Contractile dysfunction of the shoulder (rotator cuff tendinopathy): an overview

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It is now over a decade since the features defining a contractile dysfunction of the shoulder were first reported. Since this time, some progress has been made to better understand this mechanical syndrome. In response to these developments, this narrative review will explore current understanding in relation to pathology, diagnosis, treatment, and prognosis of this syndrome with reference to literature specifically relating to contractile dysfunction but also literature relating to rotator cuff tendinopathy where necessary. The review not only identifies the strengths of the mechanical diagnosis and therapy approach with reference to a contractile dysfunction of the shoulder but also identifies where further progress needs to be made.

Keywords: Contractile dysfunction, Shoulder pain, Tendinopathy, Narrative review

Introduction

In 2000, McKenzie and May¹ described the application of the principles of mechanical diagnosis and therapy (MDT) to the peripheral joints. The MDT classification system enables categorization of patients into a non-specific mechanical syndrome: derangement, dysfunction, or postural syndrome. With reference to extremity problems, dysfunction syndromes can be further categorized as articular or contractile dysfunction. Categorization is determined by the use of single and repeated active, passive, or resisted movements, with contractile dysfunction determined by the presence of shoulder pain provoked through resisted movements, particularly resisted mid-range movements, with a largely preserved range of movement.¹ In contrast, an articular dysfunction is determined by the presence of restricted active and passive range of movement, with shoulder pain provoked at the end of the available range but not with resisted movements.¹ The MDT classification system also includes derangement syndrome which is detected by rapid changes in symptoms or mechanical presentation, and 'other' categories for non-mechanical responders who do not fit one of these categories.¹ Thus contractile dysfunction is part of a comprehensive classification system for shoulder problems. According to the categorization, a specific exercise management strategy is prescribed.

In 2007, Littlewood and May² reported a case study detailing a patient classified with a contractile dysfunction of the shoulder and treated successfully using the principles of MDT. With the aim of communicating this model to a wider non-MDT audience, Littlewood and May² suggested that the contractile dysfunction of the shoulder was analogous to the more widely recognized specific diagnosis of rotator cuff tendinopathy. Since that time, little has been published in the peer-reviewed literature relating to contractile dysfunction of the shoulder but increasing literature is becoming available detailing the nature of the pathology underlying rotator cuff tendinopathy, the role of diagnostic tests, the effectiveness of interventions, and the prognosis of this condition. This paper will draw upon this literature to offer an overview of contractile dysfunction of the shoulder/rotator cuff tendinopathy.

Background

Shoulder pain is one of the most common musculoskeletal symptoms with up to one-quarter of the general population reporting a problem at any one time and up to two-thirds of all adults reporting a problem over a lifetime.³ It is the third most common reason for consultation with a physiotherapist⁴ and significantly impacts upon the most basic activities of daily living, including eating, dressing, and working.⁵ Disorders of the rotator cuff are recognized as the most common cause of this pain where the long-term outcome for a significant proportion of people is frequently poor.⁶

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Shoulder pain, incorporating rotator cuff disorders, is a significant burden to the UK National Health Service and society. Approximately 1% of adults in the UK consult their medical practitioner with a new presentation of shoulder pain each year with estimated costs of £310 million in the first 6 months. Up to 50% of this cost is attributable to sick leave from paid employment.⁷ Additional surgical costs for procedures relating to the rotator cuff are conservatively estimated at approximately £30 million/year.⁸ Clearly rotator cuff disorders are burdensome on a number of levels.

Pathology

The categorization of contractile dysfunction has been defined by the following operational definition which is entirely based on the clinical presentation: pain caused by mechanical deformation of structurally impaired soft tissues which is felt when this abnormal tissue is loaded.¹

The cause of rotator cuff tendinopathy and the cause of pain associated with tendinopathy remain uncertain.⁹ The presence of signs associated with tendinopathy, e.g. degenerative lesions, rotator cuff tears, is widely reported in the absence of pain and/or functional deficit.¹⁰ It is likely that the clinical criteria used to define contractile dysfunction could reflect a range of underlying structural pathology, relevant or otherwise. A variety of underlying pathology was found on magnetic resonance imaging in patients with long lasting subacromial pain.¹¹ They reported a range of morphological changes including various acromial morphology, calcification, tendinosis, and sub-cortical cyst, some of which changed as clinical symptoms improved but some of which did not.

