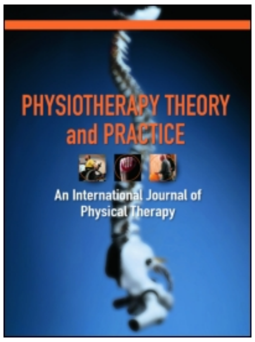

Taylor & Francis
Taylor & Francis Group

Physiotherapy Theory and Practice

An International Journal of Physical Therapy

ISSN: 0959-3985 (Print) 1532-5040 (Online) Journal homepage: http://www.tandfonline.com/loi/iptp20

The application of mechanical diagnosis and therapy on hip osteoarthritis: A case report

Lindsay Carlton ATC, DPT, Cert. MDT, Joseph R. Maccio DPT, Dip. MDT, Joseph G. Maccio MA, PT, Dip. MDT & Colin McGowan DPT, Cert. MDT

To cite this article: Lindsay Carlton ATC, DPT, Cert. MDT, Joseph R. Maccio DPT, Dip. MDT, Joseph G. Maccio MA, PT, Dip. MDT & Colin McGowan DPT, Cert. MDT (2018): The application of mechanical diagnosis and therapy on hip osteoarthritis: A case report, Physiotherapy Theory and Practice

To link to this article: https://doi.org/10.1080/09593985.2018.1485194

Published online: 20 Jun 2018.

PHYSIOTHERAPY THEORY AND PRACTICE
https://doi.org/10.1080/09593985.2018.1485194

Taylor & Francis
Taylor & Francis Group

CASE REPORT

The application of mechanical diagnosis and therapy on hip osteoarthritis: A case report

Lindsay Carlton ATC, DPT, Cert. MDT, Joseph R. Maccio DPT, Dip. MDT, Joseph G. Maccio MA, PT, Dip. MDT, and Colin McGowan DPT, Cert. MDT

Maccio Physical Therapy, Troy, NY, USA

ABSTRACT

Background: The prevalence and cost of hip osteoarthritis (OA) is rising. Mechanical diagnosis and therapy (MDT) is an orthopedic classification and treatment system based on mechanical and symptomatic response to repeated and sustained end-range movements. There has been no investigation of the association between MDT and patients diagnosed with hip OA. **Case Description**: This case report presents a 71-year-old female diagnosed with hip OA and matching the currently accepted clinical prediction rule (CPR) for symptomatic hip OA. The patient was classified and treated by a Diplomat of MDT and co-examiner using MDT. **Outcomes**: Short- and long-term (13 months) outcomes were excellent, demonstrating rapid abolishment of symptoms and improvement in function in 5 visits over 21 days. The patient demonstrated the ability to prevent and manage reoccurrence of symptoms independently; nevertheless, she received a total hip replacement which was not in accordance with current guidelines and recommendations. **Conclusion**: This case report raises questions about whether or not pathologies traditionally associated with the etiology of hip OA are actually at fault. Moreover, it raises questions about the utility of special tests and CPRs typically utilized to identify those structures. The case report provides preliminary evidence from one patient that MDT may be capable of providing effective short- and long-term outcomes in the management of hip OA.

ARTICLE HISTORY
Received 19 October 2017
Revised 5 April 2018
Accepted 13 April 2018

KEYWORDS
Arthroplasty; classification; derangement; McKenzie; radiography

Introduction

The prevalence and cost of hip osteoarthritis (OA) is rising (Birrell, Johnell, and Silman, 1999; Center for Disease Control and Prevention, 2013; Elders, 2000) . Currently, it is reported that one in four people will develop symptomatic hip OA in their lifetime (Jordan, 2012; Murphy et al, 2010). Lawrence et al. (2008) estimated the prevalence of clinical OA increased by nearly 6 million persons over a 10-year period. Elders (2000) expects this trend to continue, predicting overall annual healthcare costs for OA to reach 100-billion US dollars by 2020.

Although there is no proven benefit when compared to those who opted for a nonsurgical approach (Kemp et al, 2015), hip joint arthroplasty (THA) is the most common surgical procedure utilized to treat hip OA (Hando, Gill, Walker, and Garber, 2012). The risk for having a THA increases in the presence of radiographic findings (Franklin et al, 2011); however, hip OA can be present in the asymptomatic population (Lane et al, 2004). In addition, magnetic resonance imaging does not always accurately diagnose sources of pain in the hip joint (Martin, Irrgang, and Sekiya, 2008). Nevertheless, surgical candidacy continues to be based on diagnostic imaging (Larson, Giveans, and Taylor, 2011; McCarthy et al, 2011; Philippon, Briggs, Yen, and Kuppersmith, 2009).

The Scour and FABER Tests are common orthopedic special tests that predict OA; however, specificity (Martin, Irrgang, and Sekiya, 2008; Maslowski et al, 2010) and reliability to detect the condition being tested for is poor (Leibold, Huijbregts, and Jensen, 2008). As a result, test clusters and clinical prediction rules (CPR) have been established to identify patients with hip OA (Altman et al, 1991; Sutlive et al, 2008). Despite establishing a lack of utility for certain orthopedic special tests for hip OA in the literature (Leibold, Huijbregts, and Jensen, 2008; Martin, Irrgang, and Sekiya, 2008; Maslowski et al, 2010), the medical community continues to rely on them to help form medical diagnoses and decisions (Cook, 2010; Sutlive et al, 2008) which may be incorrect and costly (Cook, 2010).

Orthopedic special tests to identify pathology are unreliable (Leibold, Huijbregts, and Jensen, 2008), and positive radiographic findings can be found in the asymptomatic population (Birrell, Lunt, Macfarlane, and Silman, 2005; Cibere, 2006; Franklin et al, 2011; Lane

CONTACT Lindsay Carlton, ATC, DPT, Cert. MDT lindsaycarlton15@gmail.com Maccio Physical Therapy, 1 New Hampshire Ave, Troy, NY 12180, USA
Color versions of one or more of the figures in the article can be found online at www.tandfonline.com/iptp.

et al, 2004). This can lead to patho-anatomical diagnoses which simply focus on the location of dysfunction rather than the cause of such. Therefore, consideration of specific tissue involvement may not be relevant to treatment and may actually result in inappropriate clinical decisions and treatment. For those reasons, the utility of patho-anatomical assessment has been shown to be unreliable (May, Littlewood, and Bishop, 2006) and poorly understood (Maccio, Fink, Yarznbowicz, and May, 2016).

