MRI of the knee cost-efffective use

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CHAPTER 7

Summary

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Chapter 1 provides a general introduction. The main aim of this thesis is to evaluate the costs and effectiveness of magnetic resonance (MR) imaging performed to exclude the need for arthroscopy in patients with nonacute knee symptoms with high clinical suspicion of having intraarticular knee pathology.

In **Chapter 2** we determine the effectiveness of MR imaging in the identification of those patients with a high clinical suspicion of internal derangement of the knee who require arthroscopic therapy. In a prospective multicenter study, MR imaging was performed at 0.5-T in 430 consecutive patients. The sensitivity and specificity of MR imaging in the patients who underwent arthroscopy and the corrected sensitivity and specificity of MR in all the study patients were calculated. For this correction, patients with negative MR and arthroscopic results were considered representative of the patients with negative MR results who were conservatively treated, and the number of the former was doubled. The standard errors of the corrected values were adjusted with the δ method.

At MR imaging, arthroscopy was indicated in 221 patients, 200 of whom underwent arthroscopy. Two hundred nine patients with negative MR imaging results were randomized for arthroscopic (105 patients) or for conservative treatment (104 patients). Of the 105 patients randomized for arthroscopy, 93 actually underwent arthroscopy. Arthroscopic treatment was necessary in 13 of 93 patients with a negative diagnosis at MR imaging. Arthroscopic treatment was necessary in 179 of 200 patients with a positive diagnosis at MR (sensitivity, 93.2%; specificity, 79.2%). Sensitivity and specificity corrected for randomization were 87.3% and 88.4%.

We conclude that 0.5-T MR imaging is an effective tool in the selection of patients for arthroscopy.

In **Chapter 3** the cost-effectiveness of MR imaging in patients with nonacute knee symptoms with a high clinical suspicion of intraarticular knee abnormalities is evaluated prospectively.

All 584 included patients underwent MR imaging. Patients with an MR result positive for the diagnosis of intraarticular knee abnormality had arthroscopy (group A). Patients with a negative MR result were randomly assigned to have either conservative (group B) or arthroscopic (group C) treatment. Treatment was considered effective if the Noyes function score had increased 10% or more at 6 months. A cost analysis was performed from a societal perspective to compare the treatment strategy involving MR imaging with the strategy not involving MR imaging. Of the 584 patients, 294 (50.3%) were assigned to group A; 149 (25.5%), to group B; and 141 (24.1%), to group C. At 6 months, the number of patients effectively treated in group B (conservative

treatment) was a mean of 5.1% ±10.0 larger than the number of patients effectively treated in group C (arthroscopy). Due to savings in productivity costs, total societal costs were lower using the strategy involving MR imaging by a mean of $153 ± 488 (*P* = .54).

This proves MR imaging can be used without additional costs or disadvantageous effects on function to obviate arthroscopy in patients with nonacute knee symptoms who are highly suspected of having intraarticular knee abnormality. This conclusion is fairly robust and new dedicated MR systems, with comparable diagnostic accuracy and lower costs probably will favour MR triage even more.

The objective of **chapter 4** is to determine the fraction of MR imaging studies showing arthroscopically treatable intra-articular pathology in symptomatic patients with a normal standardized physical examination. Of 290 consecutive patients (between 16-45 years) with at least 4 weeks of knee complaints and low clinical suspicion on intra-articular pathology based on physical exam, 274 patients were included. Sixteen patients with prior knee surgery, rheumatic arthritis or severe osteoarthritis were excluded. MRI was used to assign patients to group1 (treatable abnormalities) or group 2 (normal or no treatable findings), depending on whether MR demonstrated treatable pathology. Arthroscopy was performed in group 1 patients. If symptoms persisted for three months in group 2 patients cross over to arthroscopy was allowed.

MR showed treatable pathology in 73 patients (26.6%). Arthroscopy was performed in 64 patients of 73 patients (group 1). In 52 patients (81.3%, 95%-CI 71.4 - 91.1%) arthroscopy was therapeutic. Of the 13 arthroscopies (6.5%) in group 2, 4 were therapeutic (30.8%, 95%-CI 1.7 - 59.8%). The highest fraction of MR studies showing treatable pathology was found in: male gender, aged over 30 years, with a history of effusion (54.5%, 6 of 11 patients).