The limited role of inflammation with reference to most tendon disorders has been recognized over recent years and the more accurate and relevant terms 'tendinopathy' and 'tendinosis' have been applied. Tendinopathy is a term used to describe a tendon disorder but without implication of pathology¹² but is widely regarded as being associated with failed healing.⁹ If this terminology is utilized, then strictly speaking the term 'tendinopathy' is most relevant to describe non-inflammatory tendon disorders diagnosed clinically without imaging devices in preference to the term 'tendinosis' which implies a non-inflammatory degenerative tendon disorder.¹² A clinical presentation of pain and/or functional deficit is not confirmatory of a degenerative lesion and hence this label should only be applied post confirmatory imaging, although the limitations and relevance of this will be discussed later.

Diagnosis

Despite the extent of rotator cuff related disorders, there appears to be a basic issue that has not been

adequately addressed and continues to serve as significant barrier to understanding this common disorder. A range of terms exist in the literature to describe these disorders, e.g. tendonitis, tendinopathy, tendinosis, bursitis, subacromial impingement syndrome, and painful arc syndrome. Whether these terms are being used to describe similar or different clinical presentations is unclear, but the failure to adequately define a clinical presentation along with the inconsistent use of terminology is a significant barrier to understanding. Littlewood *et al.*¹³ suggested: 'It is perhaps unsurprising that conflict arises when the effects of poorly defined interventions are evaluated in studies where the condition under treatment is also poorly defined.' In contrast, the MDT classification system does not advocate the formulation of structurally specific diagnoses. Instead, for the majority, a mechanical diagnosis is offered based upon symptomatic and mechanical responses during the examination, as described above.¹ The reliability of this system has been favourably evaluated¹⁴ whereas Lewis¹⁰ and May *et al.*¹⁵ criticize the use of physical examination tests to arrive at a structurally specific diagnosis as an invalid and unreproducible process.

To complement clinical tests, a range of investigative tests exist with the intention of improving diagnostic accuracy, e.g. diagnostic ultrasound, magnetic resonance imaging, or X-ray. However, the value of these diagnostic tests has been seriously challenged due to the presence of abnormal morphology in the absence of pain and/or functional deficit.¹⁶

The difficulties associated with generating a relevant structurally specific diagnosis relating to the shoulder are evident and now consistently reported across a wide body of literature. The idea that a structurally specific diagnosis is needed before a successful treatment regime is implemented has been questioned.² A review of the criteria that should be met before classifying contractile dysfunction enables the clinician to appreciate the pragmatic value of the MDT system, i.e.:

1. exclude other sources of pain, e.g. the cervical spine, which would require intervention away from the shoulder;
2. minimal resting pain — pain at rest may be indicative of bursitis and/or other inflammatory conditions that might respond adversely to vigorous movement;¹⁵
3. largely preserved range of movement — to exclude presentations with movement restriction, e.g. frozen shoulder that might respond more favourably to stretching and/or mobilization;
4. pain exacerbated consistently through resisted testing which theoretically should, at least in part, implicate contractile tissue.

Hence, with reference to current thinking, non-specific mechanical diagnosis is both logical and

justified. The MDT classification has demonstrated very good levels of reliability between clinicians ($\kappa=0.83$) and the contractile dysfunction syndrome is consistently recognizable by clinicians trained in this method.¹⁴

Effectiveness of Interventions

McKenzie and May¹ describe a programme of progressive loaded exercise for treating contractile dysfunction, which could include isometric, concentric, or eccentric exercises. This is justified with the suggestion that loaded exercise will facilitate remodelling of the dysfunctional contractile tissue. Typically contractile dysfunction would be explained to patients in terms of the muscles and tendons not functioning effectively and hence the need for exercise to restore this function. A typical exercise programme is described in Table 1. The resisted movement, e.g. abduction, that is most provocative would initially be selected as the specific exercise and would be completed twice per day with the aim of producing pain during exercise that is no worse upon cessation of that exercise.¹ Patients may begin by completing three sets of 10 repetitions and progress or regress this according to the symptomatic response. In contrast to this recommendation, a recent survey of current practice of physiotherapists in the UK suggests that a wide range of interventions are prescribed for rotator cuff tendinopathy.⁸ This survey asked participants to respond to a range of questions which were based upon the history and physical examination findings of the case report of Littlewood and May² which described a contractile dysfunction of the shoulder. Advice/education and exercise were at the core of what most physiotherapists would offer. However, the nature of the advice and exercise prescription was variable, e.g. isometric, isotonic, isokinetic, and stabilization exercise. This is an important point to consider because the proposed effects of the different forms of exercise are different which might translate into different treatment outcomes for patients. Notably, approximately 35% of respondents would consider a corticosteroid injection

as a component of their management programme. This is despite no accepted indications of an inflammatory component to the clinical presentation⁶ as well as no consistent evidence suggesting that additional benefit is to be gained from these injections in the mid or long term over other treatment options offered by physiotherapists.¹⁷ Manual therapy is commonly used by physiotherapists to treat this condition.⁸ However, in keeping with other studies, Yiasemides *et al.* reported that the addition of mobilization conferred no additional improvement over advice and exercise alone.¹⁸