Non-specific, classification-based assessment and treatment systems, such as mechanical diagnosis and therapy (MDT), have demonstrated acceptable levels of reliability and efficacy in the management of patients with spinal and extremity impairments (Abady et al, 2014; Brennan et al, 2006; Childs et al, 2004; Cook, Hegedus, and Ramey, 2005; May and Aina, 2012; May and Ross, 2009). Ten peer-reviewed reports using MDT on temporomandibular, shoulder, elbow, thumb, and knee joints have demonstrated significant symptomatic and functional improvement (Aina and May, 2005; Aytona and Dudley, 2013; Kaneko, Takasaki, and May, 2009; Kidd, 2013; Krog and May, 2012; Littlewood and May, 2007; Lynch and May, 2013; Maccio, Fink, Yarznbowicz, and May, 2016; Menon and May, 2012; Rosedale et al, 2014).

One randomized control trial, guided by MDT assessment and treatment, studied people awaiting total knee replacement and found 40% of assessed knees were classified as derangement syndrome and had superior outcomes compared to wait-list controls (Rosedale et al, 2014). A survey of 388 extremity conditions using MDT syndrome classification found 31% of patients with hip pain were classified as derangement syndrome and 53% had a directional preference for extension (May and Rosedale, 2012).

There has been no publication reporting the management of hip OA utilizing MDT; therefore, we present this case report to begin to establish a base for further research. Current literature disputing diagnostic accuracy of the CPR for symptomatic hip OA is lacking (Cibulka et al, 2009). The aim of this case report is to demonstrate MDT evaluation, classification, and management of a patient with the medical diagnosis of moderate hip OA confirmed by radiograph. This report also looks to assess the ability of MDT assessment and treatment to rapidly change special tests results, functional deficits, and CPR criteria for this patient.

Clinical approach

Two examiners were used for data collection, evaluation, and treatment. The lead examiner (JRM) holds a doctorate in physical therapy (PT) and diploma in MDT. The co-examiner (LC) was a certified athletic trainer and third-year student of a doctoral PT program who had completed three of the four MDT courses. The patient was recruited through the normal business operations of a private outpatient orthopedic PT clinic.

The patient was evaluated using a mechanical assessment based on the principles of MDT (McKenzie and May, 2003). This involved the use of repetitive and sustained movements while monitoring symptomatic (e.g. pain) and mechanical baselines (e.g. strength, range of motion (ROM), and functional movements) to classify the patient into one of the following syndromes: derangement, dysfunction, posture, or other (Table 1). Derangement is defined as an internal dislocation of articular tissue of unknown origin which causes a disturbance in the normal resting position of the affected joint surface, resulting in pain and obstruction to movement (McKenzie and May, 2003). Treatment of derangement involves repeated movement in one direction known as directional preference. Directional preference is associated with improvement in symptoms and/or mechanical presentation (e.g. ROM and strength) (McKenzie and May, 2003). Dysfunction syndrome is defined as mechanical deformation of structurally impaired soft tissue which results in pain and limited ROM. Dysfunction is subcategorized into articular dysfunction and contractile dysfunction. Treatment of dysfunction involves progressive tissue loading to remodel the articular or contractile tissue. Posture syndrome is defined as mechanical deformation of normal soft tissues or vascular insufficiency arising from prolonged positional stresses resulting in pain. The primary intervention for posture syndrome is patient education and avoidance of the offensive position (McKenzie and May, 2003).

Patient-specific active, passive, and functional concordant signs were established before beginning repeated movement testing. ROM assessment is reliable among trained clinicians (Cook and Hegedus, 2012). Baselines of flexion and abduction were taken of the patient's painful hip using a standard 18" plastic goniometer in supine lying. Hip internal and external rotations were performed in supine lying with knee and hip flexion to 90 degrees. Hip extension baseline ROM was assessed in prone lying with knee flexion to 90 degrees. Manual muscle testing (MMT) was performed according to the procedures outlined by Kendall et al. (2005). The Scour and FABER Tests were performed as described by Cook and Hegedus (2012). Functional concordant signs, or activities that produce a pain or symptom which is familiar to the patient, (i.e. squatting and step-up) were assessed for quality of movement and production of pain.

The primary outcome measures were the Numeric Pain Rating Scale (NPRS), Western Ontario and McMaster Osteoarthritis Index (WOMAC), and the Hip

Table 1. MDT syndromes.

Classification	Definition	Treatment Strategy
Derangement	• An internal dislocation of articular tissue of unknown origin which causes a disturbance in the normal resting position of the affected joint surface, resulting in pain and obstruction to movement	• Repeated movement in one direction known as directional preference • Directional preference is associated with improvement in symptoms and/or mechanical presentation (i.e. range of motion, strength, etc.) • Movement in the opposite direction may cause movement or symptoms to worsen and is known as directional vulnerability.
Dysfunction	• Mechanical deformation of structurally impaired soft tissue which results in pain and limited range of motion • The abnormal tissue can be a result of previous trauma, inflammatory, or degenerative processes that cause contraction, scarring, adherence, adaptive shortening, or imperfect repair. • Subcategorized into articular dysfunction and contractile dysfunction	• Progressive tissue loading to remodel the articular or contractile tissue
Postural Syndrome	• Non-pathological mechanical deformation of normal soft tissues or vascular insufficiency arising from prolonged positional stresses affecting the articular structures or the contractile muscles, their tendons, or the periosteal insertions	• Patient education and avoidance of the offensive position
Other	• Pain or condition of non-mechanical origin • Examples of these conditions include, but are not limited to, cancer, fracture, vascular pathology, chronic pain syndrome, trauma, soft tissue pathology, post-surgical, and inflammatory conditions	• Referral to appropriate physician or specialist

Fear Avoidance and Behaviors Questionnaire (FABQ). These validated measures assess pain, functional deficit, and fear, respectively (Stratford and Spadoni, 2001; Van Baar et al, 1998a; Waddell et al, 1993). The NPRS is an 11-point scale which measures a gradient of pain from 0 (no pain) to 10 (most intense pain imaginable). The WOMAC assesses pain, stiffness, and physical function in the presence of hip OA utilizing 24 questions on a 5-point Likert scale for a maximum score of 96; higher scores indicate worse pain, stiffness, and functional limitations. The Hip FABQ measures fear of pain, and consequently avoidance of physical activity, via 16 questions scored from 0 to 6 with higher scores indicative of greater fear and avoidance behaviors. Assessment was performed at the first, third, and last visit. Follow-up phone interviews were conducted 1, 3, 6, 12, and 13 months after discharge.

Case description

A 71-year-old female presented with the primary complaint of intermittent left lateral hip pain accompanied by anterior groin and thigh pain. She received the medical diagnosis left hip OA confirmed by radiographs from her general practitioner and was referred to an orthopedic surgeon. The surgeon recommended PT 2 times per week for 6 weeks with a caveat that THA would be considered if PT was not effective.

