

Centralization and directional preference: an updated systematic review with synthesis of previous evidence

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Centralization and directional preference: An updated systematic review with synthesis of previous evidence

1. Introduction

Centralization is defined as the abolition of distal and spinal pain *in response to repeated movements or sustained postures* (McKenzie and May, 2003).

Directional preference is defined as *the repeated movement* that produces centralization, *or* an abolition or decrease in symptoms, *or* an increase in restricted range of movement (McKenzie and May, 2003). Centralization and directional preference are thus important clinical phenomena, as they occur in response to therapeutic loading strategies and thus are clinically induced, and also as they describe a lasting change. They have been commonly referenced (May and Aina, 2012), in fact centralization is probably the most commonly spoken of clinically induced symptom response in the literature. Furthermore they are potentially useful prognostic and management indicators (May and Aina, 2012). For instance, the presence of centralization has been associated with better pain, function, return to work, and non-surgical outcomes both short and long-term (Long, 1995; Werneke and Hart, 2001; Skytte et al., 2005). Whilst directional preference has been a useful indicator of appropriate exercises, compared to other treatments in the short-term (Delitto et al., 1993;

Long et al., 2004, 2009). There is the suggestion that centralization and directional preference maybe helpful in determining the most effective management strategy (Long et al., 2004); thus being a so-called treatment effect modifier (May and Aina, 2012).

Centralization has been the subject of several systematic reviews (Aina et al., 2004; Chorti et al., 2009; May and Aina, 2012). All these are reasonably dated; even the most recent is over five years old now (May and Aina, 2012).

Although now somewhat dated that last review included 54 studies relevant to centralization and eight studies relevant to directional preference. Since the inclusion date of that last review a number of additional studies have been published (for instance, Albert et al., 2011; Petersen et al., 2011; Edmond et al., 2014; Apeldoorn et al., 2016). Furthermore, a recent systematic review of 49 articles of relevant prognostic factors, concluded that there was inconsistent evidence for the usefulness of most clinical findings, centralization and non-organic signs being the exceptions (Hartvigsen et al. 2015). Thus there are very limited tools for the clinician to determine if a patient might recover or not, and thus is an important area for further study.

In terms of updating systematic reviews, it has been suggested that the median survival time of a systematic review is 5.5 years with 23% being outdated within two years of publication (Shojania et al., 2007). A recent consensus

statement and check list focussed on the question of whether, when and how to update a previous systematic review (Garner et al., 2016). It did not stipulate how the results from the previous review(s) should be included; whether to summarise the conclusions of the previous review only, or whether to amalgamate the earlier individual studies with the new ones.

Thus it would appear to be appropriate to update the previous systematic reviews. The aims of the present paper were to summarise previous findings and to systematically review recent literature since June 2011 relating to all aspects of centralization and directional preference.

2. Methods

2.1 Study selection and reporting

Any full-text study that reported some aspect of centralization or directional preference, in adults reporting low back or neck pain, with or without radiating symptoms was included. PRISMA guidelines for reporting systematic reviews were followed (Harms, 2009). For data prior to the present search (June 2011 to December 2017) data were synthesised from the previous review (May and Aina, 2012).

2.2 Data sources and searches

A search was made of Medline, Cinahl and AMed from June 2011, the date of the last search, until December 2017. The website www.mckenziemdt.org, which lists references relevant to the McKenzie method, and includes a section on centralization, was also used. The reference lists of all included articles were also searched. Search terms used were as follows: centralization, OR directional preference; OR phenomenon; AND spine pain, OR back pain, OR neck pain, OR cervical, OR lumbar; used individually and in combination. Titles and abstract were reviewed initially by one author (AA) to see if they might be relevant and duplications removed. All potential articles were reviewed by two authors (AA, SM) to determine their final relevance, with any disagreements resolved by referral to the third author.

2.3 Data extraction and quality assessment

Data extraction was done independently and blinded to each other by two authors (SM, NR); any disagreements were resolved by consensus. Likewise quality assessment was done independently and blinded to each other by two authors (SM, NR); any disagreements were resolved by consensus. In both instances there was the option, not used, to refer to the third author if a consensus was not reached.

There is not full agreement on the best methods to assess quality either in randomized controlled trials (RCTs), or in cohort studies. There are many tools

to choose from for such tasks (Sanderson et al., 2007; Olivio et al., 2008), but the different criteria share many commonalities. The Physiotherapy Evidence Database (PEDro) scale was used to assess internal and external validity of the RCTs. The PEDro scale is comprised of 11 criteria (only 10 of which are scored), has been shown to be valid and reliable, and was used in a recent systematic review, with a score of 7 or above considered high, 5 or 6 moderate, and 4 or below poor quality (Young et al., 2018). To assess the quality of cohort and observation studies a tool for prognostic studies was used that had been adopted from earlier work by Hayden et al. (2013), and was used in a recent systematic review (Hartvigsen et al., 2015). The quality criteria consist of five domains, with 15 items, which was scored as yes, OR no / unsure / not stated, so that we had a dichotomous outcome; and led to an overall scoring of low, moderate or high risk of bias; this decision being reached by consensus.

