**Can digital rectal examination be used to detect cauda equina compression in people presenting with acute cauda equina syndrome?**

**A systematic review and meta-analysis of diagnostic test accuracy studies.**

Corresponding author: Julia Tabrah, Consultant Musculoskeletal Physiotherapist, Hounslow and Richmond Community Healthcare NHS Trust. Therapies Centre (O-Block), West Middlesex Hospital, Twickenham Road, Isleworth, TW7 6AF, UK. [julia.tabrah1@nhs.net](mailto:julia.tabrah1@nhs.net)

Dr. Nicky Wilson, Consultant Physiotherapist, Kings College Hospital NHS Foundation Trust, UK. [nicky.wilson1@nhs.net](mailto:nicky.wilson1@nhs.net)

Dr. Dean Phillips, Principal Teaching Fellow in Musculoskeletal Physiotherapy, School of Health Sciences, University of Southampton, UK. [d.r.phillips@soton.ac.uk](mailto:d.r.phillips@soton.ac.uk)

Professor Dankmar Böhning, Professor of Medical Statistics, School of Mathematical Sciences and Southampton Statistical Sciences Research Institute, University of Southampton, UK. [d.a.bohning@soton.ac.uk](mailto:d.a.bohning@soton.ac.uk)

ABSTRACT

Background: Digital rectal examination (DRE) is a commonly used test to help identify people with cauda equina compression (CEC).

Objective: To determine the diagnostic accuracy of DRE in assessment of anal tone, squeeze, sensation and reflexes, as predictors of CEC.

Design: A systematic review to investigate the diagnostic accuracy of DRE to detect CEC compared with lumbar Magnetic Resonance Imaging (MRI).

Method: Six electronic databases were searched from inception to 6 July 2020 for studies published in English. Two assessors independently performed screening, data extraction and risk of bias assessment (QUADAS-2). Meta-analysis was performed using STATA-16.

Results: Six studies were included (n=741). The sensitivity of anal tone was low across all studies (range: 0.23 to 0.53) with moderate quality evidence against the use of DRE of anal tone. One study on anal sensation found no correlation with CEC using Kendall’s tau test: p = 0.102 and another found sensation had low test accuracy. One study identified sensitivity: 0.29 and specificity: 0.96 for anal squeeze, while another identified sensitivity: 0.38 and specificity: 0.6 for anal reflexes.

Conclusion: The diagnostic accuracy of DRE of anal tone to detect CEC is low and carries a high risk of false reassurance. It is therefore not recommended in any clinical setting. More research is needed to determine the diagnostic accuracy of DRE of anal squeeze, sensation and reflexes and if done the results should be interpreted with caution.

Keywords; diagnostic accuracy; digital rectal examination; cauda equina compression; cauda equina syndrome; anal tone; anal squeeze.

INTRODUCTION

Cauda equina compression (CEC) is a surgical emergency and early diagnosis is critical. It involves compression of the lumbosacral nerve roots in the lumbar vertebral canal and is most commonly caused by a prolapsed intervertebral disc (Bydon et al. 2016). It is a rare but serious condition: only 0.27% of people with non-traumatic low back pain presenting to secondary care are diagnosed with CEC (Hoeritzauer et al. 2020).

Diagnostic and surgical delay can result in devastating consequences. The greater the duration of CEC, the higher the risk of permanent neurological damage (Todd 2005). Irreversible loss of bladder/bowel control, sexual dysfunction and permanent leg weakness can result (Fraser et al. 2009). The debilitating nature of these symptoms leads to high rates of litigation (Todd 2011), with up to 10% of cases resulting in legal review (Lavy et al. 2009). The projected value of all cauda equina syndrome (CES) related claims in England in 2017/18 was £68m (Hutton, 2019).

Diagnosing CEC is challenging because characteristic signs, symptoms and routinely used clinical tests do not reliably predict the condition (Dionne et al. 2019). Early symptoms are often subtle and vague (Greenhalgh et al. 2018) and progression of symptoms is unpredictable (Sun et al. 2014). People with CES often present to primary care services where clinicians typically work in time pressured environments without access to specialist spinal support. The National Backpain Pathway - Clinical Network (2020) have created a CES assessment and referral framework to support clinicians in primary care, but there remains a need to ensure that locally agreed pathways are integrated across settings.

Digital rectal examination (DRE) (the insertion of a gloved finger into the anal canal) is used to assess people presenting with CES. It can be used to assess anal tone (passive/resting tone), anal squeeze (muscle contraction), internal anal sensation (feeling inside the anal canal) and anal reflexes (sphincter contraction in response to pressure on the glans penis or clitoris). Abnormalities in response to any of these tests are thought to increase the likelihood of CEC (Todd and Dickson 2016). However, some primary studies suggest the sensitivity of DRE in relation to CEC assessment is low (Domen et al. 2009, Gooding et al. 2013).

Research question

Can digital rectal examination be used to detect cauda equina compression in people presenting with acute cauda equina syndrome?

Research objectives

The aims of this study were to systematically review, critically appraise and synthesise the current evidence to determine the diagnostic accuracy of digital rectal examination to detect cauda equina compression in people presenting with acute cauda equina syndrome and, if appropriate, make recommendations for practice.

MATERIALS AND METHODS

Search strategy

The review protocol was registered with PROSPERO a priori (registration id: CRD42020186965). Six electronic databases were searched from inception to 6 July 2020: CINAHL and Medline (EBSCO interface), AMED, Embase and Emcare (OVID interface) and Scopus (Elsevier interface). No search limits were applied. The search strategy combined terms related to cauda equina syndrome (CES) and low back pain, with digital rectal examination (DRE), anal tone, anal squeeze, perianal sensation and anal reflexes and were based on other similar reviews e.g. Dionne et al. 2019. The full search strategy is available in Appendix A.

Search alerts were created on all databases up to and including 31 October 2020. A grey literature search was performed on the 9 July 2020 (see Appendix B). The reference lists of all selected studies were hand searched to identify additional studies.

Eligibility criteria

*Inclusion criteria*: Primary diagnostic accuracy studies of human adults (16 years or older) presenting to secondary care (hospital emergency departments) or tertiary care (highly specialised regional centres) with acute CES, in which DRE was the index test and lumbar MRI was the reference standard. Lumbar MRI is known to have optimal sensitivity and specificity in the diagnosis of CEC (Saint-Louis 2001) and is integral to best practice guidelines (British Association of Spine Surgeons and Society of British Neurological Surgeons 2018). We only included studies where MRI was interpreted by a Radiologist in line with the Royal College of Radiologists standards for interpretation and reporting of imaging investigations (2018). Studies in any country assessing patients with CES of any cause were included.