Prior to attending our clinic, the patient attended 12 sessions at an outpatient hospital-setting clinic and was 100% compliant with the home exercise program. Her PT sessions consisted of hip strengthening, stretching, and aerobic conditioning. She stated the sessions were beneficial, although her overall pain and functional limitations did not improve. She lived independently, with her husband, in the second story of a multi-family housing unit which she maintained with tenants. She was an avid traveler and currently could not walk well or without pain while on excursion. She was unwilling to accept her functional deficits and began considering THA since conservative management had failed. She consulted a Certified McKenzie Spine and Extremity Clinic for a mechanical evaluation and second opinion of her hip condition.

Evaluation and classification – visit 1

Symptoms were present for 2 years and had worsened in the past few months. The patient's averaged NPRS was 8/10 which limited her function by 70% and she required no assistive devices during ambulation but did walk with a painful limp. Primary functional limitations were ambulation, stairs, bending, and lifting. The patient's WOMAC score of 53 indicated severe functional limitation (Table 2). She reported taking no medication for this condition. No comorbidities were identified on systems review or reported by the patient and previous medical history was unremarkable.

ROM assessment revealed a major visible loss of left hip flexion, extension, and internal rotation. Strength was limited throughout secondary to pain and limited

Table 2. Outcome measures before treatment.

Outcome measures before treatment	Visit 1	Visit 2	Visit 3	Visit 4	Visit 5
NPRS	8/10	4/10	2/10	2/10	2/10
WOMAC	53	–	19	–	11
FABQ	12	–	16	–	3

mobility. FABER and Scour Tests provoked the patient's hip symptoms and concordant signs were established (Table 3). The patient fit the CPR for OA; she presented with four of the five predictor variables indicating 91% probability that symptomatic hip OA was present (Sutlive et al, 2008). The patient did not qualify for either diagnostic test cluster developed and recognized by the American College of Rheumatology for hip OA (Table 3) (Altman et al, 1991). She also had pain and limp with ambulation, could only perform sit-to-stand with use of arms and this was painful and jerky, had pain squatting, pain with step-up, and pain with active abduction in standing.

A typical orthopedic screen was completed on the patient (Cook and Hegedus, 2012). This involves gross active and passive movement of large joints, strength testing, assessment of pain, and neurological screen. This general screen did not yield any positive signs for a lumbar condition; therefore, the hip joint was the focus of our treatment as the patient presented with moderate hip OA and was positive for the ACR diagnostic test cluster and CPR. The MDT Diplomat (JRM) was confident that there was not a relevant lumbar component since assessment determined no lumbar pain, neurological deficit, historical signs of a lumbar derangement, and no obvious lumbar movement loss.

Moving the lumbar spine to end range is a required MDT testing procedure to rule out spinal pathology (McKenzie and May, 2003). The treating

Table 3. Examination findings before treatment.

Examination findings before treatment	Visit 1	Visit 2	Visit 3	Visit 4	Visit 5
ROM (degrees)					
Flexion	70	–	110	–	110
Extension	15	–	34	–	34
Abduction	32	–	45	–	50
Internal rotation	48	–	45	–	55
External rotation	35	–	50	–	50
Strength (MMT)					
Flexion	4+/5	–	5/5	–	5/5
Extension	4+/5	–	4+/5	–	5/5
Abduction	4+/5	–	4+/5	–	5/5
Internal rotation	4+/5	–	5/5	–	5/5
External rotation	4/5	–	5/5	–	5/5
Special tests					
Scour test	Positive	–	Positive	–	Positive
FABER test	Positive	–	Negative, strain	–	Negative
Squat test	Positive	–	Negative	–	Negative
Concordant signs					
Step-up	Pain	Less Pain	Weakness only	Improvement but still weak	Strength improved
Active abduction in standing	8/10 pain	Strainful	No pain	No pain	No pain
Hip flexion in supine	Pain onset at 70 degrees	Pain onset at 90 degrees	Pain onset at 110 degrees	No pain, pressure reported	No pain
Gait	Antalgic	Antalgic, less pain	Antalgic, less pain	Pain-free limp	Pain-free limp
Sit-to-stand	Pain, jerky, use of arms	Less pain, no jerk, less use of arms	No pain	No pain	No pain
CPR					
Squat aggravates symptoms	Yes	–	No	–	No
Active hip flexion causes lateral hip pain	Yes	–	No	–	No
Scour Test with adduction causes lateral hip or groin pain	Yes	–	Yes	–	Yes
Active hip extension causes pain	Yes	–	No	–	No
Passive internal rotation less than or equal to 25	No	–	No	–	No
Total variables	4 variables	–	1 variable	–	1 variable
ACR guidelines					
Test cluster 1					
Pain reported in the hip	Yes	–	Yes	–	No
Less than 115 degrees of hip flexion	Yes	–	Yes	–	Yes
Less than 15 degrees of hip internal rotation	No	–	No	–	No
Test cluster 2					
Pain with hip internal rotation	Yes	–	Yes	–	Yes
Less than 60 minutes of morning stiffness	No	–	No	–	No
Beyond 50 years of age	Yes	–	Yes	–	Yes

Diplomat has previously found repeated movement testing, yielding hip directional preference, and a significant improvement in pain or function is more effective than first-performing spinal movements to rule out spinal involvement. If hip directional preference was not found, repeated movement testing for the spine would be performed.

In an MDT examination, mechanical or symptomatic responses are tested first in the sagittal plane. If there is no favorable response, then alternative strategies are employed using repeated movement testing in the transverse or frontal planes (McKenzie, 1981; McKenzie and May, 2003). The Diplomat's past experience using MDT in hip examination found if patients reported variable functional pain pattern (e.g. walking or stair negotiation was only sometimes painful), they were likely to fit the MDT classification of hip derangement (McKenzie and May, 2003). Although not validated, the treating therapist has recognized a common clinical pattern in the hip (Figure 1). The Diplomat has found hip derangements with limited passive flexion and passive internal rotation with end-range pain, and limited passive extension with less or no end-range pain, likely had a directional preference for hip extension (Figure 2a-b). If extension was not the directional preference, then hip extension combined with internal rotation (Figure 3) or hip internal rotation in a neutral sagittal position (Figure 4) were likely to be the patient's directional preference (May and Rosedale, 2012).

