

Central Question

Can magnetic resonance (MR) diffusion tensor imaging (DTI) diagnose compression neuropathy?

Background & Motivation

Carpal tunnel syndrome (CTS), as the most common compression neuropathy,^{1,2} has been the focus of 23 studies using DTI to diagnose CTS.³⁻²³

Electrodiagnostic studies can confirm or prognosticate the CTS clinical diagnosis. Reduced axons may be assessed as compound motor action potential (CMAP) and demyelination as conduction velocity.²⁴

DTI tracks water movements to describe microstructural tissue changes within a region of interest (ROI) specified to be within the nerve and excluding surrounding fat, vessels, and tendons. Fractional anisotropy (FA) is an index from 0 to 1 where 0 indicates isotropic water diffusion. Apparent diffusion coefficient (ADC) is comprised of radial diffusivity (by convention, perpendicular to the ROI/nerve) and axial diffusivity (parallel to the ROI).

Methods

A PRISMA-compliant, PROSPERO-registered systematic review of 5 databases was performed in duplicate to identify all peer-reviewed studies of DTI for CTS enrolling 8 or more individuals. Random effects model meta-analyses provided pooled means of FA and values for patients and controls according to 4 methods:

- 1) Assessments at the level of the hamate
- 2) Assessments at the level of the pisiform
- 3) Assessments at the level of the distal radioulnar joint (DRUJ)
- 4) Average of multiple location assessments

Investigation of high heterogeneity ($I^2 \geq 75\%$) prompted exclusion of studies that did not report use a coil or that reported use of a non-wrist coil.

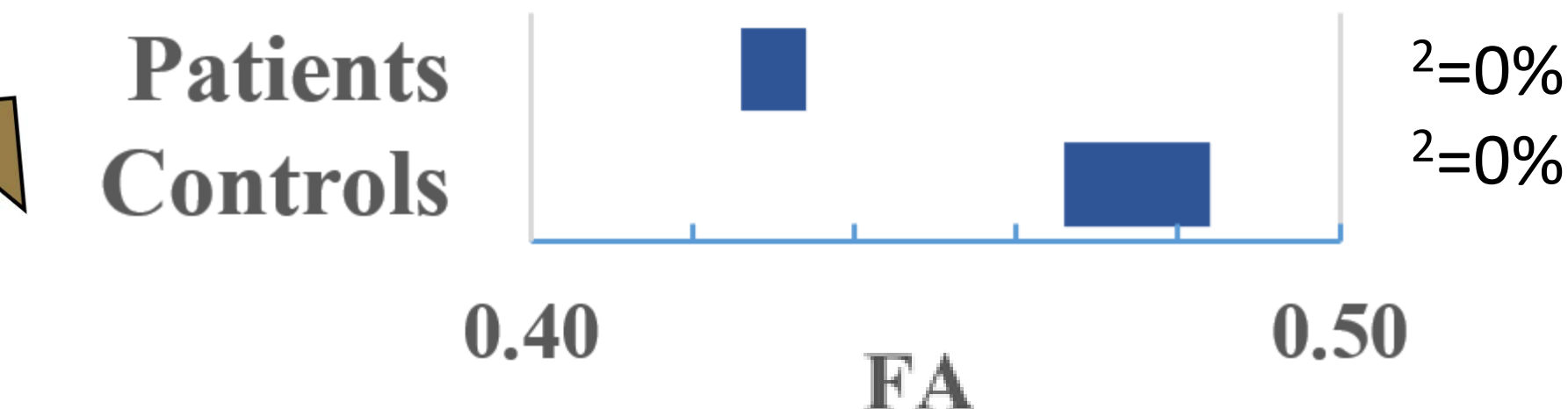
Results

- 21 studies assessed FA (including 537 patients and 409 controls) and 16 were included in the meta-analysis
- Electrodiagnostic studies confirmed the diagnosis of CTS in 18 of the 21 studies.
- 9 studies were in Europe, 9 in Asia, 2 in Africa, and 1 in North America.
- Meta-analyses of the median nerve FA were possible at the level of the hamate (5 studies on patients, 6 studies on controls), at the level of the pisiform (3 studies on patients, 3 studies on controls), at the level of the DRUJ (2 studies on patients, 0 studies on controls), and using multiple levels (13 studies on patients, 9 studies on controls).

