Magnetic resonance imaging findings in respect to carpal tunnel syndrome
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CRD summary
This review concluded that the limited quality of, and differences between included studies preclude a reliable assessment of the sensitivity and specificity of magnetic resonance imaging in diagnosing carpal tunnel syndrome. The limited evidence presented supports the authors' conclusions.

Authors' objectives
To assess the capability of magnetic resonance imaging (MRI) in diagnosing carpal tunnel syndrome (CTS).

Searching
The following sources were searched: EMBASE, NIOSHTIC, CISDOC, HSELINE to March 1999, DARE, the Cochrane Controlled Trials Register (Issue 4, 2002), and MEDLINE to December 2001. The search terms were stated. In addition, the reference lists of identified studies were checked.

Study selection
Study designs of evaluations included in the review
Studies with more than 10 patients were eligible for inclusion.

Specific interventions included in the review
Studies of MRI were eligible for inclusion. Most of the included studies used high-field MRI (1.0 T or more).

Reference standard test against which the new test was compared
The inclusion criteria were not specified in terms of the reference test standard. Most of the included studies diagnosed CTS using pathological nerve conduction studies.

Participants included in the review
Studies of patients with CTS that was not due to trauma, rheumatoid arthritis, gout or tumours were eligible for inclusion. The included studies used healthy volunteers, contralateral symptom-free wrists, and wrists with pathology other than CTS as controls. The studies also included some patients who had had surgery or steroid injections.

Outcomes assessed in the review
The review measured the difference in the following MRI findings between controls and patients with CTS: median nerve dimensions; median nerve flattening; median nerve signal intensity; contrast enhancement of the median nerve; bowing of the flexor retinaculum; dimensions of the carpal tunnel; peritendon or synovial pathology; possible anatomic variations and other pathology.

How were decisions on the relevance of primary studies made?
Two reviewers independently selected studies and resolved any disagreements through consensus.

Assessment of study quality
External validity was assessed and scored from 0 to 9 using the following criteria: use of existing consensus criteria (references provided) for the diagnosis of CTS; description of symptoms; description of clinical findings; use of nerve conduction study; grading of disease severity; exclusion criteria for patients described; co-morbid conditions stated; description of hand-loading activities; and description of any possible invasive treatment of the forearm.

Internal validity was assessed and scored from 0 to 3 for blinding of reading of the MRI, inter- or intra-observer agreement for MRI assessment, and comparability between cases and controls (mean age and gender ratio of controls
within 10% range of cases).

The MRI method was scored from 0 to 10 based on the presence of descriptions of the following: field strength; coil type; arm-wrist position; imaging direction; pulse sequence; times to repletion, time to echo and flip angle; the number of acquisitions; slice thickness; gap between slices; and pixel size and field of view or matrix size. The image quality was rated from 0 (poor) to 3 (excellent).

Two reviewers assessed internal and external validity and resolved any disagreements through consensus. Two radiologists independently analysed the imaging methods and MRI findings. The agreement between the radiologists’ ratings was assessed using the kappa statistic.

Data extraction
Two reviewers extracted the data using a structured form and resolved any disagreements through consensus. The specific MRI findings of interest were tabulated. The review authors extracted or estimated the statistical significance of the difference between cases and controls.

Methods of synthesis
How were the studies combined?
The review reported the number of studies in which the specified MRI findings were more common in cases compared with controls. The sensitivities and specificities were calculated for enlargement of the cross-sectional area, median nerve flattening, bowing of the flexor retinaculum and increased T2 signal, using data from studies presenting adequate data (9 studies).

How were differences between studies investigated?
Spearman’s correlation (rs) was used to test the association between the year of publication, magnetic field strength, MRI method scores, number of sequences and mean image quality. The correlation between internal validity and the year of publication was assessed. Results from the two studies with the highest validity scores, and studies scoring 2 or 3 for internal validity, were compared with the results for all studies.

Results of the review
Thirteen studies (509 wrists in 373 patients) were included.

None of the studies completely described the clinical characteristics of the patients, or the methods used to diagnose CTS. One study only included patients with normal nerve conduction study results. The internal validity score was positively correlated with the year of publication (rs=0.57, P=0.04). Most of the studies described the MRI method well (scores ranged from 3 to 10; median 9).

The specific median nerve MRI findings that were significantly more common in cases than in controls were enlargement of the cross-sectional area (4 studies), flattening (3 studies), the combination of enlargement plus flattening (1 study), and increased T2 signal (7 studies). Other findings that were significantly more common in cases compared with controls were bowing of the flexor retinaculum (6 studies), synovial swelling (1 study) and anatomic variants (absent hamulus, median nerve interposition and double-branching of the median nerve; 1 study).

Nine studies had adequate data for calculating sensitivity and specificity.

For enlargement of the cross-sectional area, the sensitivity was 35% and the specificity was 84%.

For median nerve flattening, the sensitivity was 54% and the specificity was 95%.

For bowing of the flexor retinaculum, the sensitivity was 70% and the specificity was 93%.

For increased T2 signal, the sensitivity was 75% and the specificity was 66%.
The results from the two studies with the highest validity scores were similar to the overall results. The results from the five studies with internal validity scores of 2 or 3 were also similar to the overall results. Three studies reporting different results scored 1 or 2 on internal validity, 2 to 5 for external validity, and 7 to 9 for MRI methods.

**Authors’ conclusions**
The authors concluded that the heterogeneity and limited quality of the studies preclude a reliable assessment of the sensitivity and specificity of MRI findings in CTS.

**CRD commentary**
The review question was clear in terms of the intervention and outcomes. The inclusion criteria were broadly defined in terms of the study design and participants. The criteria used to diagnose CTS were part of the external validity assessment, but no diagnostic criteria were required for inclusion in the review. Several relevant sources were searched and the search terms were stated, but it was unclear whether any language limitations were applied. Two reviewers independently selected studies, assessed validity and extracted the data; this reduces the potential for bias and errors. Internal and external validity were assessed and scored using specified criteria.

Some relevant information on the included studies was tabulated, but there was limited information on the methods used to diagnose CTS in the individual studies. The number of studies reporting significant differences between cases and controls for specific MRI findings were stated, but there was no indication of how many (if any) studies reported no difference for these findings. The sensitivities and specificities were calculated, although any differences among the individual studies were not commented upon. In addition, the results for the individual studies were not presented, making it impossible to assess whether differences existed. The authors correctly acknowledged that sensitivities and specificities calculated using data from a small number of heterogeneous studies should be interpreted with caution. The evidence presented appears to support the authors’ conclusions that there was insufficient evidence.

**Implications of the review for practice and research**
Practice: The authors did not state any implications for practice.

Research: The authors stated that MRI studies are required that use validated diagnostic criteria for CTS and describe hand-loading activities during work or leisure.

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Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.