The patient's first repeated test movement was partially loaded hip extension performed with her painful extremity on a chair with her knee bent (Figure 2a). Ten repetitions were performed by the patient to end range. Each repetition produced end-range pain that was no worse. Continued repetitions resulted in decreasing end-range pain that was abolished after 40 repetitions. Concordant signs of step-up and active hip abduction no longer caused pain, a statistically significant change of more than two points on the NPRS (Stratford and Spadoni, 2001). She reported less pain with walking. Scour and FABER Tests were negative. The patient no longer fit the CPR for hip OA (Table 4); prior to 40 extension self-mobilizations, the patient had 4 of the 5 predictor variables. Consequently, a provisional classification of derangement syndrome with directional preference of extension was established. After assessment and treatment, directional preference was successfully established because the CPR criteria, special tests, and concordant were no longer positive. This rapid change in clinical presentation is not typical of true moderate hip OA and therefore confirms the classification of derangement syndrome as a hallmark of this syndrome is rapid change of clinical baselines (McKenzie and May, 2003).

The patient was educated that this was the symptomatic and mechanical response of a joint derangement that has the ability to rapidly improve and is associated with a good prognosis (Long, Donelson, and Fung, 2004; Long, May, and Fung, 2008; McKenzie and May, 2003).

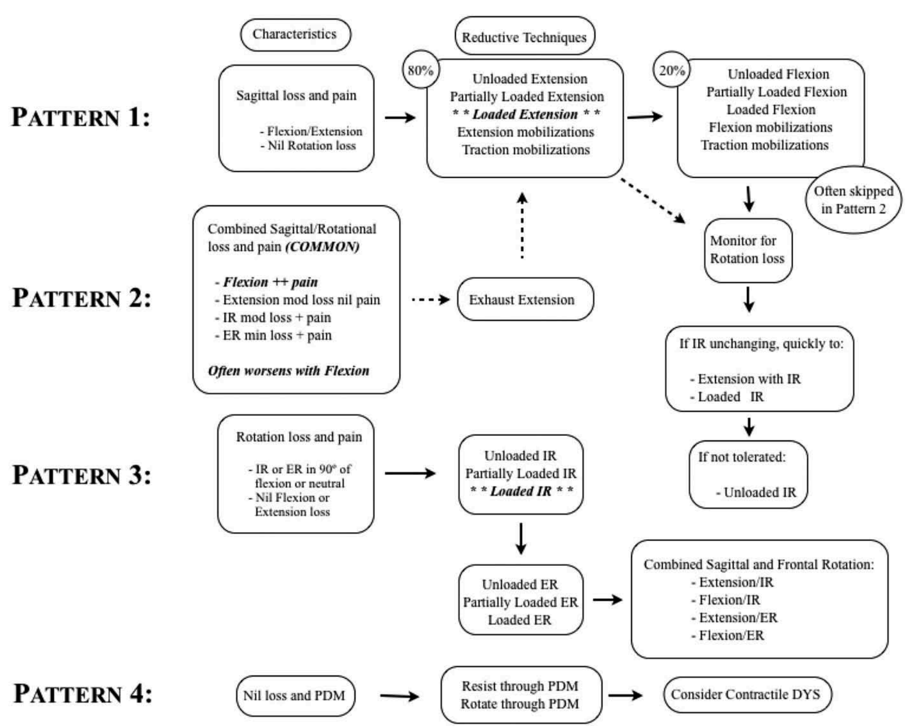

Figure 1. Common clinical patterns in the hip.

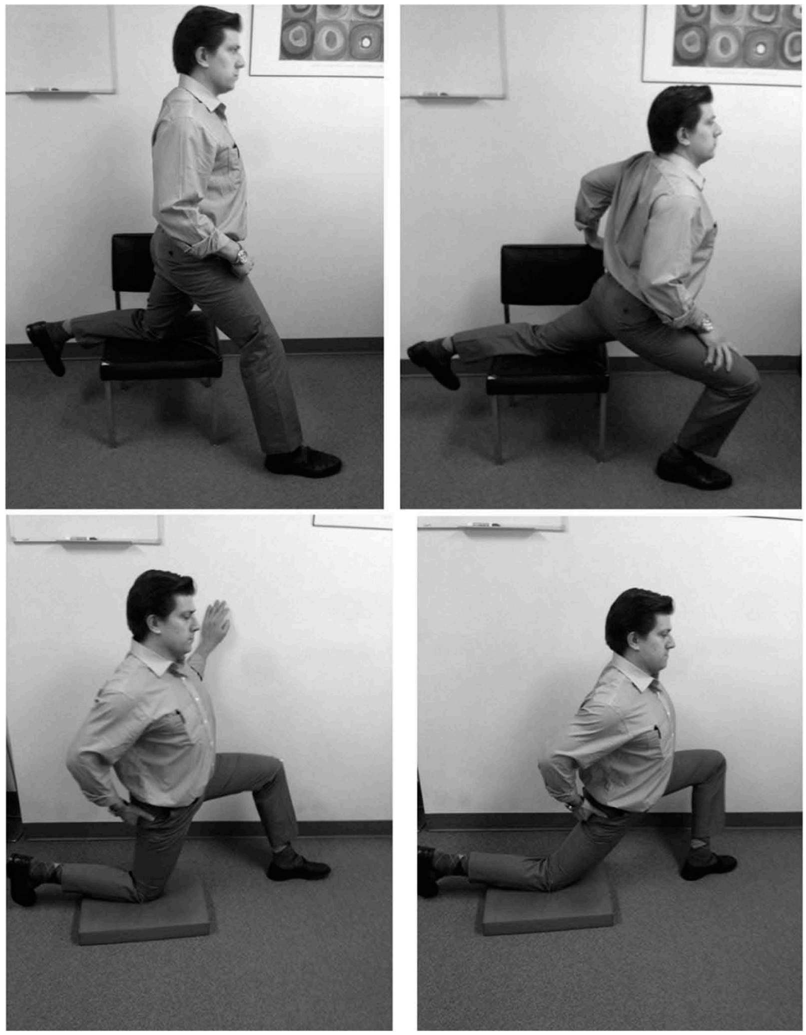

Figure 2. (**a**) Partially loaded hip extension. (**b**) Loaded hip extension.

Figure 3. Loaded hip extension in internal rotation.

She was instructed to perform 10 repetitions every hour or if she was experiencing symptoms. She was scheduled for re-evaluation in 48 hours to confirm directional preference of hip extension and classification of derangement.

Figure 4. Loaded hip internal rotation.