Besides the dichotomous outcome, other minor amendments were made to the criteria for clarification: criterion 3: 'population of interest' was changed to 'source population'; criteria 4 and 5: completeness of follow-up was defined as one-year and 85% of the inception cohort; criterion 14: we made to include the ability 'to account for other prognostic factors', as in a multivariate analysis.

Assessing methodological quality in the other studies was not possible due to the range of study designs that were retrieved.

2.4 *Data synthesis / analysis*

Studies were grouped according to study design and purpose, such as case studies, effectiveness studies, prognostic, prevalence and cross-sectional studies; and summarised and tabulated accordingly. A narrative summary was used mostly, except regarding prevalence, for which a meta-analysis was conducted, pooling individual studies for totals regarding Centralization, Directional Preference, and no Directional Preference.

3. Results

3.1.1 Study selection and characteristics of studies

2486 titles and abstracts were initially screened, 101 full texts were reviewed for eligibility, and 43 articles were finally included (see Figure 1). The 43 additional studies since the last review (May and Aina 2012) were: randomized controlled trials or controlled trials (10), or their secondary analyses (4), cohort studies (15), or case studies (10), and four cross-sectional studies (see Table 1 for full details). Seven papers related to patients with neck pain; the rest to patients with low back pain. Most studies involved patients with non-specific neck or back pain; but studies also included specific pain syndromes, including: sciatica or cervical radiculopathy (3), discogenic pain (2), candidates for lumbar disc surgery (2), potential red flags (1), and spinal stenosis (1). Although

centralization and DP were originally concepts related to the McKenzie approach of MDT, other classification systems were also referred to, which all involved some element of these clinical responses. Specifically these were the Treatment-Based classification system (Heinz and Hegedus, 2008; Stanton et al., 2011), the diagnosis-based clinical decision guide (Murphy and Hurwitz, 2011^{1,2}), the Hall classification system (Gregg et al., 2014), a combined McKenzie and patho-anatomical assessment (Flavell et al., 2016), and a discogenic sub-group from a wider classification system (Surkitt et al., 2016). These studies will be discussed relative to their study designs and purpose in the results section (Table 1).

3.1.2 Case study designs

Surprisingly, given the length of time that the concepts of centralization and directional preference have been extant, ten studies were of a case study design or case series, which is generally considered the weakest of study designs (Muir Gray, 1997). One case study (Desai et al., 2012), and two cohort studies (Van Helvoirt et al., 2014; 2016) described the effect of transforaminal epidural steroid injections at reversing cervical or lumbar disc herniations with radiculopathy from likely surgical candidates into potentially responding to conservative interventions and demonstrating centralization or directional preference. Other case studies demonstrated unusual presentations, such as

patients with spinal fractures, use of the treatment-based classification system, spinal stenosis, disc displacement, a positive cranio-cervical flexion test, a lateral component, or a patient with lower urinary tract symptoms. These patients generally responded with centralization or directional preference, reversed these pathologies, and showed improvement over time (Heintz and Hegedus, 2008; Takasaki et al., 2010; Padmanabhan et al., 2011; Williams et al., 2011; Ojha et al., 2013; Elenburg et al., 2016; Robinson, 2016; Takasaki and Herbowy, 2016; Wu and Rosedale, 2018).

3.1.3 Effectiveness of exercises based on centralization or directional preference

Some of the RCTs and trials of MDT utilising centralization and directional preference (DP) demonstrated significant improvements in Global Perceived Effect and disability at two-three months, and one year (Petersen et al., 2011; Albert and Manniche, 2012; Halliday et al., 2016; Franz et al., 2017;), and disability at one month (Garcia et al. 2013) compared to a range of controls. But there were no significant differences in other trials (Bonnet et al., 2011; Hosseinifar et al., 2013; Hagovska et al., 2014; Lopez-Diaz 2015; Moncelon 2015). In a retrospective analysis centralization or DP produced significantly better function, but not pain in patients with neck pain compared to non-centralizers (Edmond et al., 2014). Likewise in a small retrospective cohort of

patients with neck pain centralizers had better disability than non-centralizers (Rose et al., 2016). In RCTs disability, but not pain, was significantly better short-term (1m) compared to back school (Garcia et al., 2013); and also short-term (8w) in Global Perceived Effect, but not other outcomes, compared to motor control exercises (Halliday et al., 2016); whereas motor control exercises had a better outcome short-term in another trial (Hosseini et al., 2013).