*Exclusion criteria*: Non-English language studies, unpublished literature, conference abstracts, narrative reviews and case studies of less than five subjects. Studies which assessed the diagnostic accuracy of *external* saddle sensation testing (i.e. using light touch or pin prick testing) were excluded, as we were only concerned with *internal* anal sensation testing (i.e. the feeling inside the anal canal) using DRE.

Study selection

Two reviewers (JT and NW) independently screened study titles and abstracts against the inclusion criteria. Disagreements were resolved by consensus. Full texts of potentially eligible studies were obtained and reasons for exclusion were recorded. Additional information was sought from study authors in cases where eligibility was uncertain.

Data extraction, risk of bias and quality assessment.

Data were extracted and assessed for risk of bias by two reviewers (JT and NW) independently. A standardised data extraction tool was employed. Results were reported as 2 x 2 data (true positive, true negative, false positive and false negative) or as sensitivity and specificity values.

Risk of bias was assessed using the QUADAS-2 tool, which has been validated for use in diagnostic accuracy reviews with strong agreement between reviewers (Whiting et al. 2006). The tool was piloted and tailored to the review question as per the QUADAS guidelines (Whiting et al. 2011). Inconsistency in data extraction or risk of bias assessment were resolved by discussion and consensus.

Note was taken if DRE was performed/interpreted before MRI (or at least without knowledge of MRI results). Studies that did not interpret DRE before MRI were deemed ‘high risk’ of index test bias. Tertiary care studies that did not exclude pre-scanned patients were deemed ‘high risk’ of patient selection bias. Studies not including all participants in their final analysis were rated as ‘high risk’ of flow and timing bias.

When information about exclusion, timing and patient flow were not explicitly stated, these domains were rated ‘unclear risk’ of bias. To avoid double-downgrading, we did not rate studies as ‘high risk’ of index test bias *and* ‘high risk’ of reference bias for the same issue. Studies were categorised as high-quality (i.e. low risk of bias) when at least three of the four QUADAS-2 criteria were met and low-quality (i.e. high risk of bias) when two or fewer criteria were met (Whiting et al. 2011)

Data synthesis strategy

Meta-analysis was performed to statistically pool study results using STATA-16 software. Sensitivity, specificity, positive and negative likelihood ratios, diagnostic odds ratio and Youden Index were calculated. Presence of heterogeneity was tested with the chi-squared test (χ²) for heterogeneity (Q-test) and the amount of heterogeneity was assessed with Higgins’ I² statistic (which ranges from 0 to 1 with larger values indicating more heterogeneity). A Summary Receiver Operating Characteristic (SROC) analysis was also performed as this is less prone to the threshold effect.

A GRADE analysis was carried out by two reviewers (JT and NW) using anal tone, squeeze, sensation and reflexes as the clinical outcomes (Granholm et al. 2019) (see Appendix C for the GRADE Summary of Findings table).

RESULTS

The database search identified 460 records. Another five studies were found from other sources and no additional publications were identified from the grey literature. After removal of duplicates, handsearching of bibliographies and screening of titles and abstracts, 24 full text articles were retrieved. From these, 6 studies were included in the final analysis (see Fig 1 for PRIMSA diagram/Table 1 for study characteristics).

Additional records identified through other sources  
(n = 5)

Records identified through database searching  
(n = 460)

## Identification

Records after duplicates removed  
(n = 258)

Records screened

(n = 258)

Records excluded

(n = 234)

## Screening

Full-text articles excluded with reasons (n = 18)

* Incorrect index test (not DRE) (6)
* Incorrect population (not CES) (2)
* Incorrect reference standard (not MRI) (1)
* Case studies < 5 subjects (1)
* MRI not interpreted by a Radiologist (1)
* Conference abstracts and unpublished literature (7)

Full-text articles assessed for eligibility  
(n = 24)

## Eligibility

Studies which met inclusion criteria

(n = 6)

## Inclusion

Studies included in meta-analysis  
(n = 5)

Studies included in descriptive analysis  
(n = 4)

Figure 1: PRISMA flow diagram

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Study** | **Setting** | **Study design** | **Method of patient selection** | **Demographics** | **Index test** | **Reference standard** | **Number (%) of patients with CEC** |
| Ahad et al. 2015 | Secondary care radiology department, Scotland. | Retrospective observational cohort study | Consecutive recruitment | 24 males, 55 females.  Mean age 52.5 (18 – 89). | DRE for anal tone and reduced internal sensation | Lumbar MRI performed in 62/79 | 5/62 (8.1) |
| Angus et al. 2020 | Tertiary care clinical neurosciences centre, Salford. | Retrospective observational cohort study | Consecutive recruitment | Males : females ratio unknown.  Mean age 43 (19 – 79). | DRE for anal tone | Lumbar MRI performed in 313/313 | 34/313 (10.9) |
| Balasubramanian et al. 2010 | Tertiary care spinal cord injury centre, Middlesbrough. | Retrospective observational cohort study | Consecutive recruitment | Males : females ratio and mean age unknown.  Age range 21 -90. | DRE for anal tone | Lumbar MRI performed in 80/80 | 15/80 (18.8) |
| Domen et al. 2009 | Secondary care neurology centre, Maastricht, Netherlands. | Retrospective observational cohort study | Consecutive recruitment | No data. | DRE for anal tone and anal reflexes | Lumbar MRI performed in 58/58 | 8/58 (13.8) |
| Gooding et al. 2013 | Secondary care spinal unit, Derby. | Retrospective observational cohort study | Consecutive recruitment | Male : female ratio of 1:2.  Mean age of 45 (17 – 84). | DRE for anal tone and internal sensation | Lumbar MRI performed in 57/57 | 13/57 (22.8) |
| Venkatesan et al. 2019 | Tertiary spinal service, Nottingham. | Prospective observational cohort study | Consecutive recruitment | 40 males, 52 females.  Mean age 44.9 (14 – 89). | DRE for anal tone and squeeze | Lumbar MRI performed in 92/92 | 17/92 (18.5) |

