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Is MRI Overutilized for Evaluation of Knee Pain in Veterans?

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Abstract

MRI is an essential diagnostic imaging modality for many knee conditions; however, it is not indicated in the setting of advanced knee arthritis. Inappropriate MRI imaging adds to health care costs and may delay definitive management for many patients. The primary purpose of this study was to ascertain the frequency of inappropriate MRI scans performed at one Veterans' Administration Medical Center (VAMC). We performed a retrospective chart review of all knee MRIs ordered over a 6-month period. Inappropriate MRI was defined as MRI performed prior to radiographs (XRs), or in the presence of XRs demonstrating severe osteoarthritis, without leading to a nonarthroplasty procedure of the knee. Of the 304 cases reviewed, 36.8% (112) of the MRIs were deemed inappropriate, 33 were ordered by orthopedists, and 79 were ordered by other health care providers. Of the 33 ordered by orthopedists, 25 were ordered by retired/nonsurgical orthopedists. Obtaining an MRI delayed care by an average of 29.2 days. Of the 252 cases that had XR prior to MRI, none included all four views in the standard knee XR series and only four had weightbearing images. Over a third of knee MRIs performed at this VAMC were inappropriate and delayed care. Additionally, no XRs in our study contained all the necessary views to properly assess knee arthritis. These concerning findings signify a potential opportunity for education in diagnostic strategies, to better patient care and resource utilization in the VAMC.

Keywords
- MRI
- osteoarthritis
- knee pain
- veterans

Knee osteoarthritis is a highly prevalent disease in the US, and even more so among patients who are veterans, at least in part due to high physical demands on their knees while in the service.[1,2] The prevalence and debilitating nature of osteoarthritis perpetuate its financial burden, and these costs will continue to rise as more total knee replacements are being performed and at an earlier age.[3–5] Veterans, in particular, are more likely to report chronic joint symptoms and activity limitation than nonveterans, making improved efficiency in the use of health care resources devoted to this issue more critical.[2]

The Kellgren–Lawrence classification (KL classification) first described the radiographic changes characteristic of knee osteoarthritis over 50 years ago, and it is well-established that XRs are an effective means of diagnosing knee osteoarthritis.[6,7] Although debates exist, the preferred radiographic views for evaluating knee osteoarthritis are a weight-bearing anteroposterior (AP) view, a posteroanterior (PA) flexion view, a lateral view, and a sunrise/merchant view.[8–10] MRI has improved diagnosis in the evaluation of certain patients with knee pain, but at the same time has notably increased health care spending.[11,12] There has been

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Table 1 Patient demographics. Age and BMI are presented as a mean followed by 95% confidence interval

	Overall ($n = 306$)	MRI before XR ($n = 54$)	MRI after XR ($n = 183$)	MRI and XR on same day ($n = 7$)
Sex (% male)	79.7	79.6	79.8	86
Age, years	53.2 (29.9–76.5)	53.9 (31.0–76.8)	54.6 (32.6–76.6)	52.1 (22.7–81.5)
BMI	31.6 (20.0–43.2)	30.6 (25.5–35.7)	31.4 (20.0–42.8)	36.1 (28.3–43.9)

Abbreviations: BMI, body mass index; XR, radiographs.

increased study on the overutilization of MRI and "defensive medicine" in the past few years, and with good reason, as one study found that 40% of knee MRIs were deemed inappropriate for the diagnosis of the patient.[13–16] Many findings on MRI of the knee, such as degenerative meniscal tears, are present in asymptomatic patients, bringing into question the utility of MRI in patients with known osteoarthritis.[17,18] Furthermore, Song et al described MRI as "useful" in only 18% of the degenerative knee evaluations compared to 84% of the sports injury evaluations.[19] Furthermore, knee MRI is not indicated in patients with XRs diagnostic of osteoarthritis, further supporting that XRs should be obtained prior to MRI in most cases.[20] Time to acquisition of MRI should also be scrutinized, since MRI is not as readily accessible as XRs, and it has been shown to delay care of patients with anterior cruciate ligament tears by 89 days in one study in England.[21]

To our knowledge, this is the first study assessing the application of MRI in the evaluation of knee pain in veterans, focusing on inappropriate resource utilization and delay in care. The primary purpose of this retrospective study was to ascertain the number of inappropriately ordered knee MRIs performed in veterans, and to determine the delay in acquiring these MRIs. We suspected that MRI would be an overutilized diagnostic tool that delayed care in patients at VAMC. Additionally, we investigated the training of providers who ordered these MRIs, and the number of XRs that incorporated weight-bearing views and four views to adequately assess the three compartments of the knee. We hypothesize that MRI is an overutilized diagnostic tool in veterans with knee pain.

