or treatment. Level of evidence: case-control study (IIIB).

Keywords
- osteoarthritis, knee
- magnetic resonance imaging
- clinical protocols

* *Study developed at the Orthopedics and Traumatology Department, Instituto Prevent Senior, São Paulo, Brazil.*

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Resumo

Objetivo Desenvolver um protocolo, baseado em evidências, para guiar a solicitação de exames de ressonância magnética (RM) em pacientes idosos com suspeita de osteoartrose do joelho e avaliar a sua eficácia após implementação.

Métodos O protocolo institucional foi desenvolvido após revisão da literatura durante o primeiro semestre do ano de 2018. Definiu-se como grupo de controle os pacientes do primeiro semestre de 2018, antes da aplicação/divulgação do protocolo institucional, e o grupo de estudo foi composto por pacientes atendidos no segundo semestre do mesmo ano após a padronização dos pedidos de RM para a suspeita de osteoartrose do joelho.

Resultados Nossa amostra contou com 826 pacientes submetidos a RM do joelho, com média de idade de 69,3 anos. Após a implementação do protocolo, houve um decréscimo das solicitações de RM e um aumento no número de solicitações de radiografias ($p < 0,001$). Após a implementação do protocolo, a RM alterou o diagnóstico ou a conduta do médico em apenas 11,2% dos casos.

Conclusão Após a introdução do protocolo, encontrou-se uma redução de 47,5% no número de pedidos de RM do joelho, sendo que a maioria (89%) dos pacientes não tiveram suas condutas ou diagnóstico alterados. Nível de evidência: estudo caso-controle (IIIB).

Palavras-chave

- osteoartrite do joelho
- imagem por ressonância magnética
- protocolos clínicos

Introduction

Osteoarthritis (OA) is a chronic degenerative condition. It is considered a public health problem because it is the most prevalent joint disease in the world, and the single most common cause of disability in people older than 18 years of age. It mostly involves the knee joint, especially in patients aged > 50 years, currently affecting around 250 million people on the planet.[1]

In Brazil, the rapid aging of the population and the epidemic increase in obesity is expected to result in an exponential growth in the number of patients with suspected and diagnosed knee OA in the coming years.[2]

The diagnosis of OA is usually based on history, clinical examination, and x-rays. Radiography is the most used imaging method because it is cheap, widely available and validated; in addition, it facilitates the classification of disease severity. Other subsidiary exams, such as magnetic resonance imaging (MRI), may be important in specific situations.

The MRI is especially useful in confirming a suspected diagnosis when the clinical and radiographic findings are divergent or doubtful. In addition to being a non-invasive method to obtain multiplanar images, it presents high definition, sensitivity, and specificity.[3]

The choice of the most appropriate test accelerates diagnosis, increasing the likelihood of a successful treatment; moreover, it avoids unnecessary expenses for the healthcare system.[4]

However, healthcare expenses are a complex issue, since human well-being and lives are on the line.[5] Thus, the discussion must not focus only on finances, but on efforts to provide services with maximum efficiency and quality.[6]

Therefore, the development of an easy-to-use protocol based on the medical literature to guide MRI requests for elderly patients with suspected knee OA is critical, as it will not only improve the therapeutic approach to the patient but also reduce unnecessary MRI requests, resulting in a better distribution and use of the available healthcare resources.[7]

The present study aims to develop an evidence-based protocol to guide MRI-scan requests in elderly patients with suspected knee OA and to evaluate its effectiveness after implementation.

Materials and Methods

The present study evaluated 22,654 outpatient visits to the orthopedics service at Hospital Sancta Maggiore, in the city of São Paulo, Brazil. The patients were examined by knee-specialist orthopedists from January 1st to December 31st, 2018. After the application of the inclusion and exclusion criteria, a total of 826 patients with suspected knee OA underwent an MRI scan.

Institutional Protocol

The methodological strategy consisted in a query on the PubMed and SciELO databases to identify studies on the diagnosis od OA and knee pain published over the previous 5 years. The query was directed to articles written in Portuguese or English, with full public electronic access, including the following keywords: knee osteoarthritis, knee pain, diagnosis, MRI, and magnetic resonance.

The publications of interest were initially selected based on title and abstract; the relevant publications cited by the chosen articles were also analyzed.