Table 1: Summary of study characteristics

A summary of the QUADAS-2 analysis is presented in Table 2.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Study** | **RISK OF BIAS** | | | | **APPLICABILITY CONCERNS** | | |
| **PATIENT SELECTION** | **INDEX TEST** | **REFERENCE STANDARD** | **FLOW AND TIMING** | **PATIENT SELECTION** | **INDEX TEST** | **REFERENCE STANDARD** |
| Ahad et al. 2015 | ? | ? | 😊 | ☹ | 😊 | 😊 | 😊 |
| Angus et al. 2020 | ? | ? | ? | ? | 😊 | 😊 | 😊 |
| Balasubramanian et al. 2010 | ? | ? | 😊 | ? | 😊 | ? | 😊 |
| Domen et al.2009 | 😊 | ? | 😊 | 😊 | ? | 😊 | 😊 |
| Gooding et al. 2013 | 😊 | ? | 😊 | ☹ | 😊 | 😊 | 😊 |
| Venkatesan et al. 2019 | 😊 | 😊 | 😊 | 😊 | 😊 | 😊 | 😊 |

😊 Low Risk ☹High Risk ? Unclear Risk

Table 2: Summary of QUADAS-2 ratings

Anal tone

Five studies provided data on anal tone that could be combined in meta-analysis (n = 600). Two studies were conducted in secondary care (Domen et al. 2009, Gooding et al. 2013) and three in tertiary care (Balasubramanian et al. 2010, Venkatesan et al. 2019, Angus et al. 2020).

Some studies recorded anal tone as ‘normal’ or ‘reduced’ and others recorded it as ‘normal’, ‘reduced’ or ‘absent’. To standardise the data, reduced or absent tone were combined into ‘abnormal’ tone. The 2 x 2 data, sensitivity and specificity are presented in Table 3. Meta-analysis generated the forest plots presented below (Figure 2).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Study** | **TP (CEC)** | **FN (CEC)** | **TN (non-CEC)** | **FP (non-CEC)** | **Sensitivity** | **Specificity** |
| Angus et al. 2020 | 9 | 25 | 202 | 77 | 0.26 | 0.72 |
| Balasubramanian et al. 2010\* | 3 | 10 | 58 | 4 | 0.23 | 0.94 |
| Domen et al. 2009 | 2 | 6 | 39 | 11 | 0.25 | 0.78 |
| Gooding et al. 2013\*\* | 4 | 6 | 28 | 9 | 0.40 | 0.76 |
| Venkatesan et al. 2019 | 9 | 8 | 47 | 28 | 0.53 | 0.63 |

Table 3: Anal tone data

TP = true positive (number of people with CEC and positive DRE), FN = false negative (number of people with CEC and normal DRE), TN = true negative (number of people without CEC and normal DRE), FP = false positive (number of people without CEC and positive DRE), Sensitivity = TP/(TP+FN), Specificity = TN/(TN+FP).

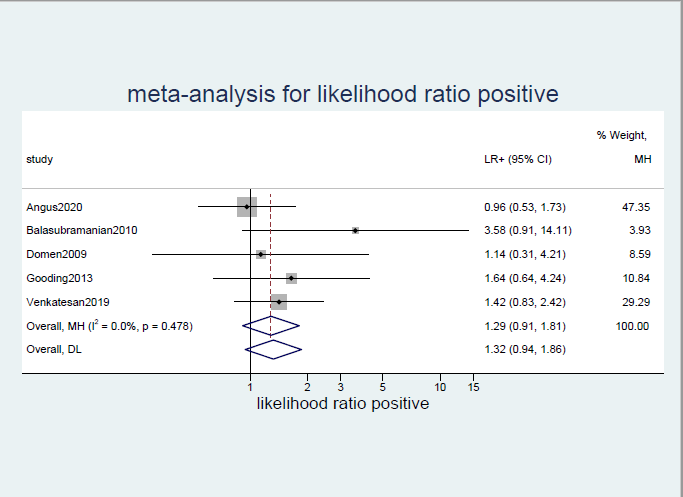
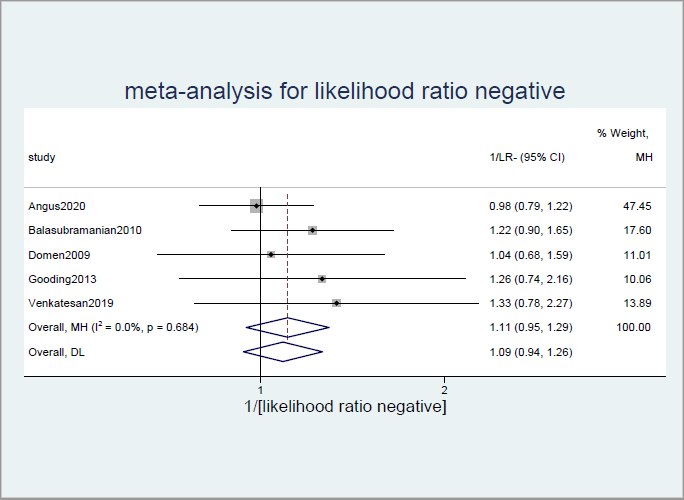
\*: 5 subjects not tested therefore n = 75 \*\*: 10 subjects not tested therefore n = 47

Chart, box and whisker chart

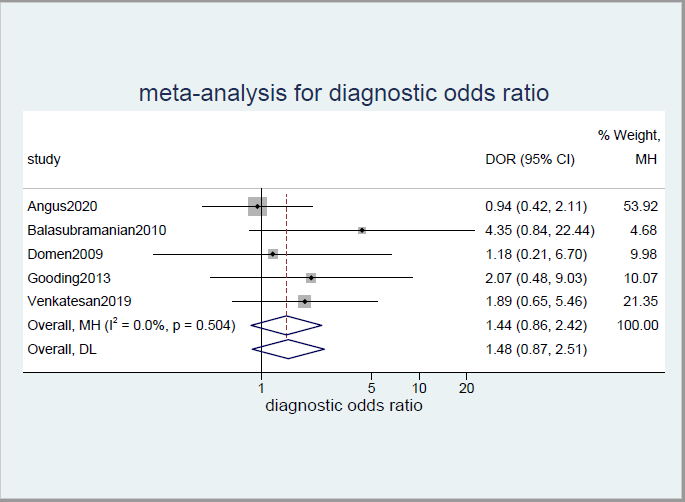
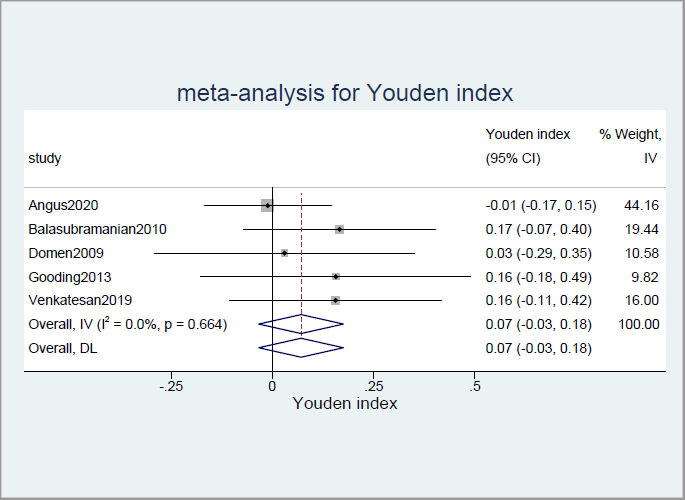
Description automatically generated Chart, box and whisker chart

