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## Comparative Effects of Different Stretching Techniques for Reducing Shoulder Internal Rotation Range-of-Motion Limitation in Individuals with Glenohumeral Internal Rotation Deficit: A Systematic Review and Network Meta-analysis of Randomized Controlled Trials

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**ADMINISTRATIVE INFORMATION****Support** - No support.**Review Stage at time of this submission** - Data analysis.**Conflicts of interest** - None declared.**INPLASY registration number:** INPLASY202680087

**Amendments** - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 24 August 2026 and was last updated on 24 August 2026.

**INTRODUCTION**

**Review question / Objective** To compare and rank the effectiveness of different interventions for improving shoulder internal rotation range of motion in individuals with glenohumeral internal rotation deficit (GIRD).

**Rationale** GIRD is commonly observed in overhead athletes and may contribute to altered shoulder mechanics and an increased risk of shoulder injury. Various stretching and manual therapy interventions have been proposed to improve shoulder internal rotation range of motion. However, their comparative effectiveness remains unclear. Although conventional pairwise meta-analyses can compare individual interventions, they cannot comprehensively determine the relative effectiveness of multiple treatment strategies. Therefore, a network meta-analysis is warranted to simultaneously compare and rank different interventions for improving shoulder internal rotation range of motion in individuals with GIRD.

**Condition being studied** The population, intervention, comparison, and outcome framework of this network meta-analysis was defined as follows: the population comprised individuals with GIRD; the interventions included different stretching techniques or joint mobilization aimed at improving shoulder internal rotation; the comparisons consisted of no intervention or regular training consisted of other stretching interventions or control conditions; and the primary outcome was the change in shoulder internal rotation range of motion.

**METHODS**

**Search strategy** Two authors independently conducted electronic searches in PubMed, MEDLINE-Ovid, and Scopus using combinations of the following keywords: ("glenohumeral internal rotation deficit" OR "GIRD" OR "posterior shoulder tightness" OR "posterior capsule tightness" ) AND ("stretching" OR "sleeper stretch" OR "cross-body stretch" OR "internal rotation stretch" OR "joint mobilization" OR "manual therapy"). Searches

covered all records from database inception through August 2026.

**Participant or population** GIRD.

**Intervention** Joint mobilization, sleeper stretching, cross-body stretching, glenohumeral internal rotation stretching, or a combination of these interventions.

**Comparator** Control.

**Study designs to be included** Randomized controlled trials.

**Eligibility criteria** (1) randomized controlled trials evaluating internal rotation or horizontal adduction range of motion; (2) studies involving adults with GIRD; and (3) intervention groups receiving joint mobilization, sleeper stretching, cross-body stretching, glenohumeral internal rotation stretching, or a combination of these interventions.

**Information sources** Two reviewers conducted screenings across multiple databases, including PubMed, Medline-Ovid, and Scopus. The search employed the following keywords: (“glenohumeral internal rotation deficit” OR “GIRD” OR “posterior shoulder tightness” OR “posterior capsule tightness”) AND (“stretching” OR “sleeper stretch” OR “cross-body stretch” OR “internal rotation stretch” OR “joint mobilization” OR “manual therapy”).

**Main outcome(s)** The outcome was shoulder internal rotation range of motion. Internal rotation range of motion was measured using validated instruments, including digital inclinometers or goniometers, with the shoulder positioned at approximately 90° of abduction.

**Quality assessment / Risk of bias analysis** The methodological quality of the included randomized controlled trials was assessed using the Physiotherapy Evidence Database (PEDro) scale, which evaluates key aspects of study quality, including randomization, allocation concealment, baseline comparability, blinding, follow-up, intention-to-treat analysis, between-group comparisons, and reporting of variability.

**Strategy of data synthesis** A frequentist network meta-analysis will be conducted using a random-effects model, primarily through MetaInsight, to compare the effects of different interventions on shoulder internal rotation range of motion. Additional analyses, including meta-regression and assessment of publication bias, will be performed

using R software. Standardized mean differences (SMDs) with 95% confidence intervals (CIs) will be calculated for continuous outcomes. Direct and indirect evidence will be synthesized within the network meta-analysis framework. Statistical heterogeneity will be assessed using the between-study variance ( $\tau^2$ ). Consistency between direct and indirect evidence will be examined using appropriate inconsistency tests. Treatment rankings will be estimated using P-scores, with higher values indicating more favorable treatment effects. Statistical significance will be defined as a two-sided p value <0.05.

**Subgroup analysis** No subgroup analyses are planned.

**Sensitivity analysis** Sensitivity analyses will be conducted using different assumed pre-post correlation coefficients ( $r = 0.3, 0.5, \text{ and } 0.8$ ) to assess the robustness of the findings.

**Language restriction** No language limit.

**Country(ies) involved** Taiwan (R.O.C.).

**Keywords** Shoulder Joint; Range of Motion, Active Stretching, Network Meta-Analysis.

#### Contributions of each author

Author 1 - Long-Huei Lin - Conceptualization; Literature search ; Methodology; Formal analysis; Data curation; Writing – Original Draft; Visualization.

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