



## Systematic review

## Inter-clinician and intra-clinician reliability of force application during joint mobilization: A systematic review

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## ARTICLE INFO

## Article history:

Received 3 September 2013

Received in revised form

22 November 2013

Accepted 13 December 2013

## Keywords:

Reliability

Force

Joint mobilization

Manual therapy

## ABSTRACT

Joint mobilizations are commonly used by clinicians to decrease pain and restore joint arthrokinematics following musculoskeletal injury. The force applied during a joint mobilization treatment is subjective to the individual clinician but may have an effect on patient outcomes. The purpose of this systematic review was to critically appraise and synthesize the studies which examined the reliability of clinicians' force application during joint mobilization. A systematic search of PubMed and EBSCO Host databases met the eligibility and were included. Five studies were included that assessed inter-clinician reliability, and six studies were included that assessed intra-clinician reliability. The overall level of evidence for inter-clinician reliability was strong for poor-to-moderate reliability (ICC = -0.04 to 0.70). The overall level of evidence for intra-clinician reliability was strong for good reliability (ICC = 0.75–0.99). This systematic review indicates there is variability in force application between clinicians but individual clinicians apply forces consistently. The results of this systematic review suggest innovative instructional methods are needed to improve consistency and validate the forces applied during of joint mobilization treatments. This is particularly evident for improving the consistency of force application across clinicians.

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## 1. Introduction

Manual therapy techniques are commonly used in the treatment of musculoskeletal conditions (Threlkeld, 1992). A common manual therapy technique known as joint mobilization is often used to restore joint arthrokinematics and reduce pain by passively moving a joint through an accessory range of motion. These treatment effects are accomplished by rhythmically oscillating a joint within specified ranges of accessory motion which is thought to increase the extensibility of non-contractile tissues surrounding a joint and activate the neurophysiological mechanisms that alter the transmission of nociceptive afferent impulses (Wright, 1995; Maitland, 2001; Bialosky et al., 2008). Therefore, joint mobilizations are often used to treat a variety of impairments associated with an array of musculoskeletal conditions.

To further categorize the type of joint mobilization, many clinicians prescribe to a joint mobilization system to describe their technique based on the amplitude, frequency, and duration of oscillations. A common joint mobilization system adopted by many clinicians is the Maitland technique (Maitland, 2001). The Maitland technique consists of passive joint movements within four grades. Grade I mobilization is a small amplitude motion performed at the beginning of the available range of motion for the specific joint being treated. Grade II mobilizations are large amplitude movements performed within a resistance-free part of the available range (within the mid-range, but not reaching end range). Grade III mobilizations are large amplitude movements that are performed up to the limit of available range of motion. Grade IV mobilizations are small amplitude movements performed at the limit of the range. Grades I and II are commonly used for pain control, while III and IV are used to increase range of motion (Maitland, 2001). Clinicians select the grade of mobilization based on their assessment of joint mobility and treatment goals (Snodgrass et al., 2009).

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Although the grades of joint mobilization have been established, the force application parameters for each grade are subjectively decided by the clinician. There are several factors which likely influence the amount of force applied to a patient including the level of tissue restriction or stiffness at the site of application, the joint being mobilized, and the level of tissue irritability experienced by the patient. Despite standardized terminology and descriptions of joint mobilization grades, there are no recommendations or guidelines for the amount of force which should be applied for each respective grade of joint mobilization. Without guidelines for force application, among several other joint mobilization application parameters, clinicians may not consistently apply joint mobilization techniques. This potential lack of consistency within or between clinicians could create deviations in treatment and ultimately impact patient outcomes.