We believe that the negative predictive value of clinical assessment in patients with sub-acute knee complaints is too low to exclude these patients from MR. MR should at least be considered in male patients aged 30 years and over with a history of effusion. Because of the limited additional value of clinical assessment by an orthopedic surgeon we believe that there is no reason to deny a general practitioner direct access to MR of the knee.

In **chapter 5** the value of radiographs in young adults with non-acute knee symptoms who are scheduled for MR imaging is determined.

Nine hundred and sixty-one consecutive patients aged between 16 and 45 years with knee symptoms of at least 4 weeks' duration were eligible for inclusion. After applying exclusion criteria, 798 patients remained. Exclusion criteria were previous knee surgery (including arthroscopy) or MRI, history of rheumatoid arthritis, clinical diagnosis of retropatellar chondromalacia, contra-indication for MRI and recent trauma. Included patients were divided in two groups: group A with no history of trauma

(n = 332), and group B with an old (> 4 weeks) history of trauma (n = 466). Patients had a standardized history taken, and underwent a physical examination, antero-posterior (AP) and lateral radiographs and MRI. We evaluated the radiographs and MRI for osseous lesions, articular surface lesions, fractures, osteoarthritis, loose bodies, bone marrow edema and incidental findings. Subsequently, patients with osseous abnormalities (Kellgren grade 1 and 2 excluded) on radiographs and a matched control group were evaluated again using MRI without radiographs. In group A, radiographs showed 36 osseous abnormalities in 332 patients (10.8%). Only 13 of these, all Kellgren grade 1 osteoarthritis, were not confirmed on MRI. MRI showed 72 (21.7%) additional abnormalities not confirmed on radiographs. In group B, radiographs showed 40 osseous abnormalities (8.6%) in 466 patients. Only 15 of these, all Kellgren grade 1 osteoarthritis, were not confirmed on MRI. MRI showed 194 (41.6%) additional abnormalities not confirmed on radiographs. The second evaluation of MRI without radiographs in 34 patients was identical to the first MRI evaluation. Common lesions were significantly more often diagnosed with MRI than with radiographs.

We conclude that radiographs should not be obtained routinely when MRI is being performed in young adults with nonacute knee complaints because the yield and added value to MRI are low.

In chapter 6 the relation between bone bruise and (peri-)articular derangement is evaluated and the impact of bone bruise on presentation and short term prognosis is assessed. We recorded MR abnormalities in 664 consecutive patients with nonacute knee complaints. Patients were divided in four groups: patients with and without intra-articular knee pathology, subdivided in patients with and without bone bruise. We assessed function and symptoms at the time of MR and 6 months thereafter. Bone bruises were diagnosed in 124 of 664 patients (18.7%). Patients with bone bruise had significantly more complete ACL, lateral meniscal, MCL and LCL tears. Both with and without intraarticular pathology patients with bone bruise had a significantly poorer function at the time of MR (Noyes score of, respectively, 313.21 versus 344.81 and 306.98 versus 341.19). Patients with bone bruise and intra-articular pathology showed significantly more decrease in activity (decrease of Tegner score from 6.28 to 2.12 versus 5.70 to 2.55). At 6 months there were no significant differences in clinical parameters between the four groups.

We conclude that bone bruise in combination with MCL tear is an important cause of initial clinical impairment in patients with sub-acute knee complaints. Clinical improvement within 6 months is more pronounced than in patients without bone bruise.

General conclusions

MR imaging is an effective tool in excluding or selecting patients with nonacute knee complaints who are highly suspected of having intraarticular knee abnormality for arthroscopy. Using MR as method for triage creates no additional costs and has no negative effects on function. This conclusion is fairly robust and new dedicated MR systems, with comparable diagnostic accuracy and lower costs probably will favour MR triage even more.

The negative predictive value of clinical assessment in patients with nonacute knee complaints is too low to exclude patients with a normal physical examination from MR. That is why there is no reason to deny a general practitioner direct access to MR of the knee.

Bone bruise is an important cause of initial clinical impairment in patients with sub-acute knee complaints. Clinical improvement is more pronounced than in patients without bone bruise.

When MR is performed, radiographs should not be obtained routinely in young adults with nonacute knee complaints because the yield and added value to MRI are low.