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Published in:
Musculoskeletal Care

DOI:
[10.1002/msc.1879](https://doi.org/10.1002/msc.1879)

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Recommended citation(APA):
Powell, J. K., Lewis, J., Schram, B., & Hing, W. (2024). Is exercise therapy the right treatment for rotator cuff-related shoulder pain: Uncertainties, theory, and practice. *Musculoskeletal Care*, 22(2), 1-12. Article e1879. <https://doi.org/10.1002/msc.1879>

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Is exercise therapy the *right* treatment for rotator cuff-related shoulder pain? Uncertainties, theory, and practice

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Abstract

Background: Exercise therapy is a popular non-surgical treatment to help manage individuals with rotator cuff-related shoulder pain (RCRSP) and is recommended in all clinical practice guidelines. Due to modest effect sizes, low quality evidence, uncertainty relating to efficacy, and mechanism(s) of benefit, exercise as a therapeutic intervention has been the subject of increasing scrutiny.

Aims: The aim of this critical review is to lay out where the purported uncertainties of exercise for RCRSP exist by exploring the relevant quantitative and qualitative literature. We conclude by offering theoretical and practical considerations to help reduce the uncertainty of delivering exercise therapy in a clinical environment.

Results and Discussion: Uncertainty underpins much of the theory and practice of delivering exercise therapy for individuals with RCRSP. Nonetheless, exercise is an often-valued treatment by individuals with RCRSP, when provided within an appropriate clinical context. We encourage clinicians to use a shared decision-making paradigm and embrace a pluralistic model when prescribing therapeutic exercise. This may take the form of using exercise experiments to trial different exercise approaches, adjusting, and adapting the exercise type, load, and context based on the individual's symptom irritability, preferences, and goals.

Conclusion: We contend that providing exercise therapy should remain a principal treatment option for helping individuals with RCRSP. Limitations notwithstanding, exercise therapy is relatively low cost, accessible, and often valued by individuals with RCRSP. The uncertainty surrounding exercise therapy requires ongoing research and emphasis could be directed towards investigating causal mechanisms to better understand how exercise may benefit an individual with RCRSP.

KEYWORDS

exercise, movement, pain, physiotherapy, shoulder

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1 | BACKGROUND

Shoulder pain is both common and burdensome (Lucas et al., 2022). While not everyone afflicted suffers to the same extent, evidence from qualitative research reveals the profound impact shoulder pain can have on many dimensions of life (Maxwell et al., 2021; Page et al., 2019). There are myriad causes of shoulder pain, the most common being rotator cuff-related shoulder pain (RCRSP) (Luime et al., 2004). RCRSP is an overarching diagnostic label that includes traditional pathoanatomical diagnoses such as rotator cuff tendinopathy, subacromial bursitis and rotator cuff tears, and can be tentatively posited when shoulder stiffness, instability, and sinister pathology are not suspected to be part of the clinical picture at the time of assessment (Lewis, 2016). A recent study suggested that RCRSP was the preferred diagnostic term of clinicians over subacromial impingement syndrome, subacromial pain syndrome and rotator cuff tendinopathy (Powell et al., 2022a).

Non-surgical management options to reduce the pain and disability associated with RCRSP include education, understanding pain, exercise therapy, life-style management, hands-on therapy, electrical modalities, taping, braces, dry needling, acupuncture, and injection therapy. Often, these are delivered in various combinations with each other. Despite the many treatment options, with approximately equivalent effects, clinical practice guidelines consistently recommend exercise therapy as the main treatment for RCRSP (Doiron-Cadrin et al., 2020; Lafrance et al., 2022).