Design

Local institutional review board approval was obtained for this retrospective study (HP-00084062). The mPower radiology analytics platform (Nuance; Burlington, MA) was used to search for all knee MRI examinations performed at the Baltimore Veterans' Administration Medical Center (VAMC) from January 1, 2018, through June 30, 2018. We collected demographic information (shown in ►**Table 1**) and determined if the MRI was obtained prior to or after XRs of 306 extremities. Fellowship-trained attending orthopedic surgeons graded the XRs using the KL grading scale, considering joint space narrowing, osteophytes, and subchondral sclerosis. We deemed MRIs inappropriate if they were 1) performed on an arthritic knee (KL 3 or 4) with no subsequent surgery or 2) prior to obtaining an XR with no subsequent surgery. In addition, we ascertained the specialty of the ordering provider, the number of days required for MRI completion from the time of the order, and whether the patient had any knee procedures prior to or after obtaining the MRI. The time to MRI completion was a surrogate in our study for delay in definitive care. The specialty of the ordering provider was categorized into two groups: orthopedists and nonorthopedic providers, which included primary care providers, other specialists, nurse practitioners, and physician assistants. We further divided orthopedic surgeons into operative and nonoperative orthopedic surgeons (the latter group consists of semiretired orthopedists who no longer perform surgery). Patients were excluded from the study if they had a prior total knee arthroplasty on the knee that underwent MRI scan. There were no prisoners, pregnant women, or children under the age of 18 in the cohort. Statistical analysis was performed with Chi-square testing, with statistical significance set at $p < 0.05$, using JMP statistical analysis software.

Results

Analysis was performed on a total of 306 knees with MRIs (298 patients): 54 (17.6%) had their MRI prior to knee XR, 183 (59.8%) had their MRI after XR, and 7 (2.3%) had the MRI and XR on the same day. The ordering providers were classified by specialty (►**Table 2**). Primary care providers ordered the most knee MRIs in this study at 137 (44.8%), followed by orthopedic surgeons at 112 (36.6%), and then other health care providers at 55 (18%).

Data from a total of 304 cases was reviewed; 37.1% (113) of the MRIs were deemed inappropriate. We were unable to ascertain the date of MRI for 2 of the knees, leaving 304 of the 306 MRIs available for data interpretation. MRI completion took 29.2 days on average with a standard deviation (SD) of 19.1 and median of 26 days (►**Fig. 1**). Of the 252 cases that obtained an XR prior to MRI, none included all four preferred views (AP, PA flexion view, lateral, and a sunrise/merchant view), while only four had weight-bearing images.

Table 2 Number of MRIs ordered by provider type

Provider	MRI before XR	MRI after XR	MRI and XR same day	Total
Orthopaedists	10	101	1	112
Surgical	3	25	1	28
Nonsurgical/retired	7	76	0	84
Nonorthopaedic providers	43	143	6	192