Re-evaluation and outcomes – visit 2

The patient returned in 48 hours and reported her condition improved by 25–30%. Since all concordant signs were abolished on the initial examination, the Diplomat expected significantly higher improvement upon reevaluation. This could have been a fault of the clinician not establishing the most reductive movement, a change in the patient's mechanical pattern, or a fault of the patient not performing extension often enough or to end range. The patient reported being compliant. All concordant signs (Table 3) were positive upon assessment. Step-up was painful, but less so than on her first visit. Active hip abduction caused strain but was not painful, painful limp was noted with ambulation but improved since her first visit, and her sit-to-stand was less painful with less reliance on arms and movement was not jerky. Repeated partially loaded hip extension self-mobilizations once again abolished or improved all concordant signs (Table 4). To generate a potentially longer lasting symptomatic improvement, maximal patient-generated force was added by placing more weight bearing through the symptomatic extremity and by applying patient-generated overpressure (Figure 2b). The patient's concordant signs remained pain-free indicating more force would not worsen symptoms. Step-up, standing hip abduction, and sit-to-stand were pain-free and walking was less painful.

Visit 3

Seven days later, she reported 60% perceived improvement in her condition. Walking and bending were significantly better although she still felt weak on stairs. She had no pain with step-up, standing hip abduction, squat, or sit-to-stand; however, she still had pain with walking but it was less than that on visit 2. Significant improvement in the patient's functional measures (Table 2) was noted and she did not fit the CPR for hip OA (Table 3), implying symptomatic hip OA was unlikely (Altman et al, 1991; Sutlive et al, 2008).

However, passive ROM and pain responses to all concordant signs were present once again. She reported that she was not performing the technique to the same end range at home as she was in clinic, which resulted in abolishment or improvement of all concordant signs. Her passive ROM and pain responses improved and special tests were negative (Table 4). The patient was instructed that hip extension must reach end range to improve and maintain gains (McKenzie and May, 2003).

Table 4. Examination findings after treatment.

Examination findings after treatment					
ROM					
Flexion	95	–	115	–	115
Extension	20	–	34	–	34
Abduction	35	–	47	–	55
Internal rotation	48	–	50	–	60
External rotation	35	–	50	–	50
Strength					
Flexion	4+/5	–	5/5	–	5/5
Extension	4+/5	–	4+/5	–	5/5
Abduction	4+/5	–	4+/5	–	5/5
Internal rotation	4+/5	–	5/5	–	5/5
External rotation	4/5	–	5/5	–	5/5
Special tests					
Scour test	Positive	–	Positive, less pain	–	Positive, less pain
FABER test	Positive, less pain	–	Negative, less strain	–	Negative
Squat test	Positive, less pain	–	Negative	–	Negative
Concordant signs					
Step-up	No pain	No pain	No pain	No pain	No pain
Active abduction in standing	No pain	No pain	No pain	No pain	No pain
Hip flexion in supine	Pain onset at 90 degrees	Pain onset at 100 degrees	Pain onset at 115 degrees	No pain	No pain
Gait	Antalgic, less pain	Antalgic, less pain	Antalgic, less pain	Pain-free limp	Pain-free limp
Sit-to-stand	Less pain and use of arms	No pain, less use of arms	No pain, no use of arms	No pain	No pain
CPR					
Squat aggravates symptoms	No	–	No	–	No
Active hip flexion causes lateral hip pain	No	–	No	–	No
Scour Test with adduction causes lateral hip or groin pain	Yes	–	Yes	–	Yes
Active hip extension causes pain	No	–	No	–	No
Passive internal rotation less than or equal to 25	No	–	No	–	No
Total variables	4 variables	–	1 variable	–	1 variable
ACR guidelines					
Test cluster 1					
Pain reported in the hip	Yes	–	No	–	No
Less than 115 degrees of hip flexion	Yes	–	No	–	Yes
Less than 15 degrees of hip internal rotation	No	–	No	–	No
Test cluster 2					
Pain with hip internal rotation	Yes	–	Yes	–	Yes
More than 60 minutes of morning stiffness	No	–	No	–	No
Beyond 50 years of age	Yes	–	Yes	–	Yes

Visit 4

One week later, she reported 70% improvement in her condition. She reported 2 days immediately after her third visit she was significantly worse, negatively impacting her ability to sleep, squat, and walk. She continued to perform her self-mobilizations, which had no effect when she was in pain. After the 2-day exacerbation, hip extension began to have a positive symptomatic and mechanical response again. She had no pain for the last 2 days with prolonged walking, stairs, and bending.

The patient was instructed to contact the office if this happened again as it indicated her directional preference changed. The treating Diplomat had seen this presentation several times and it required adding internal rotation to extension (Figure 3) or internally rotating the hip in a neutral sagittal plane (Figure 4).

She presented with a pain-free limp during ambulation and still felt weak with step-up. Repeated hip extension was tested once more with abolishment of symptoms and concordant signs (Table 4). This confirmed directional preference for extension without the need for adding internal rotation. The same instruction was given for frequency and the patient was encouraged to return to all previously limited functional activities.

Visit 5

At the final visit, she reported 80% perceived improvement in condition. Ambulation, stairs, and bending remained pain-free without weakness, although she still had a limping gait despite having full hip abduction strength at 5/5. All functional measures were improved (Tables 2 and 4) and she reported an average 2/10 NPRS pain once or twice a day with various, variable movements of the hip that would subside immediately. No pain would linger so there was no need to perform corrective self-mobilization after such instances. She was no longer concerned about her prognosis and felt she was able to continue self-management without our guidance. Hip Scour was the only movement that caused her symptom and was significantly reduced after end-range hip extension.

She was instructed to continue performing 10 repetitions of loaded hip extension 3–4 times daily for the next few months and twice daily for the next year. She was instructed to increase repetition if symptoms began to worsen and to contact our office if hip extension no longer had a positive effect.

Long-term follow-up

At 1- and 3-month follow-up, she was continuing to note improvements. She performed her self-mobilization four or five times daily. At 6-month follow-up, the patient reported being 95% better, stating that she did not feel as though there was a strength deficit or loss of motion, rather occasional pain with bending and prolonged walking. She had recently traveled cross-country and went on several hikes with only mild muscular soreness. She was instructed to continue performing her corrective exercise at least three times daily and to increase the frequency when she was walking or bending often throughout her day.

At 1-year follow-up, the patient surprisingly reported she had her hip replaced, 3 days prior, at the suggestion of her orthopedic surgeon. She had continued to perform loaded hip extension self-mobilizations up until the THA. She reported she was not having pain prior to the surgical procedure, but continued to have a pain-free limp. The patient received home PT for 2 weeks after the procedure and was given an independent home program at her 1-month surgical follow-up. She reported having no pain 1 month after her THA, which was so prior to her THA.

Discussion

The patient presented to the clinic with a script from her orthopedic surgeon, who had ordered radiography subsequently diagnosing hip OA. She had previously received 12 sessions of traditional PT without resolve. The patient then sought a MDT assessment and after 5 visits in 21 days, the patient was discharged with 80% perceived improvement in condition without pain, functional impairments, nor predictor variables for hip OA (Sutlive et al, 2008). She continued to report improvements during phone interviews with 95% perceived improvement in condition 6 months later.