Exercise and movement therapy are considered an essential component of physiotherapy practice and physiotherapists are justified in making claims of being movement experts (Nicholls & Vieira, 2023). Physiotherapy management of individuals with RCRSP is an apropos example of this, with a recent study highlighting that 99% of surveyed physiotherapists around the world indicating they would use exercise to manage an individual with RCRSP (Powell et al., 2022a). Despite physiotherapists broadly embracing exercise therapy, in both historical and modern contexts, the pre-eminent position of exercise for RCRSP (Dube et al., 2023; Littlewood et al., 2023; Page et al., 2016), and other musculoskeletal conditions such as hip and knee osteoarthritis (Henriksen et al., 2024; Holden et al., 2023; Hunter & Hall, 2023), has come under increasing scrutiny. Critics appropriately assert that exercise does not appear to be held to the same standards as other treatments, such as manual therapy, surgery, and acupuncture, when considering its modest effects and low certainty of evidence (Naunton et al., 2020; Steuri et al., 2017), lack of demonstrated efficacy (Bennell et al., 2010), and importantly uncertainty regarding the causal pathways through which it may confer a therapeutic benefit (Powell et al., 2022b). Moreover, no evidence has emerged to define the best exercise approach (including exercise type, dose, level of supervision, duration etc.) for helping an individual with RCRSP (Littlewood et al., 2015; Malliaras et al., 2020; McConnell et al., 2022). Any combination of exercise that has been investigated for RCRSP, produces on average, modest results.

This uncertainty represents a paradox for clinicians who, on one hand, are often denigrated for incorporating manual therapy into

management, but are consistently advised to prescribe therapeutic exercise, with both interventions, provided in isolation or combination, associated with less-than-optimal outcomes (Pieters et al., 2020). In this critical review, we aim to lay out where the uncertainties of exercise for individuals with RCRSP exist and conclude by offering theoretical and practical considerations to help clinicians navigate the uncertainty of delivering therapeutic exercise in their practice.

2 | EFFICACY AND EFFECTIVENESS

In order to establish the efficacy of a treatment, it is considered necessary to compare the experimental treatment (e.g. exercise) with a sufficiently similar control treatment (typically a sham/placebo treatment) (Hohenschurz-Schmidt et al., 2023). Only one high quality study (Bennell et al., 2010) compared a treatment package of manual therapy and exercise with a sham control (inactive ultrasound) for individuals with RCRSP and reported no significant difference in shoulder pain and disability after 11 weeks. At 22 weeks, the exercise and manual therapy group had a significantly greater improvement in shoulder pain and disability, but the difference was not clinically meaningful. This trial challenges the assumed efficacy of exercise for RCRSP. A criticism of this study is the comparator intervention, and considerable uncertainty exists if a detuned ultrasound machine is a sufficiently similar control for complex treatments such as exercise and manual therapy (Hohenschurz-Schmidt et al., 2023).

Exercise therapy appears to out-perform a no treatment or no exercise control for improving shoulder pain and function; however, the magnitude of this effect is generally modest (Liaghat et al., 2021; Naunton et al., 2020; Steuri et al., 2017) and the certainty of evidence is assessed to be very low to low. A systematic review and meta-analysis reported that progressive resistance exercise compared with no treatment or placebo confers a benefit of uncertain clinical importance for pain and function (Naunton et al., 2020). The same review found that non-progressive and non-resisted exercise confers no benefit over no treatment, or placebo (Naunton et al., 2020). Findings from a systematic review and network meta-analysis concluded that exercise had the most robust evidence of being an effective treatment for RCRSP when compared to other non-surgical treatments (Babatunde et al., 2021).

When compared with more invasive treatment approaches, such as injection and surgery, exercise fares well. For example, there is no clinically important difference between exercise therapy and subacromial decompression surgery and rotator cuff repair surgery (Karjalainen et al., 2019; Lähdeoja et al., 2020). Corticosteroid injections have a similar effect to exercise therapy (Hopewell et al., 2021; Page et al., 2016); however, there is uncertainty pertaining to the possible deleterious effects of corticosteroid injections on local shoulder soft tissue (Dean et al., 2014). Furthermore, exercise therapy out-performs platelet rich plasma injection at short-term follow-up and is equivalent at long-term follow-up (Nejati et al., 2017).

The main finding of a recent randomised control trial (RCT), not included in any of the aforementioned reviews, was that the addition

of a specific motor control or strengthening exercise programme to education did not enhance the clinical outcomes of individuals with RCRSP compared with education alone (Dube et al., 2023). Thus, the view that exercise is necessary for everyone diagnosed with RCRSP is challenged. Overall, exercise therapy demonstrates a modest effect of uncertain clinical importance when compared to a no treatment or no exercise control, has no evidence of being superior to a realistic sham treatment, and for many, doesn't out-perform an education programme. Exercise has comparable effects to shoulder surgery, and injections, and has the most robust evidence of effectiveness of common non-surgical treatment options.

