A meta-analytic review of surface electromyography among persons with low back pain and normal, healthy controls


CRD summary
This review found that some surface electromyography measures had the potential to distinguish between people with and without low back pain. These findings should be interpreted with extreme caution given the limitations in the search and analysis, and the failure to assess study quality and report review methods.

Authors' objectives
To evaluate the differences in surface electromyography (SEMG) between people with and without low back pain (LBP).

Searching
MEDLINE was searched; some search terms, but not search dates, were reported. The reference lists of identified studies were screened for additional studies.

Study selection
Study designs of evaluations included in the review
Inclusion criteria were not defined in terms of the study design. Diagnostic case-control studies were included.

Specific interventions included in the review
Studies that evaluated SEMG were eligible for inclusion. The positions or activities measured included: standing, flexion/extension, rotation, isometric muscle activity, bending, rising, unsupported sitting, supported sitting, prone, isometric contraction at 60% of the maximum voluntary contraction level, maximal isometric exertion at different angles of flexion, change from baseline at cervical or lumbar level, median frequency during contractions, median frequency at various positions, integrated lumbar SEMG, reflex latency and duration at different positions, standing in postural restraint device, performing lifts with and without trunk rotation, axial rotation while standing, muscle recovery time in response to quick release, integrated SEMG fatigue curves, ratio of SEMG during activity to SEMG while standing, intramuscular and rectified surface SEMG at different positions, averaged SEMG at different positions and raw SEMG at different positions.

Reference standard test against which the new test was compared
There were no details of the reference standard used to determine whether or not patients had LBP.

Participants included in the review
Studies that included healthy patients and patients with LBP were eligible for inclusion. The included studies used different definitions of LBP. Patients with LBP had the following diagnoses: spondyloarthritis, disk disorders, musculoskeletal, chronic LBP (disabling and non-disabling), neck pain, radiation pain, mechanical chronic LBP, disk herniation, pregnant women with back pain before pregnancy, and golfers with chronic LBP. The duration of LBP ranged from less than 1 month to more than 12 months.

Outcomes assessed in the review
Inclusion criteria were not defined in terms of the outcomes. The outcomes reported in the review were effect sizes, sensitivity and specificity.

How were decisions on the relevance of primary studies made?
The authors did not state how the papers were selected for the review, or how many authors performed the selection.
Assessment of study quality
The authors did not state that they assessed validity.

Data extraction
Data were extracted on the sensitivity, specificity (as reported) and effect size (mean in group without LBP minus mean in group with LBP, divided by the pooled standard deviation). Effect sizes were only reported for studies that provided data on means and standard deviations (SDs). Data reported graphically were extrapolated. Prior to calculating effect sizes, data from some studies were averaged (e.g. if studies reported data separately for each side of the back these were averaged). If studies reported SEMG differences between diagnostic groups, comparisons between each diagnostic group and the healthy control group were calculated separately. The authors did not state how many authors performed the data extraction.

Methods of synthesis
How were the studies combined?
Weighted effect sizes and mean sensitivity and specificity were calculated.

How were differences between studies investigated?
Data were presented separately for: SEMG during static position; SEMG during dynamic activity such as bending; SEMG during an isometric hold, contraction, or exertion; and SEMG response to expected or unexpected increase in physical demand or following release of physical demand. Heterogeneity was not formally assessed.

Results of the review
Forty-four studies (n=2,288) were included. Thirty-four studies (n=1,877) provided data for meta-analyses.

SEMG in static position (10 studies, 63 effect sizes).
Five studies reported higher SEMG levels between LBP patients and controls, while 5 studies reported no significant differences. Static postures investigated included standing, unsupported sitting, supported sitting, sitting supported with mental stress and prone. The effect sizes ranged from -0.20 to 4.81. The weighted mean effect size was 0.65 (SD=0.7) for all static postures combined; the pooled weighted mean effect sizes ranged from 0.34 (SD=0.3) for supported sitting to 1.11 (SD=1.0) for standing.

Two studies by the same author provided data on sensitivity and specificity. The mean sensitivity was 39.6% (range: 0 to 76.5) and the mean specificity 90.8% (range: 80 to 93.1).

Dynamic SEMG (11 studies, 37 effect sizes).
Dynamic activities investigated included rising, active sitting, flexion, full flexion, re-extension, flexion-relaxation ratio and rotation. The effect sizes ranged from -2.10 to 1.26. The overall mean weighted effect size was -0.04 (SD=0.8); the mean weighted effect sizes ranged from -1.70 for flexion-relaxation ratio to 1.25 for full flexion. Two studies assessing the flexion-relaxation ratio reported the sensitivity and specificity: the mean sensitivity was 88.8% (range: 84.6 to 93) and the mean specificity 81.3% (range: 75 to 98.8).

SEMG during isometric activity (14 studies, 22 effect sizes).
Isometric exertions assessed included integrated, initial median frequency, median frequency or mean power slope, mean amplitude, peak linear envelope and left-right correlation. The effect sizes ranged from -2.35 to 2.21. The overall mean weighted effect size was -0.55 (SD=1.1); the mean weighted effect sizes ranged from -2.33 for mean amplitude to 2.17 for peak linear envelope. The overall mean sensitivity was 84.4% (range: 40 to 100) and the mean specificity 89.9% (range: 67 to 100). It was unclear how many studies contributed data on sensitivity and specificity.

SEMG response to initiation or cessation of an expected or unexpected physical demand (3 studies, 20 effect sizes).
Physical demands assessed included recover from load release (for on antagonists and off agonists), unexpected loading (for reflex duration and latency) and expected loading (for reflex duration flexion and latency). The effect sizes ranged from -0.45 to 1.10. The overall mean weighted effect size was 0.36 (SD=0.4); the weighted mean effect sizes ranged from -0.02 to 0.64. No studies provided data on sensitivity and specificity.

**Authors’ conclusions**
Some SEMG measures had the potential to act as objective markers to distinguish between people with and without LBP.

**CRD commentary**
The review addressed a clear question that was supported by defined inclusion criteria for the participants and intervention only. The literature search was limited to one database and no attempts were made to identify unpublished studies. It was therefore likely that relevant studies had been missed and the review may be subject to publication bias. The quality of the included studies was not assessed, so it was not possible to assess the validity of the findings. Details of the review process were not reported, thus it was unclear whether appropriate steps were taken to minimise bias.

The methods used to pool the data were not reported clearly and did not seem appropriate for the calculation of summary sensitivity and specificity, which appeared simply to be an average value. Where multiple comparison groups shared a control group, no adjustment for statistical dependency was made; the authors briefly mentioned the potential for lack of independence. In addition, the range of reported diagnostic values suggested that results were not always consistent among studies and that pooling may not have been appropriate. In view of the lack of reporting of review methods, the lack of a quality assessment of the included studies, differences between the studies and concerns about the methods of analysis, the authors’ conclusions may not be reliable.

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

Research: The authors stated that further research is needed to determine the combination of measures that accurately identify LBP, whether these measures are easy to obtain, and whether they are cost-effective. Research to determine which factors contribute to SEMG abnormalities, and whether this has implications for treatment, is also required.

**Bibliographic details**

**PubMedID**
16275595

**DOI**
10.1016/j.jpain.2005.06.008

**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Action Potentials; Electromyography /method; Humans; Low Back Pain /diagnosis /physiopathology; Muscle, Skeletal /physiology

**AccessionNumber**
Date bibliographic record published
31/01/2008

Date abstract record published
31/01/2008

Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.