At 1-year follow-up, the patient had no pain or functional deficit but, despite that, had just received THA. The patient initially presented with mechanical hip pain, resulting from a disturbance in the normal resting position of the joint which was restored using MDT. In the absence of pain and functional limitation, surgical candidacy was primarily based on radiographic diagnosis, which goes against the current treatment and management recommendations for hip OA (Altman et al, 1991; Birrell, Lunt, Macfarlane, and Silman, 2005; Juhakoski et al, 2013; Martin, Irrgang, and Sekiya, 2008). When asked why she opted for surgery, she stated her surgeon told her she would need the procedure eventually based on the degenerative changes seen on imaging and she preferred to do it now, when she was younger. There is currently no literature to support or refute the assumption that THA would eventually be needed. In this case, THA did not provide any further benefit to the patient's previous function or pain, rather only exposed her to greater risk and more cost.

The high rate of incidental radiographic hip OA findings in the asymptomatic population (Birrell, Lunt, Macfarlane, and Silman, 2005; Cibere, 2006; Franklin et al, 2011; Lane et al, 2004), poor performance of orthopedic clinical special tests (Martin, Irrgang, and Sekiya, 2008; Maslowski et al, 2010; Sutlive et al, 2008), high cost of current management strategies (Center for Disease Control and Prevention, 2013; Medicare Payment Advisory Commission, 2015), and lack of consistent positive treatment outcomes (Bennell and Hinman, 2011; Beswick et al, 2012; Dawson, Fitzpatrick, Carr, and Murray, 1996; French, Brennan, White, and Cusack, 2011; Hoeksma et al, 2004; McCormick, Nwachukwu, Alpaugh, and Martin, 2012; McNair, Simmonds, Boocock, and Larmer, 2009; Messier, Thompson, and Ettinger, 1997; Pisters et al, 2007; Smidt, De Vet, Bouter, and Dekker, 2005; Van Baar et al, 2001, 1998b; Zhang et al, 2005) warrant the investigation of an alternative evaluation and treatment method. Non-specific classification-based evaluation and treatment methods, such as MDT, have been suggested as an alternative (Abady et al, 2014; Aina and May, 2005; Aytona and Dudley, 2013; Brennan et al, 2006; Childs et al, 2004; Cook, Hegedus, and Ramey, 2005; Kaneko, Takasaki, and May, 2009; Kidd, 2013; Krog and May, 2012; Littlewood and May, 2007; Lynch and May, 2013; Maccio, Fink, Yarznbowicz, and May, 2016; May and Aina, 2012; May and Ross, 2009; Menon and May, 2012; Rosedale et al, 2014).

With the incident of THA rising, the use of MDT assessment can effectively differentiate between mechanical pain and symptomatic arthritis. It is becoming clear that mechanical derangements can mimic pathological conditions and MDT has been shown to rapidly change the results of orthopedic special tests (Kaneko, Takasaki, and May, 2009; Kidd, 2013; Lynch and May, 2013; Maccio, Fink, Yarznbowicz, and May, 2016). In this case report, the predictor variables were no longer present once the derangement was resolved, which begins to question the utility of the CPR in the presence of mechanical pain. The diagnostic test clusters have not been updated or altered since their establishment in 1991. To the authors' knowledge, this is the first clinical report to call question to their utility and accuracy. Recognition of this is essential to decrease patient exposure to undue harm and increased costs as the proper treatment for mechanical derangements is repeated or sustained movements (McKenzie and May, 2003), not surgical intervention.

Further research is warranted using a larger sample to assess the utility of the CPR and to develop larger data sets and analysis of clinical outcomes for mechanical joint pain. Although this clinical example is compelling, as a single case report, the findings are not generalizable to the larger population. Additionally, inclusion of more functional gait measures (e.g. Timed Up & Go, Dynamic Gait Index, step length difference, and gait speed) in future research protocols might enhance the objectivity and provide greater insight regarding outcomes.

Conclusion

It is important to recognize the potential utility and cost savings of an MDT assessment. The patient was seen for 5 visits over a 21-day period with excellent short-term outcomes, demonstrating rapid abolishment of symptoms and return to prior levels of function. Long-term follow-up also established independent maintenance without need for further medical care; however, the patient was led to believe otherwise and had surgery for a pain-free joint. The cost associated with her MDT management was $284.28 compared to the average annual direct and indirect cost of hip OA management which was reported to be $5700 (Maetzel et al, 2004). This yielded a 2005% reduction in cost prior to her procedure. If these results are applicable to a larger sample, MDT may have the potential of significant cost saving to the currently rising orthopedic health costs and may prevent unwarranted surgical procedures.

Declaration of interest

The authors report no conflicts of interest.

References

Abady AH, Rosedale R, Overend TJ, Chesworth BM, Rotondi M 2014 Inter-examiner reliability of diplomats in the mechanical diagnosis and therapy system in assessing patients with shoulder pain. Journal of Manual and Manipulative Therapy 22: 199–205.

Aina A, May S 2005 A shoulder derangement. Manual Therapy 10: 159–163.

Altman R, Alarcon G, Applerouth D, Bloch D, Borenstein D, Brandt K, Brown C, Cooke TD, Daniel W, Feldman D, Greenwald R, Hochberg M, Hoswell D, Ike R, Kapila P, Kaplan D, Koopman W, Marino C, McDonald E, McShane DJ, Medsger T, Michel B, Murphy WA, Osial T, Ramsey-Goldman R, Rothschild B, Wolfe F 1991 The American College of Rheumatology criteria for the classification and reporting of osteoarthritis of the hip. Arthritis and Rheumatism 34: 505–514.

Aytona MC, Dudley K 2013 Rapid resolution of chronic shoulder pain classified as derangement using the McKenzie method: A case series. Journal of Manual and Manipulative Therapy 21: 207–212.

Bennell KL, Hinman RS 2011 A review of the clinical evidence for exercise in osteoarthritis of the hip and knee. Journal of Science and Medicince in Sport 14: 4–9.

Beswick AD, Wylde V, Gooberman-Hill R, Blom A, Dieppe P 2012 What proportion of patients report long-term pain after total hip or knee replacement for osteoarthritis? A systematic review of prospective studies in unselected patients. British Medical Journal 2: e000435.

Birrell F, Johnell O, Silman A 1999 Projecting the need for hip replacement over the next three decades: Influence of changing demography and threshold for surgery. Annals of the Rheumatic Diseases 58: 569–572.

Birrell F, Lunt M, Macfarlane G, Silman A 2005 Association between pain in the hip region and radiographic changes of osteoarthritis: Results from a population-based study. Rheumatology 44: 337–341.