3 | SHOULD EXERCISE BE DELIVERED IN ISOLATION OR COMBINED WITH MANUAL THERAPY?

In an update of systematic reviews (Pieters et al., 2020) made 'strong' recommendations for exercise therapy as the first-line of treatment to help manage signs and symptoms of RCRSP. A strong recommendation was also made to combine exercise therapy with manual therapy in the short term. A more recent systematic review and meta-analysis reported no significant difference between exercise in isolation compared with exercise plus manual therapy at both short and long term follow ups for both shoulder pain and function (Paraskevopoulos et al., 2023). Since the publication of these reviews, an RCT has been published by Michener et al. (2024) reporting there is an added long-term benefit to providing manual therapy in conjunction with an exercise programme compared to an exercise programme alone. It is unclear the mechanism underpinning the possible added benefit of manual therapy to an exercise programme, as highlighted by another recent RCT which reported no between group differences between sham manual therapy and real manual therapy, when added to an exercise programme (Naranjo-Cinto et al., 2022). Thus, one could speculate that any added benefit of manual therapy might be due to contextual effects. Based on current evidence, exercise could be delivered either in isolation or in conjunction with other therapies, such as manual therapy, and this will depend on shared decision making (Hoffmann et al., 2020).

4 | IS THERE AN OPTIMAL EXERCISE APPROACH?

The history of medicine has never been a particularly attractive subject in medical education...virtually anything that could be thought up for the treatment of disease was tried and, once tried, lasted decades or even centuries before being given up.

(Thomas, 1977)

The history of physiotherapy is punctuated with the rise, fall, and stagnation of various exercise approaches for managing musculoskeletal pain. Hypotheses exist that have been purported to support

stretching, strengthening, movement performance, motor control exercise, breathing and relaxation exercises for managing various musculoskeletal pain conditions, including RCRSP. At this juncture, it is arguably correct to state that there is no one best exercise approach for managing individuals with RCRSP (Littlewood et al., 2015; McConnell et al., 2022).

Here we explore common variables physiotherapists consider when constructing exercise programs for individuals with RCRSP and examine their influence on clinical outcomes.

4.1 | Is there a superior exercise type?

The selection of an exercise type (e.g. resistance exercise, motor control exercise, and stretching exercise) to manage an individual with RCRSP poses a conundrum for clinicians. There are many exercise approaches available to help an individual with RCRSP, and it is typical to see two or more different approaches combined together in the same programme (Powell et al., 2022b). In this review, we focus on two of the most popular exercise approaches for RCRSP: progressive resistance exercise and motor control, or movement facilitation exercise (Powell et al., 2022a, 2022b). Most current meta-analyses report no sustained significant difference between specific motor control exercise and general resistance exercise for RCRSP (Bury et al., 2016; Shire et al., 2017). A recent three-arm RCT not included in the latest meta-analyses corroborates these findings, reporting no significant differences between education alone, education and motor control exercise, and education and resistance exercise in clinical outcome (Dube et al., 2023). Given the apparent equivalence of the two most common exercise types, perhaps it is more useful to consider when a particular exercise approach might be more appropriate for an individual based on their preferences and symptom profile. Under this framework, clinical decisions about exercise type will depend more on the symptom irritability and preferences of an individual, rather than a preconceived bias to favour one exercise approach over another, allowing clinicians to move fluidly between exercise types as the clinical situation dictates (Lewis et al., 2022; McClure, 2015).

4.2 | Does the exercise dose make the poison?

