

“The Role of the Kinetic Chain in shoulder rehabilitation: does incorporating the trunk and lower limb into shoulder exercise regimes improve shoulder muscle recruitment patterns? - A systematic review.”

Target Journal for Publication: British Journal of Sports Medicine (BJSM)

Current situation and the need for the review:

A kinetic chain approach to shoulder rehabilitation has been advocated by expert clinicians in the literature for well over a decade (Kibler et al., 2012; Magarey and Jones, 2003; McMullen and Uhl, 2000; Sciascia and Cromwell, 2012) and there is now a growing body of evidence evaluating the effect that integrating trunk and lower extremity motion has on shoulder muscle recruitment patterns and amplitudes (De Mey et al., 2013; Kalantari and Ardestani, 2014; Kaur et al., 2014; Kibler et al., 2008; Maenhout et al., 2010; Smith et al., 2007; Tsuruike, 2014; Yamauchi et al., 2015). To date there has not been a commensurate systematic review that examines the effects of taking such a multi-segmental approach to shoulder rehabilitation. The purpose of this systematic review is therefore to evaluate whether incorporating trunk and lower limb motion into shoulder rehabilitation exercises influences EMG muscle activity and recruitment patterns around the shoulder complex and to discuss the role of the kinetic chain in shoulder rehabilitation.

Primary objective:

To investigate whether the addition of lower limb and trunk motion into shoulder rehabilitation exercises affects EMG muscle activity and muscle recruitment patterns around the shoulder complex.

Secondary objective:

To discuss the potential clinical consequences of incorporating the lower limb and trunk into shoulder rehabilitation exercises in relation to shoulder function.

Criteria for considering studies included in the review (initial screening process/Inclusion criteria):

Search Strategy:

Two experienced physiotherapists (ER & CM) shall conduct independent searches on the same day using standardized, predetermined search terms (see below). Titles and abstracts will be independently reviewed using the eligibility criteria above and any discrepancies will be discussed. Any disagreement on the inclusion of an article will be resolved through discussion between ER and CM and, if necessary, a third reviewer (JG). Hand searching of the reference lists of papers meeting the inclusion criteria will also be conducted. Consultation with kinetic chain shoulder specialists JG & JL will assist in further identification of additional “grey literature”.

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CM (*2nd reviewer and co-author*): Christopher Morgan MCSP MSc Musculoskeletal Physiotherapy (Head of Physiotherapy, Liverpool Football Club)

JG (*4th supervisor and co-author*): Jo Gibson MCSP MSc (Shoulder Clinical Physiotherapy Specialist at the Liverpool Upper Limb Unit)

JL (*3rd co-author*): Dr Jeremy Lewis PhD FCSP (Consultant Physiotherapist, Professor of Musculoskeletal Research, Sonographer)

GY (MMU APP supervisor): Dr Gill Yeowell (senior lecturer at Manchester Metropolitan University)

Databases to be searched:

Medline, CINAHL, EMBASE, PEDRO, AMED, PubMed, Dissertations/Thesis, Cochrane central register of controlled trials, Cochrane database of systematic reviews, PROSPERO, SportDiscus, The clinical trials register. Searches will be conducted between June 2015 and March 2016.

The search terms I will be using in line with PICOS:

Anatomic region: (shoulder) OR (Glenohum*) OR (scapula) OR (shoulder girdle) OR (shoulder function) OR (shoulder joint)

Intervention: (exercise*) OR (rehabil*) OR (kinetic chain) OR (resistance train*) OR (strength*) OR (muscle train*) OR (lower limb train*) OR (core stab*) OR (trunk exercises) OR (trunk rotation) OR (gym) OR (Physio*) OR (physical therapy) OR (kinetic link-model) OR (proprioceptive neuromuscular facilitation) OR (PNF) OR (non-operative) OR (conservative) OR (kinesotherapy)

Comparison: (no treat*) OR (placebo) OR (global rehab*) OR (local rehab*) OR (other intervention) OR (conventional rehab*)

Outcome: (EMG) OR (EMG activity) OR (ROM) OR (range of motion) OR (neuromuscular control) OR (control) OR (proprioception) OR (strength) OR (muscular endurance) OR (co-contraction) OR (performance) OR (function) OR (ADLS) OR (injury recurrence) OR (injury risk)

Study Design: the best available evidence (ideally evidence of level 3b and above on the Oxford level of evidence score) will be used however, Harris et al. (2013) advise against dismissing important studies that evaluate the clinical question when trying to meet the “highest” level of evidence criteria. Excluding studies in an attempt to meet only “level 1” evidence may actually reduce the effectiveness of a systematic

review (Harris et al., 2013) and therefore the “best available evidence” in relation to the research question will be included in this review following rigorous searching. Due to the topic under investigation this may include case control studies and case series.

Methods of the Review:

A PRISMA flowchart will be used to illustrate the process of the final study selection for review and the following criteria will be applied:

Exclusion criteria:

Animal studies; studies where subjects are wheelchair users; infant/paediatric studies; studies where subjects suffer shoulder pathology; studies that don't investigate BOTH kinetic and non-kinetic chain shoulder exercises/variations OR variations of a form of kinetic shoulder exercise; Studies examining only one shoulder exercise which does not include a local and global comparison

Inclusion criteria:

Healthy subjects; studies recording EMG activity as an outcome measure during standard/static shoulder exercises AND kinetic chain variations or other kinetic chain exercise (i.e additions/variations must be made in trunk/lower limb motion)

Critical appraisal tools used:

- For any RCTs identified Cochrane Risk of Bias tool will be employed (Greens et al., 2011)
- For non-RCTs Downs & Black (1998) will be used to assess methodological quality

Methods to extract data from the included trials:

Data relating to methodological quality for each article will be extracted by ER and CM using the Downs & Black scoring system/checklist (Downs & Black, 1998) or by employing the Cochrane Collaboration tool for assessing risk of bias (Greens et al., 2011). The data extraction sheet ultimately employed will be piloted first on 3 articles and adjusted accordingly to ensure that all relevant data is captured.

Data relating to the exercises evaluated in each study will be extracted using a customised spread sheet in Microsoft Excel designed with the specific research question in mind (and it's design/format informed following study identification). This will be piloted in a small number of related articles by ER and CM. Any modifications will be made prior to the final data extraction process during the actual review to avoid misunderstandings and disagreements.

Proposed presentation of results:

A summary of the scoring of all articles using the Downs and Black (1998) checklist or Cochrane Risk of Bias domains will be presented in tabular form. A Brief customised tabular narrative of each investigation with unique study details included as required with reference to the research question. Preliminary data items for this customised exercise-data-extraction-spreadsheet might include:

- Demographics characteristics of participants
- Exercise descriptions (start-motion-end position)
- Details of the kinetic chain segment variable being evaluated
- Muscles under investigation
- EMG amplitudes during each exercise
- Summary detailing the exercise that elicited the highest EMG activity for each muscle under investigation
- Summary of % difference between “standard non-kinetic exercise” Vs “standard plus kinetic chain variable exercise” for EMG amplitudes for the “best” exercise for each muscle under investigation
- Report any assumptions made/unclear information relating the exercise undertaken or the instruction/teaching procedure

Methods used to analyse data (no meta-analysis at MSc level):

The review will be conducted as outlined by PRISMA (Liberati et al., 2009). If possible, meta-analysis will be used to summarise and combine the results of independent studies. However, this may not be possible due to the high number of variables in EMG studies.

Method of presentation:

On top of the tabular summaries detailed above an overall written narrative will be provided under sections titled “conclusion”, “discussion” and “limitations” sections.

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