Editorials and letters to the editor were not included. After the final selection and full-text reading of all papers, the following specific protocol for the request of knee MRIs in

elderly patients with diagnosed or suspected knee OA was proposed and updated.

The criteria for MRI request in patients aged > 60 years with chronic knee pain (> 6 months) and suspected/diagnosed knee OA were the following:

- Previous anteroposterior (AP) and lateral (L) radiographs of the knee under load;
- History of acute knee trauma/sprain;
- Signs and symptoms of joint block;
- Positive meniscal tests with no diffuse knee pain;
- Acute/sudden knee pain with no trauma (suspected knee osteonecrosis);
- Pain disproportionate to the radiographic findings;
- Suspected fragility fracture in patients with osteoporosis; and
- Suspected knee tumor.

Patient Selection

The inclusion criteria were the following: 1) age > 60 years; 2) suspicion or diagnosis of knee OA; and 3) attendance at the institutional orthopedics outpatient clinic in 2018. Ethe exclusion criteria were the following: 1) cases of secondary osteoarthritis; 2) patients with systemic inflammatory diseases; 3) MRI requested for different purposes, such as medical reports and work-related reports; and 4) medical records with insufficient information.

Protocol Implementation and Evaluation

The institutional protocol was developed during the first semester of 2018. After its conclusion and review, the protocol was massively disseminated in the various contact channels among institutional knee-specialist orthopedists (e-mail, intranet, WhatsApp) during the second semester of 2018.

Thus, the control group was defined as patients cared for in the first semester of 2018, before the implementation of the institutional protocol, and the study group was composed of patients cared for during the second semester of 2018, after the standardization of MRI requests for suspected knee OA.

Clinical Analysis

The factors included in the clinical analysis were as follows: age, gender, laterality, number of MRIs requested in each semester, number of visits in each group, existence of prior requests (in the previous twelve months) for knee radiographs and changes in diagnosis or treatment after MRI analysis.

Statistical Analysis

The statistical analysis was performed using the stats package of the R software (R Foundation for Statistical Computing, Vienna, Austria).[8] The nominal variables were described as proportions, and the continuous variables were described as means and standard deviations. The Shapiro test[9] assessed the distribution of the continuous variables in each group. The Student *t* and Mann-Whitney U tests were applied for parametric and non-parametric measurements. The Pearson chi-square test[10] was used to compare the categorical variables between the groups. Statistical significance was set at $p \leq 0.05$.

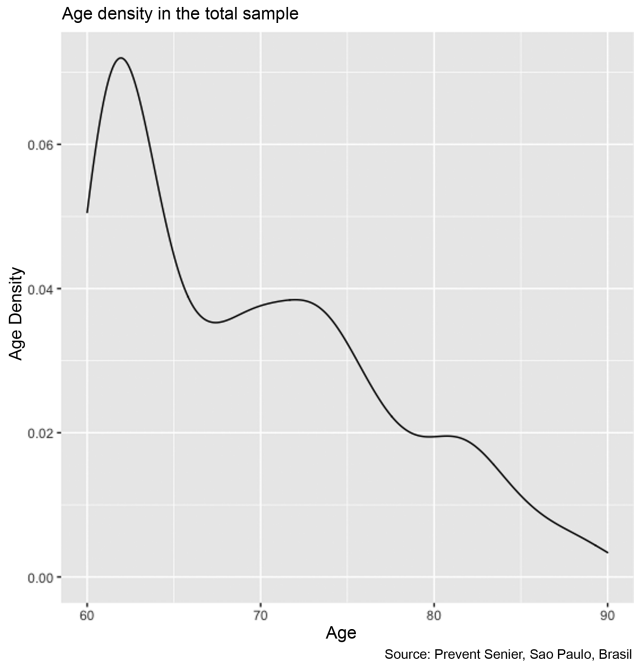

Fig. 1 Age density of the total sample.

Results

The total sample consisted of 22,654 medical visits with knee-specialist orthopedists, with 10,869 visits for the control group (first semester of 2018) and 11,785 for the study group (second semester of 2018); the number of visits was similar for both time periods. On average, the patients were 69.3 years old. ►**Figure 1** shows the age distribution of the total sample.

►**Table 1** shows epidemiological data from both groups.