Littlewood and May² described a positive response to self-managed loaded exercise for a patient classified with contractile dysfunction. Due to the nature of the underlying disorder, this exercise is frequently painful but it has been suggested that this is important to facilitate remodelling of the dysfunctional tissue.¹ However, of the survey respondents who would prescribe exercise, approximately 44% would not have prescribed exercise that was painful.⁸ Of those respondents who regarded themselves as having a special interest in the area of shoulder pain, 53% would not have prescribed exercise that was painful. The reasons underpinning such clinical reasoning are unclear but might be due to historical reasons where previous authors labelled most disorders of the rotator cuff as inflammatory in nature.¹⁹ This possibility highlights the importance of applying appropriate terminology because clearly an alternative treatment pathway is justifiable in the presence of an acute inflammatory disorder. There does not appear to be a scientific basis for thinking that there is an important inflammatory basis to most tendon disorders that have lasted more than a few days.²⁰ Interestingly chronic rotator cuff tendon disorders have been shown to demonstrate similar pathological changes to tendon disorders in other areas of the body, e.g. the elbow, Achilles tendon, and patellar tendon.^{21,22} Additionally, the benefits of loaded exercise, which is frequently painful, in these tendons have been demonstrated.²³

In terms of empirical evidence, positive responses to painful loaded exercise in the treatment of rotator cuff disorders have been reported in a pilot study including patients recruited from primary care.²¹ Another pilot study reported a favourable response to painful loaded exercise in five of nine patients awaiting surgery in relation to chronic painful impingement syndrome of the shoulder.²⁰ This is a notable finding in what is likely to be a particularly resistant group in terms of pathology but also expectations of the intervention needed to address their problem because they had previously not responded to conservative care prior to listing for surgery.

Table 1 Typical loaded exercise programme and progression

1. Week 0: baseline assessment:
• Resisted isometric (no movement) shoulder abduction (taking the arm out to the side) against a wall, or
• Resisted shoulder abduction from 0 to 30° using moderate resistance from Theraband (resistive band used for training purposes).
2. Week 3: initial follow-up:
• Resisted shoulder abduction from 80 to 120° using light weight, e.g. tin of food.
3. Week 6: second follow-up:
• Resisted shoulder abduction from 80 to 120° with progressively increasing repetition and weight, e.g. heavy Theraband or dumbbell.
4. Week 12: final follow-up/discharge

Despite rotator cuff tendinopathy being such a common shoulder problem, there is a lack of high quality studies upon which to base practice.²⁴ Numerous systematic reviews have been undertaken in relation to subacromial impingement syndrome, an umbrella term encompassing rotator cuff tendinopathy, investigating the various plausible interventions including physiotherapy, corticosteroid injections, and surgery but all identified the weakness of the evidence base when attempting to draw definitive conclusions.^{25–30}

A recent systematic review of randomized controlled trials has highlighted the potential benefit of exercise, including loaded exercise, on pain and functional disability associated with this problem.¹³ This review included only studies that appeared to meet the criteria for a diagnosis/classification of contractile dysfunction and so is directly applicable to this syndrome. However, this review also concluded that further research is warranted to fully evaluate the likely benefit of loaded exercise in the treatment of rotator cuff tendinopathy/contractile dysfunction.

Prognosis

With regards to practising physiotherapists, a range of opinion exists as to the likely prognosis of rotator cuff tendinopathy.⁸ A variety of studies have been published in relation to the prognosis of shoulder pain. However, the limitations of a majority of these studies have been recognized in relation to inadequate case definition where there is a reliance on self-report of pain in or around the shoulder and upper arm or back.³¹ It is likely that these methods of data collection will tend to misrepresent shoulder disorders because non-shoulder related disorders, e.g. referred pain from the cervical or thoracic spine, will be captured by such a vague case definition.

However, from the evidence at current disposal, it seems that a proportion of patients will improve in the short term but a significant number will go on to develop persistent pain and disability.^{32,33}

Conclusion

The features defining a contractile dysfunction of the shoulder were first reported over a decade ago. Some progress has been made in terms of reliability of classification and response to intervention. This is a promising start but more needs to be done to understand the underlying pathology, the value of the classification system in non-specialized clinicians, the response to loaded exercise in comparison to other interventions, and the prognosis of the condition.

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