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# Investigating whether advanced MR imaging can be used to demonstrate trapped nerves in healthy volunteers

**Submission date**
04/08/2020

**Recruitment status**
No longer recruiting

**Registration date**
15/10/2020

**Overall study status**
Completed

**Last Edited**
19/10/2021

**Condition category**
Musculoskeletal Diseases

[X] Prospectively registered
[X] Protocol
[ ] Statistical analysis plan
[ ] Results
[ ] Individual participant data
[ ] Record updated in last year

## Plain English summary of protocol

Background and study aims
Currently standard MRI scans for trapped nerves in the neck are performed using sequential horizontal and vertical cuts through the spine separated by 2 or 3 mm. However, the nerves travel in a canal that is neither in the horizontal or vertical plane and the nerve itself is 2 to 3 mm in diameter. Consequently, nerve root compression can be rather poorly demonstrated on standard MRI sequences. Furthermore, the currently published scoring systems are not well validated and therefore rarely used in clinical practice. This study will use healthy volunteers to develop the technique – the changes are so common that almost all healthy volunteers without symptoms over the age of 40 will have some degenerative neck disease.

Who can participate?
Healthy volunteers aged over 40

What does the study involve?
The researchers will be using standard MRI techniques in a modified plane to image the nerves in the neck at high resolution as they leave the spine. The scans will be angled so that they cut exactly along and across the nerve canal. The researchers will also develop a scoring system based on the modified plane MRI scans and measure its reliability by comparing the scores of six different observers. They will measure these variables for the established, published scoring techniques that use standard MRI sequences and will compare the modified plane MRI scans with standard MRI scans to establish which is better.

What are the possible benefits and risks of participating?
Once the researchers have found the best way to perform and score these MRI scans, they will be able to build on this by applying the newly developed techniques to patients being considered for surgery. They expect that the new technique will permit better selection of patients for surgery and inform decisions on whether to perform surgery from the front or from the back of the neck. There are no risks to the participants expected through the use of a clinical

MRI machine. All images will be reviewed by a consultant neuroradiologist to exclude unexpected findings. Should an unexpected finding be discovered the participant's GP will be informed and the appropriate clinical referral will be made.

Where is the study run from?
Leeds General Infirmary (UK)

When is the study starting and how long is it expected to run for?
September 2018 to August 2022

Who is funding the study?
1. Leeds Neurosurgical Research Fund (UK)
2. Royal College of Surgeons of England (UK)

Who is the main contact?
Dr James Meacock
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# Contact information

### Type(s)
Scientific

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### Type(s)
Public

### Contact name
Mr Simon Thomson

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# Additional identifiers

### Clinical Trials Information System (CTIS)
Nil known

### Integrated Research Application System (IRAS)
272604

### ClinicalTrials.gov (NCT)
Nil known

### Protocol serial number
IRAS 272604

# Study information

### Scientific Title
Assessing cervical foraminal stenosis: volumetric MRI study in healthy volunteers

### Study objectives
Modified plane imaging has the same internal consistency as scoring performed on standard axial images.

### Ethics approval required
Old ethics approval format

### Ethics approval(s)
Approved 26/06/2020, Leeds Teaching Hospitals NHS Trust (R&I Office, c/o Anne Gowing - Leeds General Infirmary, Great George St, Leeds LS1 3EX, UK; +44 (0)113 243 2799; anne.gowing@nhs.net, ltht.researchoffice@nhs.net)

### Study design
Non-randomised single institution feasibility/pilot study

### Primary study design
Observational

### Study type(s)
Diagnostic

### Health condition(s) or problem(s) studied
Evaluation of cervical foraminal stenosis in healthy volunteers

### Interventions

Three-dimensional volumetric data of the cervical spine will be obtained from an MRI scan. The anatomy of the cervical nerve root canal will be analysed to measure areas of nerve root compression using two-dimensional projections in the plane of the nerve root and with automated mathematical modelling measurements.

Kim System:
Grade 0
Grade 1
Grade 2
Will get number and percentage of each grade (Per cervical level for the right and level sides)

Grade 0, normal – absence of neural foraminal stenosis with narrowest width of neural foramen more than extraforaminal nerve root
Grade 1, non-severe cervical neural foraminal stenosis, including narrowest width of neural foramen same or less than (but more than 50% of) extraforaminal nerve root width.
Grade 2, severe cervical neural foraminal stenosis, including narrowest width of neural foramen same or less than 50% of extraforaminal nerve root width

Inter-rater reliability
Agreement percentage

Kappa value interpretations were poor ($\kappa < 0.1$), slight ($0.1 \leq \kappa \leq 0.2$), fair ($0.2 < \kappa \leq 0.4$), moderate ($0.4 < \kappa \leq 0.6$), substantial ($0.6 < \kappa \leq 0.8$), and nearly perfect ($0.8 < \kappa \leq 1.0$)

Intraclass correlation coefficient (ICC) less than 0.40 indicate poor reproducibility, values of 0.40–0.75 indicate fair to good reproducibility, and values greater than 0.75 indicate excellent reproducibility

Intra-rater reliability
Agreement percentage

Kappa value interpretations were poor ($\kappa < 0.1$), slight ($0.1 \leq \kappa \leq 0.2$), fair ($0.2 < \kappa \leq 0.4$), moderate ($0.4 < \kappa \leq 0.6$), substantial ($0.6 < \kappa \leq 0.8$), and nearly perfect ($0.8 < \kappa \leq 1.0$)

Intraclass correlation coefficient (ICC) less than 0.40 indicate poor reproducibility, values of 0.40–0.75 indicate fair to good reproducibility, and values greater than 0.75 indicate excellent reproducibility

The inter and intra rater reliability will be applied to all of the grading systems used.

