

# BMJ Open The Efficacy of the proprioceptive neuromuscular facilitation (PNF) approach in stroke rehabilitation to improve basic activities of daily living and quality of life: a systematic review and meta-analysis protocol

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## ABSTRACT

**Introduction** Proprioceptive neuromuscular facilitation (PNF) is a widely used rehabilitation concept, although its efficacy has not yet been demonstrated in stroke survivors. The aim of this systematic review is to identify, assess and synthesise the potential benefits of using PNF to improve the activities of daily living (ADL) and quality of life (QoL) of individuals with stroke.

**Methods and analysis** A systematic electronic search will be conducted in MEDLINE, Embase, CENTRAL and PEDro. We will include randomised or quasi-randomised controlled trials of PNF interventions conducted in stroke survivors up to April 2017. Two review authors will independently select relevant studies and will extract data using the Cochrane handbook for systematic reviews of interventions approach and the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P). The methodological quality will be assessed by using the PEDro scale. Finally, with the permitted numeric data, we will carry out a meta-analysis.

**Ethics and dissemination** Ethical considerations will not be required. Results will be disseminated in a peer-review journal. This systematic review aims to examine the effects of PNF (neuropsychological approach) in order to clarify its efficacy in improving ADL and QoL in the rehabilitation process of stroke survivors.

**PROSPERO registration number** CRD42016039135.

## INTRODUCTION

Every year, stroke survivors, related deaths, and disability-adjusted life-years are increasing, although the mortality rates for stroke have decreased in the last two decades.<sup>1</sup> Motor and sensory impairments due to stroke often affect the patients' mobility, limiting their activities of daily living (ADL) and their social participation, and hindering their chances of resuming their professional life. Motor function

## Strengths and limitations of this study

- To our knowledge this study is the first systematic review focused on the proprioceptive neuromuscular facilitation (PNF) approach for stroke survivors.
- This systematic review has an open eligibility criteria to clarify the efficacy of the PNF method for different clinical situations in stroke patients.
- The electronic search will only include randomised controlled and quasi-randomised controlled trials published in English, Spanish, French and Portuguese that could limit the inclusion of studies.

among other factors (such as social or personal factors) could contribute to a low overall quality of life (QoL).<sup>2</sup>

Throughout the years, a number of conceptualisations have been used to describe QoL in stroke survivors.<sup>3–5</sup> The lack of an agreed definition on QoL means that most QoL outcomes have been assessed using standardised questionnaires. However, these questionnaires do not reveal important domains of patients' QoL and sometimes scores may be difficult to interpret.<sup>5</sup>

Dijkers<sup>4</sup> separated the QoL term into three categories: (1) QoL as subjective well-being (SWB); (2) QoL as achievement; and (3) QoL as utility. QoL as SWB has been defined as the sum total of the cognitive and emotional reactions that people experience when they compare what they have and do in life with their aspirations, needs, and other expectations. QoL as achievement refers to people's possessions, relationships and accomplishments, among others, using metrics defined by an outsider's point of view. Within the medical rehabilitation field,

QoL measurements commonly involve health status or are qualified by the term “health-related”. Health-related QoL (HRQoL) is defined by the value assigned to the duration of life when modified by impairment, functional state, perception and social factors that are influenced by disease, injury, treatment or policy.<sup>6</sup> According to Dijkers<sup>4</sup> some researchers base themselves on the WHO’s encompassing definition of health, and may add to this different social health indicators such as interactions with others and social role functioning. Finally, in QoL as utility, achievements and statuses are judged in terms of societal norms and standards that quantify the value of a life.

An optimal rehabilitation effectively addresses components, as coded by the International Classification of Functioning (ICF), such as impairment, activity limitations and participation restrictions, and contextual and personal factors, with the goal of a satisfactory QoL as perceived by the individual. The relationship between the three domains of the ICF is clear: impairments impact activities and activities have an impact on participation. Functionality and ADL take a specific role in influencing QoL in stroke survivors positively. During the recovery process and according to the degree of disability, it is important to impact on those variables at any time throughout the rehabilitation treatment, taking into account that they are variables that change over time.<sup>7</sup> Much of the focus of stroke rehabilitation is on the recovery of impaired movement and the associated functions. According to Jørgensen<sup>8</sup> there seems to be a correlation between motor impairments and activity limitations; for example, lower-limb strength (impairment) has been correlated with independence in walking (activity level). In order to improve the neuromuscular system’s effectiveness in coordinating movement and function, there are different physical rehabilitation approaches used for enhancing recovery in post stroke patients, but neither method was more (or less) effective in terms of improving independence in ADL or motor function.<sup>9</sup> Proprioceptive neuromuscular facilitation (PNF) is widely used in rehabilitation practice.<sup>10</sup>