Brennan GP, Fritz JM, Hunter SJ, Thackeray A, Delitto A, Erhard RE 2006 Identifying subgroups of patients with acute/subacute "nonspecific" low back pain: Results of a randomized clinical trial. Spine 31: 623–631.

Center for Disease Control and Prevention 2013 Cost of Hospital Discharges with Common Hospital Operating Room Procedures in Nonfederal Community Hospitals, by Age and Selected Principal Procedure: United States, Selected Years 2000–2011. Agency for Healthcare Research and Quality. http://www.cdc.gov/nchs/data/hus/2013/116.pdf.

Childs JD, Fritz JM, Flynn TW, Irrgang JJ, Johnson KK, Majkowski GR, Delitto A 2004 A clinical prediction rule to identify patients with low back pain most likely to benefit from spinal manipulation: A validation study. Annals of Internal Medicine 141: 920–928.

Cibere J 2006 Do we need radiographs to diagnose osteoarthritis? Best Practice & Research Clinical Rheumatology 20: 27–38.

Cibulka MT, White DM, Woehrle J, Harris-Hayes M, Enseki K, Fagerson TL, Solver J, Godges JJ 2009 Hip pain and mobility deficits – hip osteoarthritis: Clinical practice guidelines linked to the international classification of functioning, disability, and healthfrom the orthopaedic section of the American Physical Therapy Association. Journal of Orthopaedic and Sports Physical Therapy 39: A1–A25.

Cook C 2010 The lost art of the clinical examination: An overemphasis on clinical special tests. Journal of Manual and Manipulative Therapy 18: 3–4.

Cook C, Hegedus E 2012 Orthopedic Physical Examination Tests: An Evidence-Based Approach (2nd edn). New York: Pearson Higher Education.

Cook C, Hegedus EJ, Ramey K 2005 Physical therapy exercise intervention based on classification using the patient response method: A systematic review of the literature. Journal of Manual and Manipulative Therapy 13: 152–162.

Dawson J, Fitzpatrick R, Carr A, Murray D 1996 Questionnaire on the perceptions of patients about total hip replacement. Journal of Bone and Joint Surgery (Br) 78: 185–190.

Elders M 2000 The increasing impact of arthritis on public health. Journal of Rheumatology 60: 6–8.

Franklin J, Ingvarsson T, Englund M, Ingimarsson O, Robertsson O, Lohmander LS 2011 Natural history of radiographic hip osteoarthritis: A retrospective cohort study with 11–28 years of followup. Arthritis Care and Research 63: 689–695.

French HP, Brennan A, White B, Cusack T 2011 Manual therapy for osteoarthritis of the hip or knee – A systematic review. Manual Therapy 16: 109–117.

Hando BR, Gill NW, Walker MJ, Garber M 2012 Short- and long-term clinical outcomes following a standardized protocol of orthopedic manual physical therapy and exercise in individuals with osteoarthritis of the hip: A case series. Journal of Manual and Manipulative Therapy 20: 192–200.

Hoeksma HL, Dekker J, Ronday HK, Heering A, Van Der Lubbe N, Vel C, Breedveld FC, Van Den Ende CH 2004 Comparison of manual therapy and exercise therapy in osteoarthritis of the hip: A randomized clinical trial. Arthritis and Rheumatism 51: 722–729.

Jordan J 2012 The Johnson County osteoarthritis project: Arthritis and disability. Center for Disease Control and Prevention http://www.cdc.gov/arthritis/funded_science/current/johnston_county.htm.

Juhakoski R, Malmivaara A, Lakka TA, Tenhonen S, Hannila ML, Arokoski JP 2013 Determinants of pain and functioning in hip osteoarthritis – A two-year prospective study. Clinical Rehabilitation 27: 281–287.

Kaneko S, Takasaki H, May S 2009 Application of mechanical diagnosis and therapy to a patient diagnosed with de Quervain's disease: A case study. Journal of Hand Therapy 22: 278–284.

Kemp JL, MacDonald D, Collins NJ, Hatton AL, Crossley KM 2015 Hip Arthroscopy in the setting of hip osteoarthritis: Systematic review of outcomes and progression to hip arthroplasty. Clinical Orthopaedics and Related Research 473: 1055–1073.

Kendall F, McCreary E, Provance P, Rodgers M, Romani W 2005 Muscles, Testing and Function: With Posture and Pain (5th edn). Philadelphia: Lippincott Williams & Wilkins.

Kidd J 2013 Treatment of shoulder pain utilizing mechanical diagnosis and therapy principles. Journal of Manual and Manipulative Therapy 21: 168–173.

Krog C, May S 2012 Derangement of the temporomandibular joint: A case study using mechanical diagnosis and therapy. Manual Therapy 17: 483–486.

Lane NE, Nevitt MC, Hochberg MC, Hung YY, Palermo L 2004 Progression of radiographic hip osteoarthritis over eight years in a community sample of elderly white women. Arthritis and Rheumatism 50: 1477–1486.

Larson CM, Giveans MR, Taylor M 2011 Does arthroscopic FAI correction improve function with radiographic arthritis? Clinical Orthopaedics and Related Research 469: 1667–1676.

Lawrence RC, Felson DT, Helmick CG, Arnold LM, Choi H, Deyo RA, Gabriel S, Hirsch R, Hochberg MC, Hunder GG, Jordan JM, Katz JN, Kremers HM, Wolfe F 2008 Estimates of the prevalence of arthritis and other rheumatic conditions in the United States. Part II. Arthritis and Rheumatism 58: 26–35.

Leibold MR, Huijbregts PA, Jensen R 2008 Concurrent criterion-related validity of physical examination tests for hip labral lesions: A systematic review. Journal of Manual and Manipulative Therapy 16: E24–E41.

Littlewood C, May S 2007 A contractile dysfunction of the shoulder. Manual Therapy 12: 80–83.

Long A, Donelson R, Fung T 2004 Does it matter which exercise? A randomized control trial of exercise for low back pain. Spine 29: 2593–2602.

Long A, May S, Fung T 2008 The comparative prognostic value of directional preference and centralization: A useful tool for front-line clinicians? Journal of Manual and Manipulative Therapy 16: 248–254.

Lynch G, May S 2013 Directional preference at the knee: A case report using mechanical diagnosis and therapy. Journal of Manual and Manipulative Therapy 21: 60–66.

Maccio JR, Fink S, Yarznbowicz R, May S 2016 The application of mechanical diagnosis and therapy in lateral epicondylalgia. Journal of Manual and Manipulative Therapy 24: 158–165.