Description automatically generated

2(a) forest plot for sensitivity 2 (b) forest plot for specificity

2 (c) positive likelihood ratio 2 (d) negative likelihood ratio

2 (e) diagnostic odds ratio 2 (f) Youden index

Figure 2: Forest plots illustrating meta-analysis results

% Weight = weight for each study based on precision; Overall, IV = Inverse variance overall estimate effect; Overall, MH = Mantel-Haenszel overall estimate effect; Overall, DL = DerSimonian-Laird overall estimate effect



Figure 3: Summary Receiver Operating Characteristic (SROC) diagram.

The sensitivity of digital rectal examination (DRE) of anal tone was low across all secondary and tertiary care studies (Fig 2(a)), with consistently high false negative results (Table 3). This low sensitivity indicates that the test, when negative, cannot be relied upon to rule out cauda equina compression.

Specificity of anal tone was generally higher as seen in the specificity forest plot (fig 2(b)) and ranged from 0.63 to 0.94. This finding suggests the test is better at ruling ‘in’ the condition, i.e. people with reduced anal tone on DRE are likely to have cauda equina compression.

However, the concepts of sensitivity and specificity alone are not sufficient to inform diagnostic accuracy and there is also a need to consider prevalence and positive/negative likelihood ratios (Baeyens et al. (2019)).

Coming to the likelihood ratios, the Mantel-Haenszel estimate found a low pooled positive likelihood ratio of 1.29 (95% CI: 0.91 to 1.81), (I² = 0.0%, p = 0.478) (Figure 2c) and a high negative likelihood ratio of 1.11 (95% CI: 0.95 to 1.29), (I² = 0.0%, p = 0.684) (Figure 2d). Both of these confirm the test’s low diagnostic accuracy and the high p-values confirm evidence of no heterogeneity.

Diagnostic odds ratio and Youden index were calculated as summary measures of sensitivity and specificity per study. The diagnostic odds ratio was low at 1.44 (95% CI: 0.86 to 2.42), I² = 0.0%, p = 0.504 (Figure 2e) suggesting that the test has low diagnostic accuracy. Youden index was also low at 0.07 (95% CI: -0.03 to 0.18), I² = 0.0%, p = 0.664 (Figure 2f) demonstrating that the test is not able to accurately discriminate between CEC and non-CEC populations.

A Summary Receiver Operator Characteristic (SROC) analysis was carried out by plotting the five studies with sensitivity on the vertical axis and 1-specificity on the horizontal axis (see Figure 3). The red square is a summary estimate based on the Hierarchical Summary Receiver Operating Characteristic (HSROC) model (Rutter and Gatsonis 2001) given with an associated 95% confidence region.  Studies expressing high diagnostic accuracy would cluster in the upper left corner of the SROC diagram, but our studies are concentrated more in the lower left corner, indicating good specificity and low sensitivity.

GRADE analysis found moderate quality evidence against the use of DRE of anal tone due to a mixture of risk of bias and imprecision. Risk of bias was mostly due to uncertainty in the conduct or interpretation of the index test and patient selection (information about excluded patients was insufficient) (see Appendix C for further information).

Anal sensation, squeeze and reflexes

Data for anal squeeze, sensation and reflexes were limited and heterogenous. A descriptive analysis is presented as the data were not suitable for meta-analysis.

*Anal sensation*

Two retrospective studies in secondary care investigated the diagnostic accuracy of DRE of anal sensation in detecting CEC (n = 136). Ahad et al. (2015) calculated Kendall’s tau test and found no correlation between saddle anaesthesia (tested with DRE) and CEC: 0.102 or non-CEC: 0.055. Gooding et al. (2013) found that anal sensation had a sensitivity: 0.4 (95% CI: 0.1 to 0.7) and specificity: 0.51 (95% CI: 0.35 to 0.68). GRADE analysis found moderate quality evidence against the use of DRE of anal sensation due to a risk of bias and imprecision (Appendix C).

*Anal squeeze*

One prospective study conducted in tertiary care with 92 participants assessed the diagnostic accuracy of anal squeeze for predicting CEC (Venkatesan et al. 2019). Sensitivity was very low at 0.29 and specificity was 0.96. This low sensitivity indicates that anal squeeze, when negative, cannot be relied upon to rule out cauda equina compression. GRADE analysis demonstrated high quality evidence against the use of DRE of anal squeeze with only minor concerns around imprecision (see Appendix C).

*Anal reflexes*

One retrospective secondary care study (n= 58) assessed the diagnostic accuracy of anal reflexes for identifying CEC (Domen et al. 2009), with low sensitivity: 0.38 and moderate specificity: 0.6 (95% CI: 0.2 to 4.2), suggesting low diagnostic accuracy. The lead author of the study explained that DRE is the most common method used to assess anal reflexes in the Netherlands but was unable to confirm that DRE was used consistently in this study (W Weber, personal communication, 27th October 2020). GRADE analysis found low quality evidence against the use of DRE of anal reflexes due to a combination of risk of bias, applicability and imprecision (Appendix C)

DISCUSSION

The findings of this systematic review and meta-analysis demonstrate that sensitivity of digital rectal examination (DRE) of anal tone is low and it therefore cannot reliably rule out cauda equina compression (CEC) in people presenting with acute cauda equina syndrome (CES). There is limited evidence suggesting low diagnostic accuracy of DRE of anal squeeze, sensation and reflexes, but more research is needed.

DRE of anal tone had low sensitivity across all studies with moderate quality evidence against its use. This finding concurs with a review by Dionne et al. (2019), which found that anal tone testing was associated with a high risk of false negative results. When screening for serious and treatable disease, tests with high sensitivity are essential to avoid false reassurance with potentially devastating consequences (Lalkhen and McCluskey 2008). The moderate quality evidence against use, agreement with existing literature and potential harm of false reassurance, all indicate that DRE of anal tone should not be used in clinical practice.