Exercise dose (volume) is described by the load lifted, the number of repetitions, and the number of sets of repetitions (Phillips & Winett, 2010). Malliaras et al. (2020) conducted a systematic review comparing higher vs. lower dose resistance exercise for RCRSP and found low to very low certainty evidence that higher dose resistance exercise confers superior functional outcomes compared to lower dose exercise (Malliaras et al., 2020). It must be noted that this review only included three RCTs in its analysis and was clear in stating that their results did not support the claim that higher dose resistance exercise was better than lower dose resistance exercise. Since the publication of the Malliaras et al. (2020) review, an RCT

exploring exercise dose for RCRSP has been published by Clausen et al. (2021) and reported that adding a large dose of resistance exercise to usual care did not provide any additional benefit for individuals with RCRSP. However, in a pre-defined secondary analysis, Clausen et al. (2023) reported that the level of baseline pain catastrophising modified the effect of the extra dose of resistance exercise (Clausen et al., 2023). Those with lower baseline catastrophising benefited more from an extra dose of resistance exercise, whereas those with higher catastrophising scores actually tended towards an unfavourable outcome. Another recent RCT, not included in the Malliaras et al. (2020) review, similarly reported no significant difference between a progressive higher load resistance exercise regimen and a lower load programme (Schydrowsky et al., 2022). For tendinopathy in general (including studies pertaining to RCRSP), it has been reported that resistance exercise with an external load, compared to body weight only, is more effective (Pavlova et al., 2023), perhaps increasing credence that some external load is better than none.

Uncertainty surrounds how often exercises should be performed (frequency) and the optimal duration of an exercise programme, with different frequencies and durations (range from 4–12 weeks) leading to beneficial effects for individuals with RCRSP (McConnell et al., 2022). The available evidence indicates, with the possible exception of those with low levels of pain catastrophising, the absence of a consistent dose-response relationship between exercise dose and clinical outcomes for individuals with RCRSP. Individual treatment goals, stage of rehabilitation, and symptom irritability may influence shared decision making about the optimal dose of exercise.

4.3 | Does the muscle contraction type matter?

The early success and subsequent popularity of eccentric exercise for Achilles tendinopathy (Alfredson et al., 1998) inevitably led to its exploration for RCRSP (Camargo et al., 2014). Mirroring the initial promising results for Achilles and patellar tendinopathy, eccentric exercise for RCRSP was associated with improvement in shoulder pain and function (Holmgren et al., 2012; Maenhout et al., 2013). However, as more studies were performed, the results gradually tended towards eccentric exercise, which was no better than concentric (Blume et al., 2015) or isotonic (Dejaco et al., 2017) exercise. The most recent systematic review and meta-analysis exploring the effects of eccentric exercise for RCRSP formalises this regression towards equivalence (Larsson et al., 2019).

Similar to the substantial interest in eccentric exercise based on preliminary results in the Achilles and patellar tendons, isometric exercise enjoyed a surge in popularity after the publication of a seminal paper by Rio et al. (2015), showing the analgesic effect of an isometric contraction for patellar tendinopathy. When testing the effectiveness of isometric exercise for people with RCRSP, the best

available evidence suggests it is no better than simple ice therapy (Dupuis et al., 2018; Parle et al., 2017). For tendinopathy in general, isometric exercise does not appear to be superior to isotonic exercise for immediate pain relief or clinical outcomes (Clifford et al., 2020). So, is there a best contraction type? Not according to the evidence.

4.4 | Should exercise be supervised?

Current meta-analyses report no differences between supervised and unsupervised exercise for individuals with RCRSP (Gutierrez-Espinoza et al., 2020; Liaghat et al., 2021). An RCT published since, compared a supervised physiotherapist-led training regimen with an education and exercise leaflet, following a corticosteroid injection for both groups (Roddy et al., 2020). At 6 months of follow-up, the supervised physiotherapist-led exercise group demonstrated a significant improvement in shoulder pain and function. There was no difference at 6 weeks and 12-month follow-ups. A possible explanation for these results was the disproportionately higher exercise adherence in the supervised exercise group compared with the unsupervised group. Based on the available evidence, decision making on the level of supervision of an exercise programme should be made with consideration of individual patient circumstances.

4.5 | Should pain be permitted during exercise?