The PNF approach has existed since the late 1930s and '40s when the physician and neurologist Herman Kabat, and the physiotherapist Margaret Knott, began using proprioceptive techniques on younger individuals with cerebral palsy and other neurological conditions. The main goal of this intervention method is to help patients achieve their highest function level. PNF uses the body’s proprioceptive system to facilitate or inhibit muscle contraction. The definition of PNF encompasses the terms proprioceptive (which has to do with any of the sensory receptors that provide information concerning movement and position of the body); neuromuscular (involving the nerves and muscles); and facilitation (making it easier).<sup>11</sup>

Recently, various systematic reviews<sup>12–17</sup> and an evidence-based clinical practice guideline<sup>18</sup> have evaluated the efficacy of stroke rehabilitation interventions, including PNF techniques. However, none were specifically focused on

PNF, and only one narrative review assessed PNF as the principal topic.<sup>10</sup> Furthermore, the most frequent objectives to assess the efficacy of this intervention method were motor function and mobility. It is necessary that therapists base their clinical decisions on the most reliable scientific evidence available; hence, this systematic review aims to determine the efficacy of PNF techniques in improving ADL and QoL in stroke survivors.

## OBJECTIVES

The primary purpose of this systematic review is to examine the efficacy of PNF in improving ADL and QoL in individuals with stroke. Secondary specific aims are to determine the efficacy of the PNF techniques in postural control, gait, upper limb function and muscle strength.

## METHODS

This systematic review protocol was registered prospectively in Prospero (registration number: CRD42016039135); it will follow the recommendations of the Cochrane handbook for systematic reviews of interventions<sup>19</sup> and will be reported in accordance with the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P).<sup>20</sup>

### Criteria for considering studies for this review

#### Type of studies

We will include all randomised controlled trials and quasi-randomised controlled trials.

#### Type of participants

We will include adult stroke participants (>18 years old) in the acute, subacute or chronic phase.

#### Type of interventions

We will include all trials which reported the PNF approach alone or in combination with another rehabilitation or medical intervention compared with a control group (conventional physiotherapy, another physiotherapy approach (not PNF), no treatment).

#### Types of outcomes measures

##### Primary outcomes:

- i. ADL evaluated mainly by the Barthel Index (BI), Functional Independence Measures (FIM), modified Ranking Scale (mRS) and the Community Integration Questionnaire (CIQ).
- ii. QoL evaluated mainly by the Medical Outcomes Study Short Form 36 (SF-36) and the Stroke Specific Quality of Life Scale (SS-QOL).

##### Secondary outcomes:

- i. Postural control assessed mainly by the Postural Assessment Scale for Stroke Patients (PASS), Rivermead Mobility Index (RMI) and the Trunk Impairment Scale (TIS).

- ii. Gait assessed mainly by the Brunel Balance Assessment (BBA), Tinetti test, Functional Ambulation Category (FAC), Dynamic Gait Index (DGI), 6 Minute Walk Test (6 MWT) or 10 Meter Walk Test (10 MWT).
- iii. Upper limb function assessed mainly by the Wolf Motor Function Test (WMFT), Fugl-Meyer Assessment (FMA), Box and Block Test (BBT) or Motor Activity Log (MAL).
- iv. Muscle strength assessed mainly by the Oxford Scale, Hand-held Dynamometer/Grip Strength or Five Times Sit to Stand Test (FTSST).

### Search methods for identification of studies

A systematic electronic search will be conducted in the following databases: the Cochrane Central Register of Controlled Trials (CENTRAL) (The Cochrane Library, 2017, Issue 3), MEDLINE (1964 to April 2017; via PubMed), Embase (1980 to April 2017; via Ovid) and PEDro (1999 to April 2017; via website). In addition, expert opinions, the reference lists of the selected studies and previous systematic reviews will be reviewed. The search strategy will involve two kinds of terms,

“stroke and “PNF”, that will be combined with the Cochrane Highly Sensitive Search Strategy for the identification of randomised trials in MEDLINE: sensitivity-maximising version (2008 revision); PubMed format. Finally, all studies published in English, Spanish, French, and Portuguese will be included. This search strategy is described in [table 1](#).