The specificity of anal tone in this review was higher but varied significantly between studies. Balasubramanian et al. (2010) demonstrated very high specificity with potential for over-estimation, as the authors did not clearly exclude pre-scanned patients or confirm that DRE was performed before MRI. Venkatesan et al. (2019) found a lower specificity which is more likely to be accurate, as it was a prospective study that excluded pre-scanned patients, performed DRE before MRI and included all patients in the analysis.

However, the relatively high specificity offers little reassurance. Reduced anal tone is well recognised as a ‘late-stage’ symptom of CEC (Todd 2013) and clinicians must not wait for the onset of irreversible sphincter disturbance (Sun et al. 2014) because the surgical prognosis is poorer than when CEC is identified earlier (Todd 2005).

The low positive likelihood ratio, high negative likelihood ratio, low diagnostic odds ratio and low Youden Index, all reinforce the low diagnostic accuracy of DRE of anal tone to detect CEC. This may in part be due to the inherently subjective nature of assessing anal tone and the difficulty of quantifying ‘normal’ or ‘abnormal’ tone. Studies that compare DRE of anal tone with anal manometry (Eckardt and Kanzler 1993) or endo-anal ultrasound (Roos et al. 2012) have shown DRE to have low intra-rater reliability. *Inter*-rater reliability is also known to be poor (Tudose et al. 2017).

Two studies provided evidence that DRE of anal sensation to detect CEC has low diagnostic accuracy (Gooding et al. 2013, Ahad et al. 2015) with moderate quality evidence against its use. Both studies were conducted in secondary care and their results may not be generalisable to tertiary care.

One study (Venkatesan et al. 2019) provided high quality evidence against the use of DRE of anal squeeze. Conversely, a study of 142 patients conducted in a tertiary medical centre (Zusman et al. 2020) found that DRE of ‘voluntary rectal tone’ (i.e. anal squeeze), had 80% sensitivity and 86% specificity for diagnosing CEC. We were unable to include this study in our review as the MRI scans were not interpreted by a Radiologist. In addition, patients were only included in this study if they complained of bladder and/or bowel dysfunction ‘such as retention or incontinence’. These are known to be late-stage symptoms (Todd 2017) and so the findings cannot be used to assist early detection of CEC.

One study provided low quality and limited evidence against the use of DRE of anal reflexes (Domen et al. 2009), with a risk of patient selection bias as the authors excluded patients with cancer and the findings are therefore not generalisable to the whole CEC population.

DRE is known to cause moderate to high levels of discomfort or pain to most patients (Romero et al. 2008) with anecdotal evidence about the risk of infection and rectal wall injury (Quinn et al. 2018). DRE can also trigger vasovagal syncope which carries its own significant risks (Tizes and Tizes 1981). Clinicians need to consider if the test is ethically justifiable in light of these potential risks, in addition to its low diagnostic accuracy.

Limitations

Five of the six studies included in this review were retrospective, with a ‘high’ or ‘unclear’ risk of bias, but GRADE analysis found the overall quality of evidence was largely moderate. Five studies were conducted in the UK, so findings may not be generalisable to other countries. Most studies were small in scale due to the rarity of the condition, but statistical pooling helps to improve confidence in our review findings.

Studies not published in English and in which MRI scans were not interpreted by a Radiologist were excluded, so we may have missed some relevant research. We included a study with at least one child (Venkatesan et al. 2019) and we were unable to clarify how many children were included due to a lack of author response.

Despite these limitations, our systematic review of the literature was robust, with screening, data extraction and quality assessment undertaken in duplicate. We are confident that a good representation of the relevant research was included.

Recommendations for clinical practice and future research

***DRE of anal tone is not recommended in any clinical setting***

This review provides moderate quality evidence against the use of DRE of anal tone. It cannot rule out CEC in secondary or tertiary care and is no more accurate when performed by experienced clinicians (Balasubramanian et al. 2010, Sherlock et al. 2015). None of the studies identified by this review were conducted in primary care, but the expert consensus is that DRE is not a necessary part of primary care cauda equina screening (Finucane et al. 2020). The authors of this review suggest that clinicians focus on the subjective history and use thorough questioning to gain a clear understanding of the nature, duration, frequency and progression of any changes to bowel function.

***DRE of anal tone may give false reassurance leading to diagnostic and surgical delay***.

The consistently low sensitivity of this test suggests a high risk of false reassurance that increases the risk of missing a case of CEC, with subsequent diagnostic and surgical delay. Ironically, anecdotal evidence suggests that some clinicians perform DRE to avoid charges of incomplete assessment and potential litigation. However, delayed diagnosis was the most common cause of litigation in England in 2017/18 (Hutton 2019).

***Adopt a low threshold for emergency imaging***

Prompt diagnosis and surgical decompression are imperative to prevent significant morbidity (Kohles et al. 2004). We recommend that clinicians adopt a low threshold for emergency referral and imaging as per the guidance from British Association of Spine Surgeons and Society of British Neurological Surgeons (2018) when patient’s report recent onset or recent progression of CES symptoms.

***More research is needed on DRE of anal squeeze, sensation and reflexes***

GRADE analysis found high-quality evidence against the use of DRE of anal squeeze, moderate-quality evidence against the use of DRE of anal sensation and low-quality evidence against the use of DRE of anal reflexes. However, the authors believe that it is not possible to make meaningful recommendations based on such limited research and more high-quality prospective studies are needed. Meantime, if clinicians do use these tests, the results should be interpreted with caution.

**HIGHLIGHTS**

* DRE of anal tone for cauda equina screening has low sensitivity with a high risk of false reassurance
* DRE of anal tone is not recommended in any clinical setting
* More research is needed on the diagnostic accuracy of DRE of anal squeeze, sensation and reflexes
* If DRE of anal squeeze, sensation and reflexes is done, results should be interpreted with caution

CONCLUSION

There is moderate quality evidence that anal tone testing with digital rectal examination (DRE) has low diagnostic accuracy for detecting cauda equina compression (CEC) in people presenting with acute cauda equina syndrome (CES). It carries a high risk of false reassurance with potential for diagnostic and surgical delay and is not recommended in any clinical setting.

There is limited evidence against the use of DRE of anal squeeze, sensation and reflexes but more research is needed to clarify their diagnostic accuracy. If these tests are used, results should be interpreted with caution.