There was a 47.5% reduction in the number of MRI requests by orthopedists specialized in knee surgery after the implementation of the institutional protocol, from 559 (67.7%) requests during the first semester of 2018 to 267 (32.3%) requests in the second semester of 2018, as shown in ►**Figure 2**.

When analyzing the number of MRI scans in each group according to the number of visits, there were 2 MRI scans for every 100 visits after the implementation of the protocol. For the control group, that is, the patients examined before the protocol was implemented, there were 5 MRI requests for every 100 visits, totaling an approximate reduction of 3 scans for every 100 visits.

Protocol implementation increased the number of radiographs requested prior to MRI, with an increase of almost 96% in the total number of requests. Previous radiographs were requested for 23.9% of the control group, and for 47.1% of the study group (►**Figure 3**), with a statistically significant difference ($p < 0.001$).

Table 1 Characteristics of the patients included in the study

Characteristic	Before the protocol	After the protocol	*p*-value
Age	69.3 (7.6)*	69.4 (7.9)*	0.62
Gender	Female = 73.7% Male = 26.3%	Female = 69.1% Male = 30.9%	0.34
Dominant side	Right = 50.5% Left = 49.5%	Right = 44.7% Left = 55.3%	0.22
Was a radiograph requested before the magnetic resonance imaging scan?	Yes = 23.9% No = 76.1%	Yes = 47.1% No = 52.9%	$p < 0.001$
Did the magnetic resonance imaging scan change the conduct or diagnosis?	Yes = 13.8% No = 86.2%	Yes = 11.2% No = 88.8%	0.30

Source: Data from the Orthopedics and Traumatology Department, Instituto Prevent Senior, São Paulo, Brazil.
Note: *Mean and standard deviation.

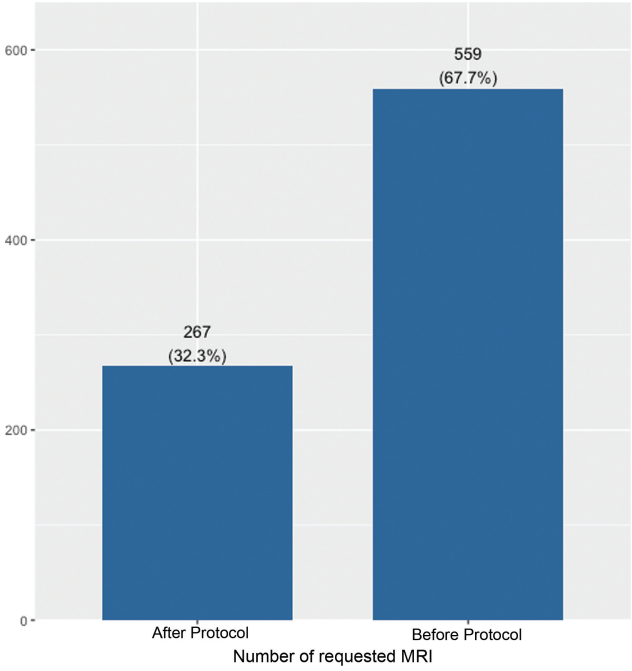

Fig. 2 Number of magnetic resonance imaging (MRI) scans requested for the study and control groups.

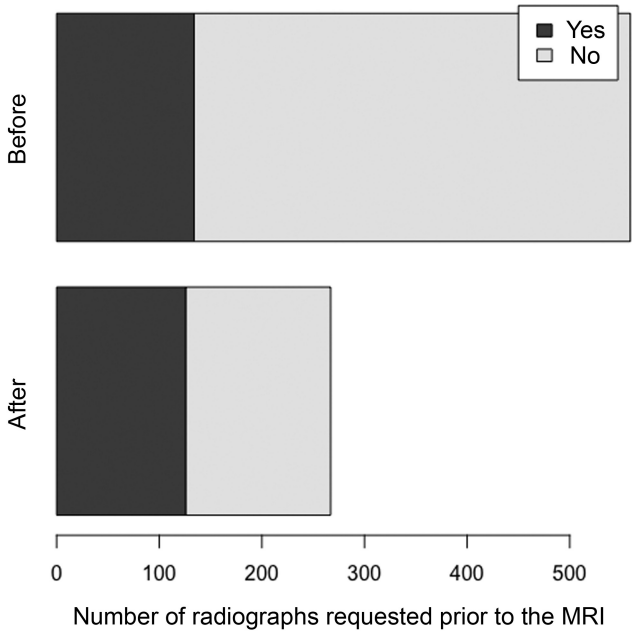

Fig. 3 Number of radiographs requested prior to the MRI requests for the study and control groups.