Modified Kim System:
Grade 0
Grade 1
Grade 2
Will get number and percentage of each grade (Per cervical level for the right and level sides)

Grade 0 signifies that the narrowest portion of the cervical neural foramen is >80% of the width of the extraforaminal nerve root (FR ratio >80%).
Grade 1 indicates that the narrowest portion of the cervical neural foramen is <80% but >50% of the width of the extraforaminal nerve root (50%<FR ratio less than or equal to 80%)
Grade 2 for the mKim system is the same as that for the Kim system

Park System:
Grade 0
Grade 1
Grade 2
Grade 3
Will get number and percentage of each grade (Per cervical level for the right and level sides)

Grade 0, oblique sagittal plane of the cervical neural foramen shows no significant stenosis and no perineural fat obliteration
Grade 1, mild (below 50% of nerve root circumference) perineural fat obliteration. No morphological change of the nerve root is seen
Grade 2, moderate (above 50% of nerve root circumference) perineural fat obliteration. No morphological change of the nerve root is seen.
Grade 3, collapsed nerve root and morphological change of the nerve root. Severe perineural fat obliteration is also combined

Anterior v posterior compression (all views):
a) Measurement of anterior compression from bony margin (Green)
b) Measurement of posterior compression from bony margin (Green)
c) Type of compression is it disc, osteophyte, both or unknown. Based on T2 signal

Laterality of compression (all views):

a) Measurement of the point of maximum compression. This is a measurement from the apex of the ligamentum flavum to the maximum compression (Red)

b) Is the point of maximal compression:
i. Medial to the root canal
ii. Proximal 50% of the nerve root canal
iii. Distal 50% of the nerve root canal

Length of compression (all views):
Length of neuroforamina diameter that is less than uncompressed nerve root diameter (Yellow) or 2.6mm if nerve diameter is unrecordable.

Inter and intra rater reliability as above for Kim

Subjective score (all views):
a) Mild
b) Moderate
c) Severe

## Intervention Type
Device

## Phase
Not Applicable

## Primary outcome(s)
The inter-rater reliability for the Kim grading system on measuring the narrowest diameter of the nerve root canal. This will be applied to the standard axial images and modified plain images. Success will be determined if there is a significant improvement in the inter-observer reliability.

The MRI scan will be graded once to gain the initial reading (which will then be used for inter-rater correlation) and then the same rater will grade the same scan again to determine intra-rater correlation.

### Key secondary outcome(s))
1. The inter-rater reliability for subjective score, Kim grade, Modified Kim Grade, Park Grade, length and laterality of compression
2. The intra-rater reliability for narrowest diameter, subjective score, Kim grade, Modified Kim Grade, Park Grade, length and laterality of compression
The MRI scan will be graded once to gain the initial reading (which will then be used for inter-rater correlation) and then the same rater will grade the same scan again to determine intra-rater correlation.

### Completion date
31/08/2022

## Eligibility

### Key inclusion criteria
1. Age over 40 years
2. Able to provide fully informed written consent
3. Able to lie flat for 1 hour in an MRI scanner
4. Females of childbearing age must be using effective contraception
5. Sufficient understanding of English to participate in the trial

### Participant type(s)
Healthy volunteer

### Healthy volunteers allowed
No

### Age group
Adult

### Sex
All

### Total final enrolment
5

### Key exclusion criteria
1. Cervical myelopathy
2. History of cervical trauma
3. Evidence of suspected or histologically proven tumour
4. Previous cervical spine surgery
5. Non-MRI compatible implantable device e.g. pacemaker
6. Unable to have MRI scan due to claustrophobia
7. Female participants must not be pregnant and if of childbearing age must be using adequate contraception

**Date of first enrolment**
01/03/2021

**Date of final enrolment**
31/08/2021

# Locations

**Countries of recruitment**
United Kingdom

England

**Study participating centre**
**Leeds Teaching Hospitals NHS Trust**
Great George Street
Leeds
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LS1 3EX

# Sponsor information

**Organisation**
Leeds Teaching Hospitals NHS Trust

**ROR**
https://ror.org/00v4dac24

# Funder(s)

**Funder type**
Research organisation

**Funder Name**
Leeds Neurosurgical Research Fund

**Funder Name**
Royal College of Surgeons of England

**Alternative Name(s)**

RCS England, RCS ENG, The Royal College of Surgeons of England, RCS

### Funding Body Type
Private sector organisation

### Funding Body Subtype
Universities (academic only)

### Location
United Kingdom

## Results and Publications

### Individual participant data (IPD) sharing plan
The datasets generated during and/or analysed during the current study are/will be available upon request from Mr Simon Thomson (simon.thomson1@nhs.net) on study publication for 7 years, for researchers wishing to confirm the findings or undertake metanalysis, by secure data transfer, consent from participants was obtained, data will be anonymised.

### IPD sharing plan summary
Available on request

### Study outputs

| Output type | Details | Date created | Date added | Peer reviewed? | Patient-facing? |
|---|---|---|---|---|---|
| Participant information sheet | Participant information sheet version V7 | 11/11/2025 | 11/11/2025 | No | Yes |
| Protocol file | | 15/10/2020 | 15/10/2020 | No | No |