Clinicians should adopt a low threshold for emergency referral and imaging when patients present with recent onset or recent progression of CES symptoms.

Funding

This review received no specific grant from any funding agency in the public, commercial or not for profit sectors. The authors have no competing interests to declare.

REFERENCES

Ahad A, Elsayed M and Tohid H (2015) The accuracy of clinical symptoms in detecting cauda equina syndrome in patients undergoing acute MRI of the spine. *Journal of Neuroradiology* 28:438–442.

DOI: <https://doi.org/10.1177/1971400915598074>

Angus M, Berg A, Carrasco R, Horner D, Leach J and Siddique I (2020) The Cauda Scale – Validation for Clinical Practice. *British Journal of Neurosurgery* 34(4):453-456.

DOI: [10.1080/02688697.2020.1754337](https://doi.org/10.1080/02688697.2020.1754337)

Baeyens JP, Serrien B, Goossens M and Clijsen R (2019) Questioning the “SPIN and SNOUT” rule in clinical testing. *Archives of Physiotherapy* 9, 4.

DOI: <https://doi.org/10.1186/s40945-019-0056-5>

Balasubramanian K, Kalsi P, Greenough CG and Kuskoor-Seetharam MP (2010) Reliability of clinical assessment in diagnosing cauda equina syndrome. *British Journal of Neurosurgery* 24:383–386.

DOI: <https://dx.doi.org/10.3109/02688697.2010.505987>

British Association of Spine Surgeons and Society of British Neurological Surgeons (2018). Standards of Care for Investigation and Management of Cauda Equina Syndrome.

Available from: <http://www.spinesurgeons.ac.uk/news/standards-of-care-for-investigation-and-management-of-cauda-equina-syndrome-ces/> [Accessed 04 February 2021].

Bydon M, Lin JA, Dela Garza-Ramos R, Macki M, Kosztowski T and Sciubba DM (2016) Time to surgery and outcomes in cauda equina syndrome: an analysis of 45 cases. *World Neurosurgery* 87:110–115.

DOI: [https://dx.doi.org/10.1016/j.wneu.2015. 12.054](https://dx.doi.org/10.1016/j.wneu.2015.%2012.054).

Dionne N, Adefolarina A, Kunzelmana D, Trehana N, Finucane L, Levesquea L, Waltona DM and Sadia J (2019) What is the diagnostic accuracy of red flags related to cauda equina syndrome (CES), when compared to Magnetic Resonance Imaging (MRI)? A systematic review. *Musculoskeletal Science and Practice* 42:125-133.

DOI: 10.1016/j.msksp.2019.05.004

Domen PM, Hofman PA, van Santbrink H and Weber WEJ (2009) Predictive value of clinical characteristics in patients with suspected cauda equina syndrome. *European Journal of Neurology* 16:416–419.

DOI: <https://doi.org/10.1111/j.1468-1331.2008.02510.x>.

Eckardt VF and Kanzler G (1993) How reliable is digital examination for the evaluation of anal sphincter tone? *Internal Journal of Colorectal Disease* 8(2):95-7.

DOI: 10.1007/BF00299335

Finucane L, Downie A, Mercer C, Greenhalgh S, Boissonnault WG, Pool-Goudzwaard AL, Beneciuk JM, Leech RL and Selfe J (2020) International Framework for Red Flags for Potential Serious Spinal Pathologies. *Journal of Orthopaedic & Sports Physical Therapy* 50:(7)350-374.

DOI: <https://doi.org/10.1016/j.msksp.2020.102179>

Fraser S, Roberts L and Murphy E (2009) Cauda equina syndrome: a literature review of its definition and clinical presentation. *Archives of Physical Medicine and Rehabilitation* 90:1964–8.

DOI: <https://doi.org/10.1016/j.apmr.2009.03.021>

Gooding BWT, Higgins MA and Calthorpe DAD (2013) Does rectal examination have any value in the clinical diagnosis of cauda equina syndrome? *British Journal of Neurosurgery* 27:156–159.

DOI: <https://doi.org/10.3109/02688697.2012.732715>

Granholm A, Alhazzani W and Moller MH (2019) Use of the GRADE approach in systematic reviews and guidelines. *British Journal of Anaesthesia* 123 (5): 559-564.

DOI: 10.1016/j.bja.2019.08.004

Greenhalgh S, Finucane L, Mercer C and Selfe J (2018) Masterclass: Assessment and Management of Cauda Equina Syndrome. *Musculoskeletal Science and Practice* 37; 69-74.

DOI: <https://pubmed.ncbi.nlm.nih.gov/29935940/>

Hoeritzauer I, Wood M, Copley PC, Demetriades AK and Woodfield J (2020) What is the incidence of cauda equina syndrome? A systematic review. *Journal of Neurosurgery: Spine* 14:1-10.

DOI: 10.3171/2019.12.SPINE19839

Hutton (2019*) Spinal Services: GIRFT Programme National Speciality Report* London, England

Available from: <https://gettingitrightfirsttime.co.uk/wp-content/uploads/2019/01/Spinal-Services-Report-Mar19-L1.pdf> [Accessed 21 June 2021]

Kohles SS, Kohles DA, Karp AP, Erlich VM and Polissar NL (2004) Time-dependent surgical outcomes following cauda equina syndrome diagnosis: comments on a meta-analysis. *Spine* (Phila Pa 1976) 29(11):1281-7.

DOI: 10.1097/00007632-200406010-00019

Lalkhen AG and McCluskey A (2008) Clinical tests: sensitivity and specificity. Continuing Education in Anaesthesia Critical Care & Pain: 8(6):221–223.

DOI: <https://doi.org/10.1093/bjaceaccp/mkn041>

Lavy C, James A, Wilson-Macdonald J and Fairbank J (2009) Cauda equina syndrome. *British Medical Journal* 338:881-4.

DOI: <https://doi.org/10.1136/bmj.b936>

National Backpain Pathway – Clinical Network (2020) Early recognition of cauda equina syndrome: A framework for assessment and referral for primary care/MSK interface services. *United Kingdom Spine Societies Board website*

Available from: <https://www.ukssb.com/nbpcn-ces-framework> [Accessed 10 March 2021].

Quinn JM, Zeleny T, Rajaratnam V and Benkco V (2018) Debate: the per rectal/digital rectal examination in the emergency department, still best practice? [*International Journal of Emergency Medicine*](https://www.researchgate.net/journal/International-Journal-of-Emergency-Medicine-1865-1380?_sg=EzWwwGggZFUQpKP_2TegQ_bGIOxWTYws--refkhx8p4955kOCH6uChacErL7Z6SGkHROeNBCg6gkqQiGydBeSLUygmCSWnE.y7rvS_B8d6M32XKgxMl8Q2Rq_yCpMZaz2fj21VhfAUUayDdBsIxUH2Ym37_424S9VD7OkT4fIJ2GLt-VYr5T7A) 11(1):20.