A systematic review and meta-analysis found that painful therapeutic exercise was not a barrier to experiencing a successful outcome with exercise therapy for a variety of musculoskeletal conditions (Smith et al., 2017). In fact, at short-term follow-up, exercising into pain was significantly better (Smith et al., 2017). Within this meta-analysis, three of the included studies were classified as RCRSP (Holmgren et al., 2012; Littlewood et al., 2016; Maenhout et al., 2013). There were no significant differences in long-term outcomes between exercise programs that permitted pain and those that prohibited pain. In the short-term, the Holmgren et al. (2012) trial demonstrated that painful exercises (up to 5/10 on a 0–10 scale) were associated with superior outcomes (Holmgren et al., 2012). This does not imply that permitting painful exercise causally explains the superior benefits observed at short-term follow-up, or any time frame, but it does demonstrate that exercising into pain need not be avoided or demonised as a rule. Further research is required to corroborate this conjecture. Individual circumstances will of course dictate the level of pain permitted, if any, and it is conjectured that exercising into pain when pain catastrophising is high could be counterproductive (Clausen et al., 2023).

The common view that there is no best exercise approach (on average) for helping individuals with RCRSP is thus supported, and uncertainty envelops much of the implementation of exercise therapy.

5 | WHAT CAN WE LEARN FROM THE LIVED EXPERIENCE OF INDIVIDUALS WHEN IT COMES TO EXERCISE FOR RCRSP?

It would be remiss to explore the role of exercise in managing RCRSP without considering the lived experience of individuals. Qualitative research reveals that participants randomised to an exercise-arm of a clinical trial can feel disappointed and sceptical, preferring a manual therapy-based approach (Littlewood et al., 2014). Conversely, other research highlights that some individuals prefer exercise-based rehabilitation due to previous failure of traditional hands-on approaches (Littlewood et al., 2014; Powell et al., 2023). This is concordant with recent research illustrating that individuals often want and expect exercise from their physiotherapist, as described by a participant in the Subialka et al. (2022) qualitative assessment (Jensen et al., 2022; Subialka et al., 2022):

I'm just looking for them to teach me how to do the exercises I need to do at home to keep that range of motion going and to knock that pain level down without major surgery.

(Subialka et al., 2022)

A qualitative investigation exploring how and why individuals with lived experience of RCRSP believed exercise helped their symptoms reported that all participants in the study had a positive experience with exercise, but only under certain conditions (Powell et al., 2023). Foremost among these conditions was the therapeutic relationship with their treating clinician, in which a failure to build a strong therapeutic relationship led to the inevitable failure of prescribed exercises. Another identified clinical condition, in this study and others (Sandford et al., 2017), was the importance of an individualised exercise programme, rather than a seemingly generic regimen.

Yeah, it felt like it was a more tailored approach to me about me getting better as opposed to just a cookie cutter; here's a default programme for six to eight weeks that should make you better. Everyone does the same thing approach.

(Powell et al., 2023)

Other commonly expressed barriers to engaging with an exercise programme are poor access to equipment, uncertainty about approximate recovery timeframe, lack of motivation and time, and beliefs and expectations about whether exercise is the appropriate treatment for their shoulder pain (O'Shea et al., 2022; Sandford et al., 2017). Conversely, cogent advice and education about their shoulder condition and how to perform their exercise programme, access to equipment, lack of exercise burden, and a supportive social network were key facilitators of engaging with an exercise programme (O'Shea et al., 2022; Sandford et al., 2017).

The qualitative literature highlights the complexity and context-

dependency of an individual's experience engaging with an exercise programme. However, when provided within the appropriate clinical context, exercise is often expected, wanted, and for the most part, positively received by individuals with RCRSP.

6 | HOW DOES EXERCISE HELP INDIVIDUALS WITH RCRSP?

The pursuit of effective treatments for RCRSP is of paramount research importance. Another important aim of clinical research, and science in general, is to generate causal explanations of how a particular treatment caused a particular outcome. While hundreds of effectiveness trials exist testing exercise and other treatments for RCRSP, research focused on the specific identification of causal explanations (mechanisms) is sparse. A scoping review by Powell et al. (2022a, 2022b) identified 32 unique causal explanations that have been proposed for the beneficial effect of exercise for individuals with RCRSP, of which the vast majority pertained to traditional biomechanical mechanisms such as muscle strength, motor control, and acromiohumeral distance (Powell et al., 2022b). Very few of these biomechanical causal explanations have been tested, much less verified, by appropriate experimental and statistical methods and remain hypothetical (Powell et al., 2022b; Powell & Lewis, 2021).

