A systematic review of the reliability of rehabilitative ultrasound imaging for the quantitative assessment of the abdominal and lumbar trunk muscles

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CRD summary
This review found that most results of high-quality studies indicated that rehabilitative ultrasound imaging had good levels of rater reliability, but the quality of research needed to be improved. These conclusions are likely to be reliable, but should be interpreted with some caution due to the possibility of publication bias and small size and methodological limitations of the included studies.

Authors' objectives
To determine the rater reliability of rehabilitative ultrasound imaging measurements to assess the morphology of the abdominal and lumbar trunk musculature.

Searching
MEDLINE, EMBASE, PEDro, AMED, CINAHL, The Cochrane Library, SPORTDiscus, MANTIS, CIRRIE and ProQuest Digital Dissertations were searched to December 2006 or January 2007. Search terms were reported. Reference lists of included studies and relevant reviews were screened. The review was restricted to published peer-reviewed studies and theses in English or French.

Study selection
Studies that evaluated imaging of the abdominal or lumbar trunk muscles and reported on the psychometric properties of quantitative measures of trunk muscles using rehabilitative ultrasound imaging by comparing the measurements with repeated measurements, external measurements or longitudinal measurements were eligible for inclusion. Studies were excluded if measurement properties were for a combination of tests and not from rehabilitative ultrasound imaging alone.

Included studies assessed rehabilitative imaging in brightness or motion mode in resting or contracted state. Included patients had low back pain (acute or chronic), adolescent idiopathic scoliosis or were asymptomatic. Muscles targeted ranged across studies.

Two reviewers independently selected studies for inclusion. Disagreements were resolved by consensus with a third reviewer.

Assessment of study quality
Two reviewers independently assessed study quality according to the criteria: inclusion of representative patient spectrum; representative sample of examiners; possibility of replication of the assessment procedure; stable patient characteristics under study; sufficiently large estimate of intra-examiner reliability; examiners blinded to clinical information; examiners blinded to each others' results or prior results; non-random loss to follow-up ruled out; appropriate measures used for calculating reliability; and appropriate measures used for calculating precision. Studies were judged to be of high quality if they fulfilled at least 50% of the quality criteria. Disagreements were resolved through consensus or referral to a third reviewer.

Data extraction
Two reviewers independently extracted data on rehabilitative ultrasound imaging measurements as means and standard deviations (SD), together with estimates of reliability and precision. Disagreements were resolved through consensus or referral to a third reviewer.

Methods of synthesis
A narrative synthesis was presented.
Results of the review
Twenty-four studies (n=479) were included in the review. Only six studies were judged to be of high quality. Studies generally scored poorly on inclusion of a representative sample of patients, reporting a sufficiently large estimate of intra-examiner reliability and use of appropriate measures for calculating reliability and precision. It was generally unclear whether a representative sample of examiners was used.

Studies that reported intra-rater reliability using intra-class correlation (ICC) coefficients reported values ranged from 0.48 to 1.0 (number of studies unclear). Two studies reported ICC coefficients for inter-rater reliability on different images of 0.91 and 1.0. All ICC estimates of intra-rater and inter-rater reliability for the repeated measurement of the same rehabilitative ultrasound images were greater than 0.90.

When analysis was restricted to the four high-quality studies that assessed intra-rater reliability, ICC coefficients ranged from 0.62 to 0.97. One high-quality study assessed inter-rater reliability and reported good reliability and ICC estimates that ranged from 0.91 to 1.00.

Authors' conclusions
The methodologic quality of research investigating the reliability of rehabilitative ultrasound imaging to measure the abdominal and lumbar trunk muscles needed to be improved. Most results of high-quality studies indicated that rehabilitative ultrasound imaging had good levels of rater reliability. Improved reliability was observed among studies that examined muscle thickness and when using mean measurement values obtained by more experienced examiners.

CRD commentary
The review assessed a defined question. Inclusion criteria were clearly specified. An extensive literature search was used. The restriction to published, peer-reviewed studies and theses in English and French risked language and publication biases. Appropriate steps were taken to minimise bias and errors in the review process. Study quality was formally assessed with relevant criteria and the results were clearly reported and considered in the review. Some relevant study details were summarised using tables. A narrative synthesis was appropriate given the differences between studies.

The authors' conclusions were supported by the results of the review, but should be interpreted with some caution due to the possibility of publication bias and the small sizes and methodological limitations of the included studies.

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

Research: The authors stated that future research that examined the reliability of rehabilitative ultrasound imaging for the quantitative assessment of the abdominal and lumbar trunk musculature should take steps to ensure the internal and external validity of the results. Calculation of minimal detectable change statistics should be a priority of future studies. Future studies should emphasise the utility of estimates of measurement errors.

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