Maetzel A, Li LC, Pencharz J, Tomlinson G, Bombardier C; Community Hypertension and Arthritis Project Study Team 2004 The economic burden associated with osteoarthritis, rheumatoid arthritis, and hypertension: A comparative study. Annals of the Rheumatic Diseases 63: 395–401.

Martin RL, Irrgang JJ, Sekiya JK 2008 The diagnostic accuracy of a clinical examination in determining intra-articular hip pain for potential hip arthroscopy candidates. Arthroscopy 24: 1013–1018.

Maslowski E, Sullivan W, Harwood JF, Gonzalez P, Kaufman M, Vidal A, Akuthota V 2010 The diagnostic validity of hip provocation maneuvers to detect intra-articular hip pathology. PM&R 2: 174–181.

May S, Aina A 2012 Centralization and directional preference: A systematic review. Manual Therapy 17: 497–506.

May S, Littlewood C, Bishop A 2006 Reliability of procedures used in the physical examination of non-specific low back pain: A systematic review. Australian Journal of Physiotherapy 52: 91–102.

May S, Rosedale R 2012 A survey of the McKenzie classification system in the extremities: Prevalence of preferred loading strategies. Physical Therapy 92: 1175–1186.

May S, Ross J 2009 The McKenzie classification system in the extremities: A reliability study using McKenzie assessment forms and experienced clinician. Journal of Manipulative and Physiological Therapeutics 32: 556–563.

McCarthy JC, Jarrett BT, Ojeifo O, Lee JA, Bragdon CR 2011 What factors influence long-term survivorship after hip arthroscopy? Clinical Orthopaedics and Related Research 469: 362–371.

McCormick F, Nwachukwu BU, Alpaugh K, Martin SD 2012 Predictors of hip arthroscopy outcomes for labral tears at minimum 2-year follow-up: The influence of age and arthritis. Arthroscopy 28: 1359–1364.

McKenzie R 1981 The Lumbar Spine: Mechanical Diagonsis and Therapy. Wellington: Spinal Publications New Zealand Ltd.

McKenzie R, May S 2003 The Human Extremities: Mechanical Diagnosis and Therapy (2nd edn). Wellington: Spinal Publications New Zealand Ltd.

McNair PJ, Simmonds MA, Boocock MG, Larmer PJ 2009 Exercise therapy for the management of osteoarthritis of the hip joint: A systematic review. Arthritis Research and Therapy 11: R98.

Medicare Payment Advisory Commission 2015 The Next Generation of Medicare Beneficiaries. Report to Congress: Medicare Healcare Delivery System. http://www.medpac.gov/documents/reports/chapter-2-the-next-generation-of-medicare-beneficiaries-(june-2015-report).pdf?sfvrsn=0.

Menon A, May S 2012 Shoulder pain: Differential diagnosis with mechanical diagnosis and therapy extremity assessment – A case report. Manual Therapy 18: 4–7.

Messier SP, Thompson CD, Ettinger WH Jr 1997 Effects of long-term aerobic or weight training regimens on gait in an older, osteoarthritic population. Journal of Applied Biomechanics 13: 205–226.

Murphy LB, Helmick CG, Schwartz TA, Renner JB, Tudor G, Koch GG, Dragomir AD, Kalsbeek WD, Luta G, Jordan JM 2010 One in four people may develop symptomatic hip osteoarthritis in his or her lifetime. Osteoarthritis and Cartilage 18: 1372–1379.

Philippon MJ, Briggs KK, Yen Y-M, Kuppersmith DA 2009 Outcomes following hip arthroscopy for femoroacetabular impingement with associated chondrolabral dysfunction: Minimum 2-year follow-up. Journal of Bone and Joint Surgery (Br) 91: 16–23.

Pisters MF, Veenhof C, Van Meeteren NL, Ostelo RW, De Bakker DH, Schellevis FG, Dekker J 2007 Long-term effectiveness of exercise therapy in patients with osteoarthritis of the hip or knee: A systematic review. Arthritis and Rheumatism 57: 1245–1253.

Rosedale R, Rastogi R, May S, Chesworth BM, Filice F, Willis S, Howard J, Naudie D, Robbins SM 2014 Efficacy of exercise intervention as determined by the McKenzie system of mechanical diagnosis and therapy for knee osteoarthritis: A randomized controlled trial. Journal of Orthopaedic and Sports Physical Therapy 44: 173–181.

Smidt N, De Vet HCW, Bouter LM, Dekker J 2005 Effectiveness of exercise therapy: A best-evidence summary of systematic reviews. Australian Journal of Physiotherapy 51: 71–85.

Stratford P, Spadoni G 2001 The reliability, consistency and clinical application of numeric pain rating scale. Physiotherapy Canada 53: 88–114.

Sutlive TG, Lopez HP, Schnitker DE, Yawn SE, Halle RJ, Mansfield LT, Boyles RE, Childs JD 2008 Development of a clinical prediction rule for diagnosing hip osteoarthritis in individuals with unilateral hip pain. Journal of Orthopaedic and Sports Physical Therapy 38: 542–550.

Van Baar ME, Dekker J, Lemmens JA, Oostendorp RA, Bijlsma JW 1998a Pain and disability in patients with osteoarthritis of hip or knee: The relationship with articular, kinesiological, and psychological characteristics. Journal of Rheumatology 25: 125–133.

Van Baar ME, Dekker J, Oostendorp RA, Bijl D, Voorn TB, Bijlsma JW 2001 Effectiveness of exercise in patients with osteoarthritis of hip or knee: Nine months' follow up. Annals of the Rheumatic Diseases 60: 1123–1130.

Van Baar ME, Dekker J, Oostendorp RA, Bijl D, Voorn TB, Lemmens JA, Bijlsma JW 1998b The effectiveness of exercise therapy in patients with osteoarthritis of the hip or knee: A randomized clinical trial. Journal of Rheumatology 25: 2432–2439.

Waddell G, Newton M, Henderson I, Somerville D, Main C 1993 Fear-avoidance beliefs questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability. Pain 52: 157–168.

Zhang W, Doherty M, Arden N, Bannwarth B, Bijlsma J, Gunther K-P, Hauselmann HJ, Herrero-Beaumont G, Jordan K, Kaklamanis P, Leeb B, Lequesne M, Lohmander S, Mazieres B, Martin-Mola E, Pavelka K, Pendleton A, Punzi L, Swoboda B, Varatojo R, Verbruggen G, Zimmermann-Gorska I, Dougados M 2005 EULAR evidence based recommendations for the management of hip osteoarthritis: Report of a task force of the EULAR Standing Committee For International Clinical Studies Including Therapeutics (ESCISIT). Annals of the Rheumatic Diseases 64: 669–681.