Mediation analysis is an empirical method of ascertaining how a treatment causes an outcome (Lee et al., 2021); for example, how does resistance exercise reduce shoulder pain? Mediation analyses investigating the causal mechanisms of exercise for shoulder pain are scarce and only two could be identified at the time of writing (Gutierrez Espinoza et al., 2023; Hotta et al., 2022), of which, both warrant discussion. Hotta et al. (2022) conducted a secondary mediation analysis of an RCT which compared general periscapular muscle strengthening exercises to general periscapular muscle strengthening plus scapular stabilisation exercises (Hotta et al., 2020, 2022). They reported that scapular motion, position, and muscle strength did not mediate shoulder pain and disability outcomes in people with RCRSP.

Gutierrez Espinoza et al. (2023) conducted an RCT comparing specific exercises to general exercises for people with RCRSP. For clarity, the specific exercises aimed to improve scapular orientation, both static and dynamic, and to optimise the position of the humeral head in the glenoid to prevent superior translation (presumably to avoid subacromial impingement). The general exercises were targeted towards improving the strength, mobility, and coordination of the shoulder girdle to 'unload' the subacromial space. The results of the trial showed a significant improvement in shoulder pain and disability in favour of the specific exercise group, but the difference was not clinically meaningful. Interestingly, the effect of the specific exercise programme was reported to have been partly mediated through a reduction in kinesiophobia, possibly representing a treatment target for clinicians with patients who present with higher levels of kinesiophobia. It is unclear what aspect of the specific exercise programme led to a reduction in kinesiophobia, or whether this could be achieved

via other exercise approaches. For example, qualitative research highlights that individuals express a reduction in kinesiophobia via simple strengthening-based exercise (Powell et al., 2023).

In the qualitative research literature, when individuals with lived experience of RCRSP were asked about how exercise helped their shoulder pain, the following three mechanisms were frequently reported: (1) improvements in muscle strength, (2) changes to psycho-emotional status, and (3) the acknowledgement of the widespread positive health effects of exercise (see Table 1 for supporting quotes) (Powell et al., 2023). Patient perceptions of exercise mechanisms approximate those proposed in the scientific literature in relation to shoulder strength but differ in the level of importance attached to psycho-emotional mechanisms (Powell et al., 2022b).

At this stage, there is a void of knowledge regarding the causal mechanisms for improvement associated with exercise for RCRSP. However, current evidence indicates that traditional targets of exercise, including increasing muscle strength, optimising scapular position and motion, and increasing acromiohumeral distance, may not explain clinical improvements in shoulder pain and function (Powell et al., 2022b; Powell & Lewis, 2021). Psychological constructs, such as kinesiophobia and pain self-efficacy, are promising mediators and treatment targets, but more research is needed to corroborate this hypothesis. Another possible mechanism is restoring biochemical homeostasis to the shoulder tissues (Docherty et al., 2022), but this too needs further research. At this juncture, we recommend clinicians refrain from providing definitive monocausal explanations for the effect of exercise (e.g. optimising scapular movement, improving strength) and rather advise that exercise may help reduce shoulder pain and improve shoulder function via a number of inter-related biopsychosocial mechanisms (Powell & Lewis, 2021). Further research is crucial to understanding the causal pathways through which exercise confers a benefit to individuals with RCRSP, which may improve the implementation and clinical outcomes of exercise therapy.

7 | NAVIGATING UNCERTAINTY: THEORETICAL CONSIDERATIONS FOR USING EXERCISE THERAPY

The current societal burden of musculoskeletal pain is profound and is only expected to increase (Blyth et al., 2019; Diseases & Injuries, 2020). This is predicted to increasingly strain already strained health care systems, and as such, physiotherapists are encouraged to

