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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

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Additional identifiers

EudraCT/CTIS number
Nil known

IRAS number
272604

ClinicalTrials.gov number
Nil known

Secondary identifying numbers
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

Secondary study design
Case series

Study setting(s)
Hospital

Study type(s)
Diagnostic

Participant information sheet
Not available in web format, please use contact details to request a participant information sheet

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 measure
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.

Secondary outcome measures
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.

Overall study start date
01/09/2018

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

Age group
Adult

Sex
Both

Target number of participants
5

Total final enrolment

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
England

United Kingdom

Study participating centre
Leeds Teaching Hospitals NHS Trust
Great George Street
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Sponsor information

Organisation
Leeds Teaching Hospitals NHS Trust

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Sponsor type
Hospital/treatment centre

Website
http://www.leedsth.nhs.uk/home/

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

Funding Body Type
Private sector organisation

Funding Body Subtype
Associations and societies (private and public)

Location
United Kingdom

Results and Publications

Publication and dissemination plan
The study will be registered with an authorised registry, according to the International Committee of Medical Journal Editors (ICMJE) guidelines, prior to the start of recruitment.
The success of the study depends upon the collaboration of all participants. For this reason, credit for the main results will be given to all those who have collaborated in the study, through authorship and contribution. Uniform requirements for authorship for manuscripts submitted to medical journals will guide authorship decisions. These state that authorship credit should be based only on substantial contribution to:
1. Conception and design, or acquisition of data, or analysis and interpretation of data,

2. Drafting the article or revising it critically for important intellectual content,
3. And final approval of the version to be published,
4. And that all these conditions must be met (http://www.icmje.org)
In light of this, the Chief Investigator and other investigators will be named as authors in any publication. Publication is planned in a high-impact peer-reviewed journal.
To maintain the scientific integrity of the study, data will not be released prior to the first publication of the analysis of the primary endpoint, either for study publication or oral presentation purposes.

Intention to publish date
31/08/2022

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?
Protocol file	version V7	15/10/2020	15/10/2020	No	No