DOI: [10.1186/s12245-018-0165-z](https://intjem.biomedcentral.com/articles/10.1186/s12245-018-0165-z)

[Romero](https://pubmed.ncbi.nlm.nih.gov/?term=Romero+FR&cauthor_id=18972927) FR, [Romero](https://pubmed.ncbi.nlm.nih.gov/?term=Romero+AW&cauthor_id=18972927) AW, [Filho](https://pubmed.ncbi.nlm.nih.gov/?term=Brenny+Filho+T&cauthor_id=18972927) TB, [Bark](https://pubmed.ncbi.nlm.nih.gov/?term=Bark+NM&cauthor_id=18972927) NM, [Yamazaki](https://pubmed.ncbi.nlm.nih.gov/?term=Yamazaki+DS&cauthor_id=18972927) DS and [De Oliveira](https://pubmed.ncbi.nlm.nih.gov/?term=de+Oliveira+FC&cauthor_id=18972927) FCJ (2008) Patient’s perceptions of pain and discomfort during digital rectal exam for prostate cancer screening. *Archivos Espanoles de Urologia* 61(7):850-4.

DOI: 10.4321/s0004-06142008000700018

Roos AM, Abdool Z, Thakar R and Sultan AH (2012) Predicting anal sphincter defects: the value of clinical examination and manometry. *Internal* *Urogynaecology Journal* 23:755-63.

DOI: <https://doi.org/10.1007/s00192-011-1609-7>

Rutter CM and Gatsonis CA (2001) A hierarchical regression approach to meta-analysis of diagnostic test accuracy evaluations. *Statistics In Medicine* 15(19):2865-84.

DOI: <https://pubmed.ncbi.nlm.nih.gov/11568945/>

Saint-Louis LA (2001) Lumbar spinal stenosis assessment with computed tomography, magnetic resonance imaging and myelography. *Clinical Orthopaedics and Related Research* 384: 122 – 136.

DOI: <https://europepmc.org/article/MED/11249157>

Sherlock KE, Turner W, Elsayed S, Bagouri M, Baha L, Boszczyk B and McNally D (2015) The evaluation of digital rectal examination for assessment of anal tone in suspected cauda equina syndrome. *Spine* 40:1213-8.

DOI: 10.1097/BRS.0000000000000902

Sun J-C, Xu T, Chen K-F, Mmed WQ, Liu K, Shi J-G, Yuan W and Jia L-S (2014) Assessment of Cauda Equina Syndrome Progression Pattern to Improve Diagnosis. *Spine* 39(7):596-602.

DOI: 10.1097/BRS.0000000000000079

The Royal College of Radiologists (2018) Standards for interpretation and reporting of imaging investigations.

Available from: <https://www.rcr.ac.uk/publication/standards-interpretation-and-reporting-imaging-investigations-second-edition> [Accessed 08 October 2021]

Tizes R and Tizes SM (1981) Vasovagal (vasodepressor) syncope following rectal examination. *New York State Journal of Medicine* 81(9):1309-1310.

Todd NV (2005) Cauda equina syndrome: The timing of surgery probably does influence outcome. *British Journal of Neurosurgery* 19(4):301-306.

DOI: [10.1080/02688690500305324](https://doi.org/10.1080/02688690500305324)

Todd NV (2011) Causes and outcomes of cauda equina syndrome in medico-legal practice: a single neurosurgical experience of 40 consecutive cases. *British Journal of Neurosurgery* 25(4):503-508.

DOI: [10.3109/02688697.2010.550344](https://doi.org/10.3109/02688697.2010.550344)

Todd NV (2013) Cauda equina syndrome: Findings on perineal examination. *British Journal of Neurosurgery* 27 (6): 852.

<https://pubmed.ncbi.nlm.nih.gov/24168659/>

Todd NV (2017) Guidelines for cauda equina syndrome: Red flags and white flags. Systematic review and implications for triage. *British Journal of Neurosurgery* 31:336–9.

Todd NV and Dickson RA (2016) Standards of care in cauda equina syndrome. *British Journal of Neurosurgery* 30:518–522.

<https://doi.org/10.1080/02688697.2016.1187254>

Tudose A, Hogg F, Giamouriadis A, Low D, Bassi S and Selway, R (2017) The neurosurgical rectal examination (PR) - obsolete practice or standard of care? *British Journal of Neurosurgery* 31 (2): 119–158.

Venkatesan M, Nasto L, Tsegaye M and Grevitt M (2019) Bladder Scans and Postvoid Residual Volume Measurement Improve Diagnostic Accuracy of Cauda Equina Syndrome. *Spine* 44(18):1303-1308.

DOI: 10.1097/BRS.0000000000003152

Whiting PF, Weswood ME, Rutjes AW, Reitsma JB, Bossuyt PN and Kleijnen J (2006) Evaluation of QUADAS, a tool for the quality assessment of diagnostic accuracy studies. *BMC Medical Research Methodology* 6:6-9.

DOI: 10.1186/1471-2288-6-9

Whiting P, Rutjes AWS, Westwood ME, Mallett S, Deeks JJ, Reitsma JB, Leeflang MMG, Sterne JAC and Bossuyt PMM (2011) QUADAS-2: a revised tool for the quality assessment of diagnostic accuracy studies. *Annals of Internal Medicine* 155:529-36.