The analysis of the MRI changed treatment or diagnosis for 11.2% of the patients from the study group, and for 13.8% of the control group, with no significant difference between the groups ($p = 0.30$).

Discussion

The main results of the present study were the development of an institutional protocol, based on the current literature, for the request of knee MRIs in elderly patients with suspected knee OA and the subsequent confirmation of its effectiveness after implementation among the team of knee-specialist orthopedists.

There was a 52% reduction in the number of knee MRI requests after the implementation of the institutional protocol. This represented a decrease of 292 scans during the second semester of 2018, corresponding to 49 fewer knee MRI scans per month. These vacancies could then be filled by more urgent, critical MRI requests, reducing the waiting time and list for these tests. Spence et al.[7] found similar results, with a 71% reduction in inappropriate knee MRI requests in OA patients after protocol implementation. This reduction resulted in 45 vacancies per month for more urgent tests.

Kandiah et al.[11] demonstrated a 21% reduction in knee, shoulder and hip MRI requests after the development and implementation of a protocol to request these tests for patients over 55 years old. These results were inferior to those observed in other studies, possibly due to the joint analysis of MRI requests for several joints, including those of the shoulder and hip.

The differences from previous studies can also be related to the doctors requesting these tests, since other authors[5,12] have demonstrated differences in the request patterns from

general orthopedists, specialized orthopedists, and primary care physicians. The protocol developed in the present study was only implemented among knee specialists.

Another important finding of the present study was the 96% increase in the number of requests for knee radiographs after the implementation of the institutional protocol. This change resulted in a reduction from 76% to 52% in the number of patients with diagnostic suspicion of OA who underwent a knee MRI with no prior radiographs. Despite this reduction, the numbers still show a low adherence to the current protocol, since one criterium was not met by these requests.

Gonzalez et al.[13] also observed a low adherence to the protocol (57%) by primary care physicians in a study with patients with non-acute knee pain with an average age of 53 years. In a study evaluating limb MRI requests at the emergency room, Glover et al.[14] demonstrated that the most common reason for inappropriate MRI requests was the failure to perform previous radiographs. In a study with elderly patients, Parent et al.[15] observed that only 38% of patients undergoing knee MRI scans had been submitted to knee radiographs in the previous 24 months.

In the present study, treatment was not altered in approximately 86% of the patients after the analysis of the MRI scans requested by the doctor. Another similar study[13] showed that approximately 20% of the patients had their clinical therapy altered by knee MRI findings. Lehnert et al.[16] also demonstrated that 76% of the general MRI scans requested by general practitioners presented normal findings and did not change the treatment of the patients.

The development of institutional protocols to guide medical practices is essential for standardization and correct decision making. In addition, these guidelines provide better use of finite, scarce healthcare financial resources. Parker et al.[17] estimated a cost of 2 billion dollars in 2020 alone with musculoskeletal MRI requests for Medicare beneficiaries in the United States. Thus, the emergence and implementation of protocols in this area are vital for better financial control, avoiding waste.

Although the knee OA classification has been described by Kellgren-Lawrence,[18] it remains current for the diagnosis and management of the condition despite some divergences between radiological and clinical findings. The MRI is more sensitive and specific compared to radiography, and it can be used in certain situations, because the scan does not alter the diagnosis and radiographic classification.

The present study has some limitations. Since it was carried out in a single institution, with its own orthopedics team and ease of internal communication, it is difficult to generalize the findings to other services. In addition, the protocol was implemented only for knee-specialist physicians; therefore, there is no comparison with general practitioners and primary care physicians. The reasons for non-adherence and follow-up of the developed protocol by the doctors were not evaluated.

Conclusion

After developing and implementing an institutional protocol for knee MRI requests in elderly patients with suspected knee OA, there was a 47.5% reduction in the number of requests, and a 96% increase in the number of initial requests for knee radiograph. In addition, most (89%) patients did not have their treatment changed after the analysis of the findings from the MRI scans requested by the doctors.

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Conflict of Interests
The authors have no conflict of interests to declare.

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