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Original Article

Novel Framework for Measuring Whole Knee Osteoarthritis Progression Using Magnetic Resonance Imaging

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Abstract

Objective

We developed and validated a set of composite scores that combine quantitative magnetic resonance imaging (MRI)–based measurements of hyaline cartilage damage, bone marrow lesions (BMLs), and effusion-synovitis into composite scores.

Methods

We selected 300 participants (n = 100 for development cohort; n = 200 for validation cohort) from the Osteoarthritis Initiative with complete clinical, radiographic, and MRI data at baseline and 24 months. We used semiautomated programs to quantify tibiofemoral and patellar cartilage damage, BML volume, and whole-knee effusion-synovitis volume. The candidate composite scores were formed by summing changes from baseline to 24 months based on prespecified methods. We evaluated the candidate composite scores for 1) the ability to differentiate groups with and without knee osteoarthritis progression (17 radiographic and patient-reported definitions), 2) sensitivity to change (standardized response means), and 3) relative performance relating to legacy outcome measures of knee osteoarthritis progression.

Results

Three of 13 developed composite scores qualified for testing in the validation cohort (ranked by sensitivity to change): whole-knee cumulative cartilage damage, unweighted total knee score, and BML plus effusion-synovitis volume. Change in cumulative cartilage damage associated with radiographic progression (Kellgren/Lawrence grade: odds ratio [OR] 1.84; joint space width progression: OR 2.11). Changes in the unweighted total knee score (OR 1.97) and BML plus effusion-synovitis score (OR 1.92) associated with Western Ontario and McMaster Universities Osteoarthritis Index knee pain progression.

Conclusion

Two composite scores emerged, reflecting discrete domains of knee osteoarthritis progression. First, cumulative damage, which is measured by a whole-knee cartilage damage score, reflects the damage accrued over time. Second, dynamic disease activity, which is measured by a BML plus effusion-synovitis score, relates to changes in a patient's state of disease and symptoms.

Supporting Information

Filename	Description
acr24512-sup-0001-TableS1.docx Word 2007 document , 90.2 KB	**Supplementary Table 1** Ability of 13 candidate composite scores to differentiate groups defined by 17 measures of 3 constructs (radiographic progression, quality of life, and pain)

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