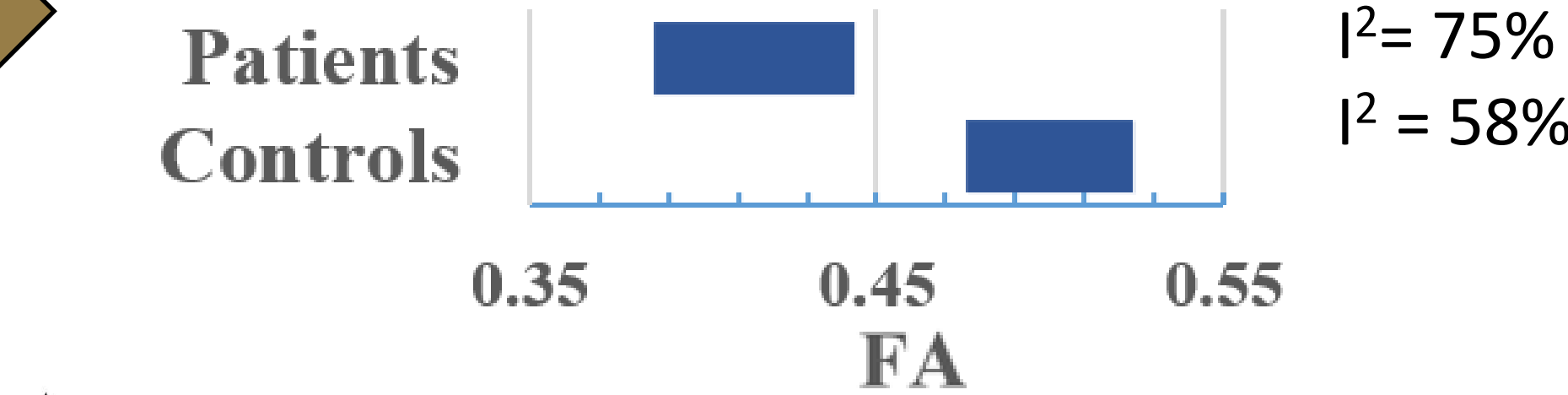


Figure 1. Illustration of carpal levels where DTI assessments of the median nerve were made. X-ray image credit to: Jud C, Braig E, Dierolf M, Eggl E, Günther B, Achterhold K, Gleich B, Rummeny E, Noël P, Pfeiffer F, and Muenzel D from publication by *Scientific Reports*, Springer Nature. Image used according to open-access Creative Commons license without changes to the image <https://creativecommons.org/licenses/by/4.0/>