Zusman NL, Radoslovich SS, Smith SBS, Tanski M, Gundle KR and Yoo JU (2020) Physical Examination Is Predictive of Cauda Equina Syndrome: MRI to Rule Out Diagnosis Is Unnecessary. *Global Spine Journal.* DOI:[10.1177/2192568220948804](https://doi.org/10.1177/2192568220948804)

APPENDIX

Appendix A: Search strategy

Database: Embase <1974 to 2020 Week 22>

Search Strategy:

--------------------------------------------------------------------------------

1 "cauda equina".ab. or "cauda equina".ti. (5440)

2 "cauda equina syndrome".ab. or "cauda equina syndrome".ti. (1886)

3 "cauda syndrome".ab. or "cauda syndrome".ti. (54)

4 "syndrome, cauda".ab. or "syndrome, cauda".ti. (5)

5 "cauda equina compression syndrome".ab. or "cauda equina compression syndrome".ti. (24)

6 CES.ab. or CES.ti. (10551)

7 CESC.ab. or CESC.ti. (103)

8 CESI.ab. or CESI.ti. (137)

9 CESR.ab. or CESR.ti. (64)

10 CESS.ab. or CESS.ti. (477)

11 "suspected cauda equina syndrome".ab. or "suspected cauda equina syndrome".ti. (35)

12 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 (16411)

13 "low back pain".ab. or "low back pain".ti. (35496)

14 "lumbar disc herniation".ab. or "lumbar disc herniation".ti. (3849)

15 12 or 13 or 14 (54560)

16 "per rectum exam\*".ab. or "per rectum exam\*".ti. (28)

17 "per rectum assess\*".ab. or "per rectum assess\*".ti. (0)

18 "rectal exam\*".ab. or "rectal exam\*".ti. (8736)

19 "rectal assess\*".ab. or "rectal assess\*".ti. (6)

20 "rectal tone".ab. or "rectal tone".ti. (217)

21 "digital rectal".ab. or "digital rectal".ti. (6835)

22 "digital rectal examination".ab. or "digital rectal examination".ti. (5774)

23 "PR exam\*".ab. or "PR exam\*".ti. (32)

24 "PR assess\*".ab. or "PR assess\*".ti. (120)

25 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 (9282)

26 "anal tone".ab. or "anal tone".ti. (179)

27 "anal squeeze".ab. or "anal squeeze".ti. (170)

28 "anal sphincter tone".ab. or "anal sphincter tone".ti. (175)

29 26 or 27 or 28 (516)

30 "perianal test\*".ab. or "perianal test\*".ti. (0)

31 "perineal test\*".ab. or "perineal test\*".ti. (24)

32 "perianal sensation test\*".ab. or "perianal sensation test\*".ti. (0)

33 "perineal sensation test\*".ab. or "perineal sensation test\*".ti. (0)

34 "perianal assess\*".ab. or "perianal assess\*".ti. (0)

35 "perineal assess\*".ab. or "perineal assess\*".ti. (26)

36 30 or 31 or 32 or 33 or 34 or 35 (50)

37 "perianal an?esthesia".ab. or "perianal an?esthesia".ti. (15)

38 "perineal an?esthesia".ab. or "perineal an?esthesia".ti. (29)

39 "perianal para?sthesia".ab. or "perianal para?sthesia".ti. (4)

40 "perineal para?sthesia".ab. or "perineal para?sthesia".ti. (0)

41 "perianal hypo?sthesia".ab. or "perianal hypo?sthesia".ti. (8)

42 "perineal hypo?sthesia".ab. or "perineal hypo?sthesia".ti. (12)

43 37 or 38 or 39 or 40 or 41 or 42 (68)

44 "anal sphincter reflex".ab. or "anal sphincter reflex".ti. (11)

45 "rectal reflex".ab. or "rectal reflex".ti. (20)

46 "bulbocavernosus reflex".ab. or "bulbocavernosus reflex".ti. (294)

47 "bulbospongiosus reflex".ab. or "bulbospongiosus reflex".ti. (2)

48 "Osinski reflex".ab. or "Osinski reflex".ti. (0)

49 "penile reflex".ab. or "penile reflex".ti. (33)

50 44 or 45 or 46 or 47 or 48 or 49 (358)

51 25 or 29 or 36 or 43 or 50 (10200)

52 15 and 51 (154)

53 cauda equina syndrome/ (2505)

54 15 or 53 (55316)

55 51 and 54 (156)

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Appendix B: Grey literature search results

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Platform** | **Search terms** | **Results** | **Results which meet inclusion criteria and aren’t already identified** | **Links to relevant results** |
| **Government departments** | | | | |  |
| Gov.uk | “cauda equina”  “cauda equina syndrome”  “digital rectal examination” | 1  0  0 | 0  0  0 |  |
| Clinicaltrials.gov  <https://clinicaltrials.gov/> | “cauda equina”  “cauda equina syndrome”  “digital rectal examination” | 0 | 0 |  |
| **Research organisations** | | | | |  |
| NICE | “cauda equina”  “cauda equina syndrome”  “digital rectal examination” | 14  9  8 | 0  0  0 |  |
| The International Standard Randomised Controlled Trials Number (**ISRCTN**) registry  <http://www.isrctn.com/> | “cauda equina syndrome”  “digital rectal examination” | 0 | 0 |  |
| UK Clinical Trials Gateway (NIHR portfolio database) <https://www.ukctg.nihr.ac.uk/> | “cauda equina syndrome” | 0 | 0 |  |
| Cochrane  <http://www.cochranelibrary.com/> | “cauda equina”  “cauda equina syndrome”  “digital rectal examination” | 0 | 0 |  |
| NIHR  <https://www.journalslibrary.nihr.ac.uk/search/> [EME, HS&DR, HTA, PGfAR, PDG, PHR] | “cauda equina”  “cauda equina syndrome”  “digital rectal examination” | 0 | 0 |  |
| James Lind alliance <http://www.jla.nihr.ac.uk/about-the-james-lind-alliance/> | “cauda equina syndrome” | 4 | 0 |  |
| **Independent charitable organisations** | | | | |  |
| The Kings Fund | “cauda equina”  “cauda equina syndrome”  “digital rectal examination” | 0  0  0 |  |  |
| **Professional bodies** | | | | |  |
| The Chartered Society of Physiotherapy | “cauda equina”  “cauda equina syndrome”  “digital rectal examination” | 57  40  2 | 0  0  0 |  |
| **Grey literature portals** | | | | |  |
| OpenGrey | “cauda equina”  “cauda equina syndrome”  “digital rectal examination” | 6  2  2 | 0  0  0 |  |
| North Grey Literature Collection | “cauda equina”  “cauda equina syndrome”  “digital rectal examination” | 0  0  0 |  |  |
| GreyGuide | “cauda equina”  “cauda equina syndrome”  “digital rectal examination” | 0  0  0 |  |  |
| **E-theses online services** | | | | |  |
| EThOS (British Library) | “cauda equina”  “cauda equina syndrome”  “digital rectal examination” | 7  2  7 | 0  0  0 |  |
|  |  |  |  |  |
| **Other** | | | | |  |
| Google scholar | “cauda equina”  “cauda equina syndrome”  “digital rectal examination” | 271 | 0 |  |

Appendix C: GRADE analysis: Summary of findings table

Table

Description automatically generated