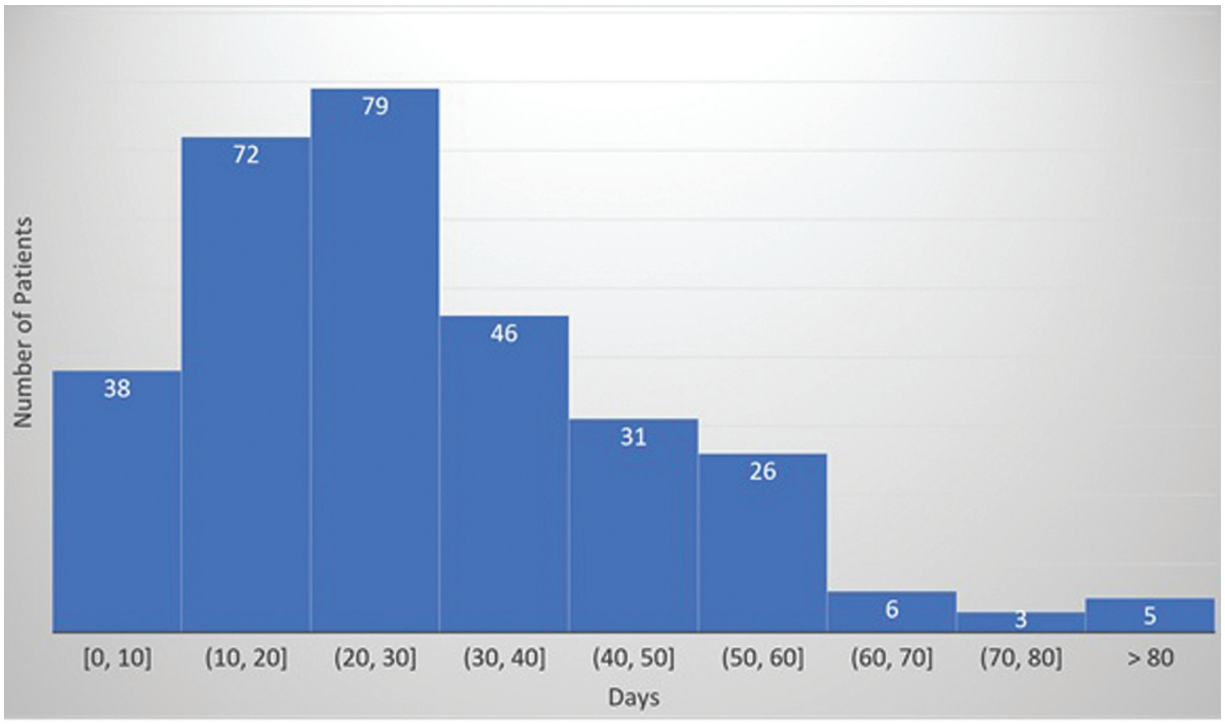

Fig. 1 Delay in care due to ordering of MRIs. Median = 26 days; mean = 29.2 days; standard deviation (SD) = 19.1 days.

The distribution of providers ordering unnecessary MRIs can be found in ►**Fig. 2**. There were 113 (37.1%) MRIs deemed inappropriate; 46 patients had undergone an MRI without prior XR and no subsequent surgeries, and 67 patients had an arthritic knee (KL 3 or 4) without subsequent surgeries. Of those inappropriate MRIs, 33 (29.5%) were ordered by orthopedic surgeons, while 79 (70.5%) were ordered by non-orthopedic providers. There was one entry that lacked provider type in the system, so this data point was eliminated from this analysis, leaving 112 instead of 113 knees. A Chi-square test of goodness of fit was performed to examine the relationships between provider type and inappropriately ordering MRIs. The relationship between these variables was significant, $X2$ (1, $n = 112$) = 18.893, $p = 0.00001$. Of the 33 ordered by orthopedic surgeons, 25 were ordered by orthopedic surgeons who are no longer surgically active. Another Chi-square test was performed, dividing orthopedists into surgical and nonsurgical; the relationship between provider type and inappropriately ordered MRIs was also found to be significant with a much lower p value, X2 (1, $n = 33$) = 8.758, $p = 0.003$. Of the total number of MRIs ordered, orthopedic surgeons ordered 29.4% (33) of the total number of unnecessary MRIs (112).

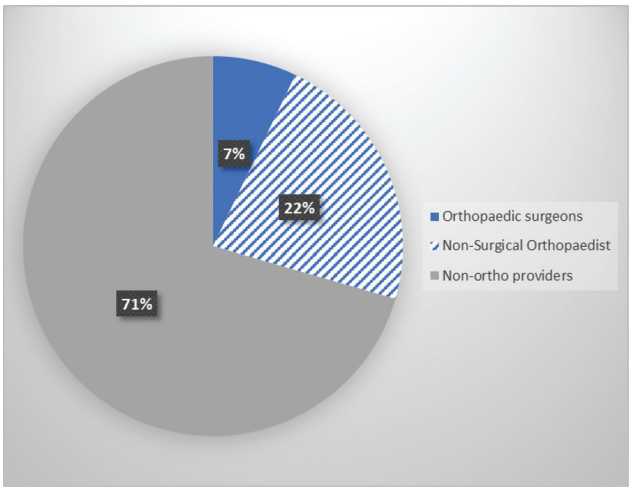

Fig. 2 Proportion of inappropriately ordered MRIs by provider type.

Discussion

To our knowledge, this study is the first to evaluate overuse of MRI in the evaluation of knee pain in the veteran population. Health care spending is becoming increasingly scrutinized, and the inappropriate use of MRI is contributing to higher orthopedic health care expenditures.[22,23] Acute injury, effusion, and ligamentous instability in patients without osteoarthritis are considered appropriate indications for ordering knee MRIs, according to most orthopedic sports surgeons.[24] Although the cost of MRI varies, one study noted a knee MRI costs around $459 in Medicare and as high as $1,628 in private settings.[25] Reducing health care costs in VAMC specifically has been the subject of research in other fields of medicine.[26–28] Our study hypothesis was strongly supported in this study, and reveals that the overuse of MRI may be a potential area VAMC can target to reduce health care expenditures and prevent delays in the care of orthopedic patients with knee pain.