3.1.4 Centralization and directional preference as treatment effect modifiers

Because of the nature of all study designs it was not possible to determine if either symptom response was a useful treatment effect modifier; no trial had determined their presence at baseline, and then randomized patients to management based on those concepts versus another management strategy.

3.1.5 Prognosis of centralization and directional preference and other prognostic factors

Centralization or peripheralization was not associated with any particular type of disc lesion, but both improved more than the no pain response group (Albert et al., 2012). Other secondary analyses looked at factors that improved outcomes. Older age was associated with better outcomes in a MDT group compared to a back school group (Garcia et al., 2016). Age, severity of leg pain, pain distribution, nerve root involvement and centralization were not found to

be treatment effect modifiers favouring MDT over manipulation; however nerve root involvement and peripheralization together did make the chance of success greater especially for the MDT group (Petersen et al., 2015).

In the other cohort studies or secondary analysis of RCTs centralization or directional preference compared to their absence or to guideline-based advice, was associated with better pain and functional outcomes, but mostly only in the short to medium-term (Werneke et al., 2011; Al-Obaidi et al., 2013; Edmond et al., 2014; Gregg et al. 2014; Rose et al., 2016; Surkitt et al., 2016; Werneke et al., 2018; Yarnbowicz et al. 2018); but did not add to predictive factors in one study (Werneke et al., 2016). (See table 1 for details)

3.1.6 Prevalence of centralization and directional preference

The occurrence of centralization and directional preference could be calculated from 21 studies (Table 2, which also shows the summary data from the previous review). Out of 5135 spinal patients centralization occurred in 2028 (39.5%), and directional preference in 1321 (26%); neither centralization nor directional preference was reported in 1716 (33.5%), and only 70 patients with LBP were not counted in one of these groups. The total included 720 patients with neck pain in who the following was reported: centralization, 56%, directional preference, 18%, and no directional preference, 26%. Centralization was found in 44% of those with chronic low back pain in the 11 papers that

reported specifically on chronic, as opposed to mixed symptom duration, of low back pain.

Five studies reported on the plane of movement of the directional preference; which was predominantly extension (about 80%) in four of them; generally smaller proportions with lateral movements (mostly 10-14%); and less than 10% for flexion (Table 2 for prevalence from previous and this review).

3.1.6 Cross-sectional studies

Only one recent study considered the reliability of therapists to identify centralization, directional preference, and other aspects of the MDT assessment process (Werneke et al. 2014). Reliability was generally weak, with 15 kappa values (k) all below 0.44 ; the level of training in MDT that the therapists had undertaken did not make any difference. Three judgements were poor ($k < 0.20$), 10 fair($k = 0.21-0.40$), and two moderate ($k = 0.41-0.60$) according to Altman (1991). Another study looked at the reliability and prevalence levels of the treatment-based classification system, which included directional preference (Stanton et al., 2011). One study looked at the effect of centralization and directional preference on tests for spinal control (Apeldoorn et al., 2016). Two studies examined the prevalence levels of different classification systems including MDT responses (Flavell et al., 2016; Mazzone et al., 2016)

3.1.7 Quality of the studies

Two authors (SM, NR) independently rated the quality of the 10 RCTs against the PEDro quality scale, and of 12 cohort studies against the quality scale (Hartvigsen et al., 2015). There was 97% and 84% agreement between raters (85 / 88 agreements; 126 / 150 agreements) respectively. Kappa values between the two authors were respectively 0.92 and 0.78, indicating excellent to good levels of reliability in the two judgements (Altman, 1991).

Rated against the PEDro quality scale it was concluded that four RCTs were low, three RCTs were moderate and three RCTs were high quality (Table 3). It was concluded that the quality of the 12 cohort studies were as follows: six were low, one was moderate and five were high quality (Table 4). Regarding the effect of quality, in the RCTs four of the six moderate and high quality trials had positive outcomes for the MDT groups. In the cohort studies two of the six moderate and high quality analyses had positive outcomes for the MDT groups; but in the others a clear dichotomous comparison was not possible.