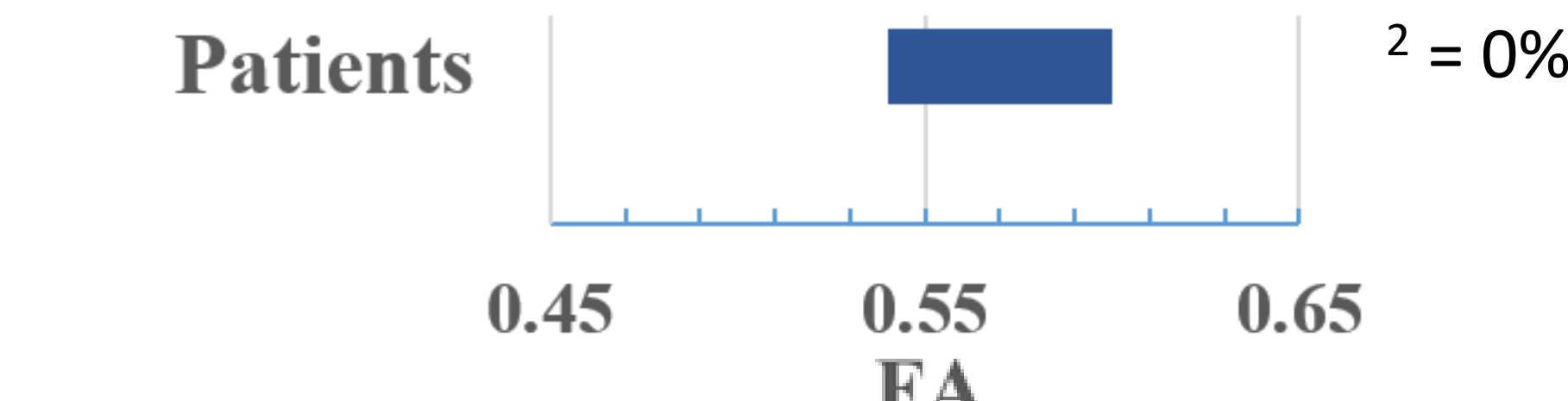
Hamate level FA 95%-CI



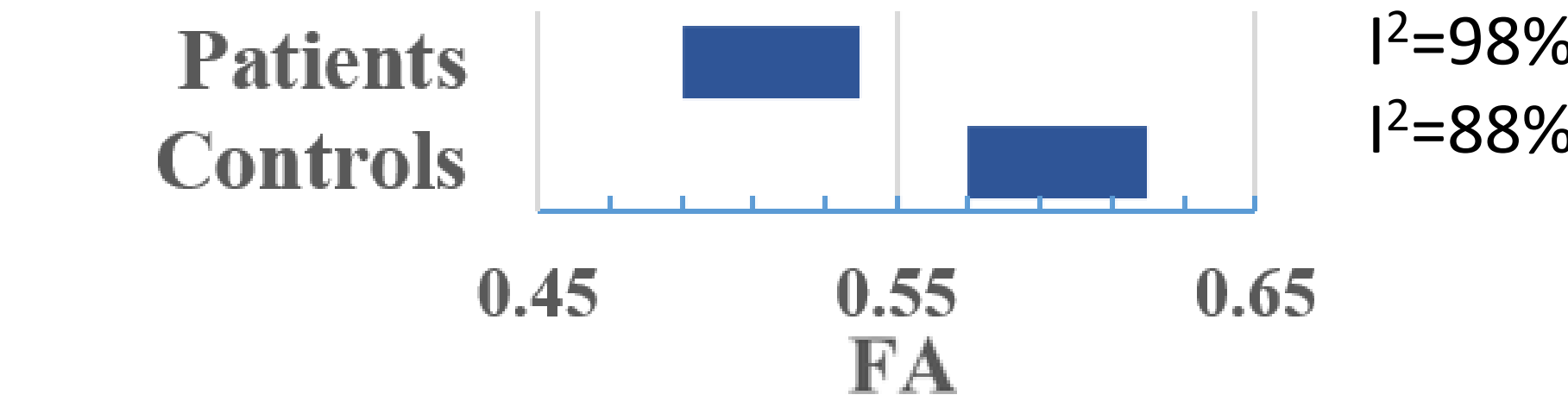
Pisiform level FA 95%-CI



DRUJ level FA 95%-CI



Multi-level FA 95%-CI



Conclusions

- DTI FA values were significantly different between patients and controls in all anatomic regions with data for comparison. However, significant heterogeneity in FA values obtained from combining FA values from multiple regions limits this method of comparing patients to controls
- Median nerve FA assessments at the level of the hamate were the most comparable between studies and were significantly different between patients and controls
- The use of a non-dedicated wrist coil (i.e. cardiac, cranial, or general purpose coils) provides FA data incomparable with studies that used a dedicated wrist coil.
- Several studies reported that FA values change incrementally with increasing grades of CTS pathology (according to electrodiagnostic grading by sensory and motor conduction velocity, SNAP and CMAP). FA was correlated with both conduction velocity and action potential magnitude.

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