Our results showed that 37.1% of veteran patients had knee MRIs either prior to any XRs or in the presence of known KL grade 3 or 4 osteoarthritis on radiographs. These

are situations in which the MRI is unnecessary and are unlikely to change the treatment plan. These findings are significantly higher than the 13% inappropriate MRIs reported in the study by Sherman et al, suggesting the problem of MRI misuse in orthopedic knee pathology may be worse in the VAMC than the private setting.[16] In part, this may be because MRI orders at the VAMC are not subject to insurance review such as by private insurers. In addition, a miniscule amount of the radiographs obtained were weight-bearing and included all relevant views to properly assess knee osteoarthritis. This suggests there may be a lack of understanding among providers in how to properly evaluate knee osteoarthritis in this patient population. There is a high prevalence of osteoarthritis among veterans, and they tend to present for care with more chronic joint problems such as osteoarthritis, so it is all the more imperative that knee OA should be high on the differential and properly evaluated.

In our study, obtaining an MRI of the knee took an average of 29 days. Delays in access to health care amongst veterans has been the subject of national news in recent years. The national database research recently backed these comments, showing that 29% of American veterans delayed seeking care compared to 17.2% of civilian Americans, even after adjusting for regions and personal factors.[29] Recognizing areas of improvement in the system can be the first step to real implemented changes that lead to progress as demonstrated at VAMC in Indiana.[30] There have been others including the "Veteran's Choice program," a process by which the VAMC can offer non-VA health care services for eligible veterans to help facilitate care in situations of geographical constraints or overburdened VA facilities.[31] For a population of patients which is already subject to delays in care, ordering inappropriate MRIs that perpetuate the delay is a problem that requires similar attention and actions. Our findings also support the results found by Bernstein et al, suggesting that nonorthopedic physicians may use knee MRI scans to screen normal or osteoarthritic knees for a diagnosis more often than orthopedic surgeons.[32] Randomized controlled trials in the UK have investigated a similar topic, assessing if MRI referral by the general practitioner or emergency department is cost-effective in younger patients with traumatic knee pain. They similarly found that MRI was adding to health care costs due to physiotherapy sessions and arthroscopies without improving outcomes.[33–35] The authors hoped to provide evidence in this environment of defensive medicine to support health care providers in following appropriate diagnostic practices, in order to stunt cost expenditures. Our study supports these beliefs in a different patient population but with the same goal.

There are several limitations to our study. The information obtained was from a single institution during a 6-month span. At our institution, the orthopedic intake clinic is primarily staffed by nonoperative providers, and may result in unique data patterns. It is worth noting that while nonoperative orthopedic providers ordered more unnecessary MRIs, the proportion of unnecessary MRIs to total MRIs (30%; 25/84) was very similar to that in surgical orthopedists (28%; 8/28). This could be explained by the fact that nonoperative orthopedic providers may see more "non-operative" or "pre-operative" knee pain complaints. The population of this study was from a single institution, which may lead to selection bias. Thus, a multicenter study would provide more information on the generalizability of our findings across VA hospitals. Additionally, there were veterans in our study who elected to participate in the Veteran's Choice program and transfer their care to private providers in the community. It was largely clear from notes provided by primary care physicians, physical therapists, and orthopedic surgeons if the patient eventually underwent surgery after the MRI, but we did not have direct access to non-VA provider notes from the program. The determination of osteoarthritis was based on the KL radiographic scale, which is subjective and therefore a limitation worth mentioning.[36] Furthermore, further studies may be needed to evaluate the effect of social factors such as socioeconomic and insurance status. There is no funding to be disclosed for this study.

This study provides evidence that MRI is being overutilized for the assessment of knee pain and is likely a source of inefficient utilization of resources at our local VAMC. The data reveals that ordering MRI in the setting of advanced osteoarthritis is a topic that needs to be addressed through increased awareness and education. Future directions and guidelines should be developed to assist VAMC physicians with regard to appropriate criteria for ordering diagnostic imaging for the evaluation of knee pain, in an effort to reduce the number of inappropriately ordered MRIs.

Conclusion

A notable number of MRIs were inappropriately ordered at a VAMC and likely increased the costs of care and contributed to delay in definitive patient care. Furthermore, XRs ordered for evaluation of knee pain lacked the gold standard views in this study. There is a strong need to educate the providers, particularly VAMC nonorthopedic physicians, on when it is appropriate to order an MRI for evaluation of knee pain, in order to optimize the use of VAMC resources and deliver care in a time-efficient manner.

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Conflict of Interest

F.H. 3rd has a grant with Arthrex, which is not relevant to this work. The remaining author do not report any conflicts of interests.

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