### Data collection and analysis

#### Study selection

Two reviewers will independently screen all retrieved references and select studies that meet the inclusion criteria by following these steps: (1) reading title and abstracts; and then (2) by reading the full-texts.

#### Data extraction and management

Two reviewers will independently extract data using a data extraction form, which will be designed and tested before use. Disparities will be resolved by discussion or, if necessary, referred to a third reviewer.

The data extraction form will be based on the recommendations of the Cochrane handbook for systematic reviews of interventions<sup>19</sup> and will extract information

**Table 1** MEDLINE (PubMed) search strategy

Stroke	<ol style="list-style-type: none"> <li>1. “Cerebrovascular Disorders”[Mesh] OR stroke*[tiab] OR poststroke*[tiab] OR cerebral vascular OR accident*[tiab] OR cva*[tiab] OR brain injur*[ti] OR apoplex*[tiab]</li> <li>2. “Brain”[Mesh] OR brain*[tiab] OR cerebr*[tiab] OR cerebell*[tiab] OR intracran*[tiab] OR intracerebral*[tiab] OR vertebrobasilar*[tiab]</li> <li>3. “Blood vessels”[Mesh] OR blood vessel*[tiab] OR vascular*[tiab] OR “arteries”[Mesh] OR arter*[tiab]</li> <li>4. “Intracranial Aneurysm”[Mesh] OR “Intracranial Hemorrhages”[Mesh] OR “Intracranial OR Hemorrhage, Hypertensive”[Mesh] OR “Hematoma, Subdural, Intracranial”[Mesh] OR “Subarachnoid Hemorrhage”[Mesh] OR “SAH”[tiab]</li> <li>5. “Hemorrhage”[Mesh] OR hemorrhag*[tiab] OR haemorrhag*[tiab] OR “hematoma”[Mesh] OR hematoma*[tiab] OR haematoma*[tiab] OR bleed*[tiab]</li> <li>6. “Intracranial Embolism and Thrombosis”[Mesh] OR “Intracranial Embolism”[Mesh] OR “Vasospasm, OR Intracranial”[Mesh] OR “Ischemic Attack, Transient”[Mesh] OR “TIA”[tiab] OR “Brain Ischemia”[Mesh]</li> <li>7. “Ischemia”[Mesh] OR ischemi*[tiab] OR ischaemi*[tiab] OR thrombo*[tiab] OR “embolism”[Mesh] OR emboli*[tiab] OR oclus*[tiab]</li> <li>8. “Disease”[Mesh] OR disease*[tiab] OR disorder*[tiab] OR infarc*[tiab] OR stenosi*[tiab] OR spasm*[tiab] OR accident*[tiab]</li> <li>9. (#2 AND #7) OR #6</li> <li>10. (((#2 OR subarachnoid*[tiab]) AND #5) OR #4)</li> <li>11. #17 AND #23 AND #61</li> <li>12. #1 OR #9 OR #10 OR #11</li> </ol>
Proprioceptive neuromuscular facilitation (PNF)	<ol style="list-style-type: none"> <li>13. Neuromuscular facilitation*[tiab] OR neuromuscular stimulation*[tiab] OR proprioceptive*[tiab] OR PNF*[tiab] OR autogenic inhibition*[tiab] OR reciprocal inhibition*[tiab] OR rhythmic stabilization*[tiab] OR repeat contraction*[tiab] OR hold relax*[tiab] OR antagonist contract*[tiab] OR slow reversal*[tiab] OR functional stretch reflex*[tiab] OR reflex excitability*[tiab] OR contract relax*[tiab] OR Kabat*[tiab]</li> </ol>
Cochrane Highly Sensitive Search Strategy for identifying randomised trials in MEDLINE: sensitivity-maximising version (2008 revision); PubMed format	<ol style="list-style-type: none"> <li>14. Randomised controlled trial [pt] OR controlled clinical trial [pt] OR randomized [tiab] OR placebo [tiab] OR drug therapy [sh] OR randomly [tiab] OR trial [tiab] OR groups [tiab]</li> <li>15. Animals [mh] NOT humans [mh]</li> <li>16. #15 NOT #16</li> </ol>
Final search	<ol style="list-style-type: none"> <li>17. #12 AND #13 AND #16</li> </ol>