4. Discussion

The present and previous review (May and Aina, 2012) bring together over 100 pieces of evidence about centralization and directional preference. This probably make them the most referenced clinical responses exposed during

routine physical examination of specific and non-specific spinal patients. The focuses in the previous review were on the definitions used for centralization, the prevalence of centralization and directional preference, and their role as prognostic indicators. There was limited evidence for them as treatment effect modifiers, variable evidence for the reliability of assessment of centralization, evidence for extension movement as the most common directional preference, and some evidence of a link between centralization and discogenic problems. Some of the focuses in the present review were similar, but study designs were different between the two reviews. The previous review contained 36 studies (N = 7113 patients) from which prevalence data could be extracted, whereas this review contained 21 studies (N = 5135 patients). Between reviews the prevalence of centralization was very similar, about 40%, whereas there was a marked decline in reporting of directional preference, from 70% down to 26%. The previous review only reported directional preference in five studies, compared to 13 in the present review; so it might be suggested that the present estimate is more robust. In the present review there was also a much clearer identification of the absence of centralization or directional preference, with a lack of either symptom response occurring in about a third of all patients. This has important clinical implications; the point of centralization and directional preference is that they direct patient management. If these

symptom responses are missing in about a third of patients, then patient management is seriously compromised. However centralization and directional preference between them would appear to account for a sizeable proportion (60-70%) of patients.

In the previous review symptom duration was a definite determinant of centralization; with 77% prevalence in acute patients (N = 317), and about 40% in patients with chronic and mixed duration symptoms (4305). In the present review very few patients with acute / sub-acute LBP were included (250); all the other studies reported mixed or chronic duration of symptoms. So it is not possible to make any present judgement about the role of symptom duration in the occurrence of these phenomena.

In the previous review centralization was generally associated with a good prognosis, and non-centralization with a poor prognosis, whereas directional preference had limited evidence. However, the latter had some evidence, and centralization limited evidence as a treatment effect modifier. In the present review there was some evidence that centralization and directional preference were positive prognostic indicators in eight out of nine studies, although only short to medium-term. Due to lack of appropriate study designs it was not possible to comment on either as treatment effect modifiers. There was conflicting evidence from recent RCTs that MDT-management based on these

concepts lead to more successful outcomes than control groups; with five out of ten trials either way.

In the previous review reliability of the MDT assessment process had been evaluated by six studies, and found to be very variable, mostly from moderate to good (Altman, 1991). In this review only one high quality study (Werneke et al., 2014) had evaluated reliability of several components of the MDT assessment process, including centralization and directional preference, and overwhelmingly found it fair at best. So, despite training, it appears that therapists are not reliable at classifying sub-groups that are purported to determine management.

In this review as in previous literature the movement of directional preference and centralization has been pretty consistent. Most patients appear to respond to extension forces, and far fewer proportions respond to flexion or lateral forces.

There are some differences from the previous review. There were 30 cohort studies or secondary reviews of such, 16 RCTs or secondary analysis of such, seven criterion validity studies, six reliability, two surveys and one mini case series - a total of 62 studies (May and Aina, 2012). In the present review there were 43 studies, of which there were 15 cohort studies, 14 RCTs or related studies, four cross-sectional studies, and ten case studies. It seems very

surprising that at this distance from the foundation and development of the McKenzie Method that virtually a quarter of the recent published articles are simply case studies, which have so limited a role in the development of evidence-based physiotherapy. Furthermore it is also disturbing that reliability amongst practitioners is still so untrustworthy. If even trained therapists cannot agree, then this is a major problem, as MDT is a practitioner-led classification system that leads to management strategies.

In the previous review there were several studies that appeared to link centralization with discogenic pain, although heterogeneous definitions of Centralization produced different results, very high levels of specificity were clearly linked to non-Centralization (Laslett et al. 2005). In the present review only one study attempted to explore this link, and found that type of disc lesions, such as, whether contained or extruded, were not associated with centralization or non-centralization responses, as might have been expected (Albert et al., 2012). However this study explored abnormal morphology, whereas the earlier study used provocation discography (Laslett et al. 2005), a much more direct way to establish a link between pathology and symptoms. In addition there was one case series and two cohort studies that evaluated the ability of transforaminal steroid injections to make disc herniations with

radiculopathy amenable to directional preference management (Desai et al., 2012; van Helvoirt et al., 2014; 2016).

These studies that investigated the McKenzie intervention using centralization or directional preference add further to the literature about the inconclusive benefit of MDT. There is some indication for their therapeutic value, but no further evidence that they might be treatment effect modifiers. However there is still reasonably good evidence that both are a positive prognostic sign. In other words the recognition of these clinical responses at baseline is a good indicator of outcome, perhaps regardless of the applied management strategy.

Additionally in this review we evaluated the quality of studies that were included; but unfortunately this provided limited further information, suggesting possibly that MDT had some added value, but not with any clarity.

5. Conclusion.

This review has synthesised literature from 62 previous studies, but also evaluated 43 additional studies. The importance of centralization and directional preference as prognostic factors is probably overwhelming; whether they indicate a particular management pathway is not clear.

Centralization and directional preference are still very important clinical indicators to monitor during the taking of patients' history and physical

examination. Although about a third of patients may demonstrate neither clinical response, they are still common and important prognostic indicators.

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