The consistency or reliability of force applications within and between clinicians has been examined in several studies (Cook et al., 2002; Conradie et al., 2004; Snodgrass et al., 2007, 2009, 2010; Gautam and Sharma, 2011; Silvernail et al., 2011). Despite several studies which examined the consistency of joint mobilization force applications, it is difficult to draw conclusions from this body of research because different types of clinicians, body regions, and grades of joint mobilization have been examined. Performing a systematic review on this body of research would provide a synthesis of the evidence that may generate clear inferences and directions for future research. Therefore, the purpose of this systematic review was to collate, synthesize, and critically appraise the published evidence describing the inter-clinician and intra-clinician reliability of force application during peripheral and spinal joint mobilizations.

## 2. Methods

### 2.1. Search strategy

A systematic search strategy was conducted to locate studies assessing the reliability of force application during graded joint mobilizations; any mobilization technique, mobilized joint, and clinicians at all levels of experience in the application of joint mobilizations were searched for inclusion. The databases were searched using combinations of key words and specific subject headings related to reliability, clinicians, and force (Table 1). Boolean operators “OR” and “AND” were utilized to combine search terms and the search was limited to humans.

**Table 1**  
Search strategy: keywords and search terms used.

Step	Search terms	Boolean operator	EBSCO Host	PubMed
1	Joint		49,991	253,220
2	Mobilization Mobilization Manipulation	OR	66,705	2,976,749
3	Reliability Reproducibility Repeatability Accuracy Inter-rater reliability Intra-rater reliability Inter-therapist Intra-therapist Inter-clinician Intra-clinician	OR	429,676	349,924
4	Force		113,852	72,785
5	1, 2	AND	1409	32,052
6	5, 3	AND	136	639
7	6, 4	AND	24	28
	Duplicates			7*

\*Total number of duplicates between EBSCO Host and PubMed.

All investigators conducted the systematic search for literature pertaining to reliability of force application during joint mobilizations. PubMed and EBSCO Host (CINAHL, MEDLINE, SportDiscus) were searched from their inception through March 1, 2013. A hand search of the reference lists of the articles screened for inclusion was also performed to ascertain any publications not identified through the electronic database searches.

### 2.2. Eligibility criteria

All authors reviewed the articles obtained by the systematic search for eligibility and possible inclusion. The titles, abstracts and full text of all articles were screened for eligibility based on the criteria listed below. In cases of eligibility uncertainty, the full text of the manuscript was screened by all reviewers for inclusion into the systematic review.

#### 2.2.1. Inclusion criteria

The following inclusion criteria were used to select and screen studies for inclusion into the systematic review:

- Type of studies: Studies were included if clinicians' reliability of force application during joint mobilizations was measured. Peer reviewed, full text articles were included for the review.
- Type of participants: Studies on human participants were included for the review. No restrictions were made with respect to the demographics to individuals receiving the joint mobilization. Clinicians of varied levels of clinical experience in application of joint mobilizations were included for review and no restrictions were made based on their demographics.
- Type of interventions and outcome measures: Studies utilizing graded mobilizations were included for review. No restrictions were made to the grade of mobilization, application protocol, or the joint mobilized. The studies were included if they assessed the force (i.e., mean applied force) the clinician applied to the subject.

#### 2.2.2. Exclusion criteria

The following exclusion criteria were used to screen studies for their suitability for inclusion into the systematic review:

- Articles that did not assess reliability using intraclass correlation coefficients or the ability to calculate this statistic from the data provided
- Biomechanical in-vitro studies
- Articles that did not assess force application
- Articles that restricted the range of force application
- Articles not published in English

### 2.3. Data extraction

Two independent reviewers (NTW and KSG) extracted data during initial review including: study aims, study design, study quality, participant details, clinician details, protocol for application of joint mobilization, grade of joint mobilization, joint or segment mobilized, outcome measures, statistical techniques, conclusion and relevant methodological limitations. Discrepancies in interpretation were resolved by discussion seeking consensus and use of a third reviewer (BVL) if needed.

### 2.4. Assessing quality of studies

The Quality Appraisal of Reliability Studies (QAREL) (Lucas et al., 2010) scale was used to assess the methodological quality of the included studies. This scale has shown acceptable levels of inter-

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