from each selected study on demographic characteristics (eg, age, gender, time since stroke, side of the paresis, unilateral or bilateral stroke, first ever or recurrent stroke, the aetiologic and localisation of stroke lesions), study design, description of intervention conducted both in the experimental and control groups, risk of bias, outcomes measures and results. For better data reporting, we will use the TIDieR (Template for intervention description and replication)<sup>21</sup> in the intervention section and the PEDro scale<sup>22</sup> to assess the risk of bias.

#### Assessment of the risk of bias in individual studies

Two reviewers will independently evaluate the methodological quality from each selected study using the PEDro scale.<sup>22</sup> Disparities will be resolved by involving a third author.

#### Measures of treatment effect

Within this systematic review, results from continuous outcomes will be reported through the mean difference (if the same scale is available) or standardised mean difference (if different scales were used) with 95% confidence intervals (95% CI), and dichotomous outcomes through risk differences and 95% CI.<sup>19</sup>

#### Data synthesis

If a meta-analysis is possible, statistical analysis will be conducted using Revman 5.3. We will use a fixed effects model to summarise the results of the studies with non-significant heterogeneity; otherwise, we will use the random effects model. If there is great heterogeneity within the studies ( $I^2 > 70\%$ ), which will not allow the performance of a meta-analysis, a narrative synthesis of the available data will be conducted.<sup>19</sup>

#### Dealing with missing data

If data are unreported, when possible, we will contact the original authors to request the missing data, especially for those necessary for the completion of the meta-analysis.<sup>19</sup>

#### Assessment of heterogeneity

Heterogeneity will be assessed using the  $I^2$  statistic according to the recommendations of the Cochrane handbook for systematic reviews of interventions.<sup>19</sup> Values above 50% will indicate the existence of substantial heterogeneity.<sup>19</sup>

#### Subgroup analysis and investigation of heterogeneity

We will consider the following variables: the aetiology of the disease, type of stroke, stroke localisation, stroke severity evaluated by the National Institute of Health Stroke Scale (NIHSS) and modified Rankin Scale, thrombolysis and thrombectomy treatment, and the chronicity of the disease. Finally, evaluation of the methodological heterogeneity will take into account the study design and the risk of bias of the studies included.<sup>19</sup>

#### Sensitivity analysis

We will perform a sensitivity analysis as follows: (a) random allocation, (b) concealed allocation, (c) methodological quality, (d) subjects blinding, (e) therapists blinding, (f) outcomes assessor blinding, (g) intention to treat analysis, and (h) drop outs.<sup>19</sup>

#### Ethics and dissemination

No ethical statement will be required for the performance of this review and meta-analysis. Results of this research will be published. These results will contribute towards improving the therapeutic strategy of patients with stroke.

## DISCUSSION

This systematic review will focus on the different techniques of PNF that are currently applied in stroke survivors to explore their influence in ADL and QoL. PNF has been a relevant approach in therapeutic techniques for years. More recently, the focus on functional activities has allowed the techniques of PNF to become an integral part of this type of exercise programming. PNF can and should be incorporated into any functional training by stroke survivors.

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**Contributors** FXGT conceived, designed and co-ordinated the protocol review. He registered the protocol review in the Prospero database, wrote the protocol review, provided a clinical perspective and commented on drafts of the protocol review, and contributed to and approved the final manuscript of the protocol review. RCV provided a clinical perspective, especially to the PNF method. She contributes to the outcome assessment and commented on drafts of the protocol review, and contributed to and approved the final manuscript of the protocol review. MSR conceived and designed the review. She provided a methodological perspective and she wrote the manuscript and commented on drafts of the protocol review, and contributed to and approved the final manuscript of the protocol review. GU provided a methodological perspective, commented on drafts of the protocol review, and contributed to and approved the final manuscript of the protocol review. NGT provided a clinical perspective, especially to the assessment outcomes. She wrote the manuscript and commented on drafts of the protocol review, and contributed to and approved the final manuscript of the protocol review.

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