provide high-value care (Cook et al., 2021; Gleadhill et al., 2023). High value care is defined as delivering an intervention where the probability of benefit exceeds probable harm (Elshaug et al., 2017). For many non-traumatic musculoskeletal conditions, including RCRSP, the benefits of various surgical and non-surgical interventions are equivalent and modest, making it a clinical challenge to select an obvious high value treatment for an individual seeking care. Perhaps another way to approach the provision of value-based care is *high quality care* (Gleadhill et al., 2023) or the *right care*. In 2017, the Lancet published the *Right Care Series* and defined the *right care* as 'care that is tailored for optimising health and wellbeing by delivering what is needed, wanted, clinically effective, affordable, equitable, and responsible in its use of resources' (Elshaug et al., 2017). Exercise for RCRSP is modestly effective (Babatunde et al., 2021; Naunton et al., 2020; Steuri et al., 2017), often desired (Maxwell et al., 2021; Powell et al., 2023; Subialka et al., 2022), relatively affordable, and cost-effective (Oppong et al., 2021). We submit that exercise is equitable and responsible in its use of resources, certainly when compared to surgery for the majority of cases (Lewis, 2022). Exercise therapy can also be delivered in a timely fashion, without intensive supervision or extensive delay, and has been shown to be effective for patients on a waiting list for shoulder surgery (Holmgren et al., 2012). Whether it is needed in a particular clinical scenario should be a shared decision-making process between the individual seeking care and the treating clinician (Hoffmann et al., 2020).

Shared decision making is a dynamic process in which the clinician and patient are empowered to make health care decisions collaboratively, with due consideration of the benefits and harms of available treatment options, and the individual patient preferences, values and circumstances (Hoffmann et al., 2020, 2022). Shared decision making is considered appropriate when there is not one clearly superior treatment approach available (Hoffmann et al., 2022). This applies to both selection of a treatment, such as exercise, and also to the delivery of a chosen treatment, such as the exercise parameters. As emphasised in Section Four of this paper, uncertainty underpins much of the provision of therapeutic exercise for an individual with RCRSP, and in such cases it is considered best practice to invoke shared decision making when choosing and implementing a treatment. What this looks like in clinical practice will be expounded upon in Section Eight. It must be emphasised that exercise is one, but not the only, option to help an individual diagnosed with RCRSP;

TABLE 1 Causal mechanisms of exercise expressed by individuals with lived experience of rotator cuff-related shoulder pain.

Causal mechanisms	Supporting quotes
Improvement in muscle strength	'And then the second I started strength training, I felt, yeah, just doing one exercise, every part of my shoulder was engaged. I was feeling that instant connection between the exercise I was doing and a positive improvement in my shoulder' (Powell et al., 2023)
Changes to psycho-emotional status	'Just restoring that faith in my shoulder, I suppose, which is what he got me to eventually do with all of the strength exercises' (Powell et al., 2023)
Exercise has widespread positive health effects	'It's a positive. It's beneficial. Feels good [exercise]... Obviously exercise is a good thing, if done right. It's good for joints. It's good for muscle. It's good for tendons. It's good for ligaments. It's good for strength. It's good for mental health' (Powell et al., 2023)

however, because exercise therapy appears to largely satisfy the *right care* criterion, we propose it is well placed to remain a principal treatment option for RCRSP.

8 | NAVIGATING UNCERTAINTY: PRACTICAL CONSIDERATIONS FOR USING EXERCISE THERAPY

If the shared decision is to proceed with a trial of exercise therapy, in conjunction with appropriate advice and education (Dube et al., 2023), how might one construct an effective programme given the enduring uncertainty surrounding much of its implementation? (Figure 1).

If the aim of exercise is to reduce shoulder pain, there are many approaches that may be considered. The uncertainty of how exercise causes a reduction in shoulder pain means the identification of traditional exercise targets, including weak and tight muscles, and aberrant scapular motion and position, need not dictate the selection of exercise type. With this in mind, the clinician is encouraged to select an exercise type and progression that they, and most importantly the patient, are most comfortable with, and has the least number of barriers (financial, exercise complexity, time constraints etc.) for adherence, and is tailored to their clinical presentation. If the clinician and patient agree to trial a form of resistance exercise, the type of contraction (isometric/isotonic/eccentric), the intensity of exercise, and the overall dose of the exercises will largely depend on what the patient can tolerate at the time and their goals for rehabilitation. There is inherent flexibility in

this, will likely vary from patient to patient, and should be fit for purpose. Clinicians might consider conducting 'exercise experiments', similar to behavioural experiments described in the Shape-Up-My-Shoulder rehabilitation programme (Lewis et al., 2022) and the cognitive functional therapy literature (O'Sullivan, 2018), where exercise type, intensity, and context are trialled and adjusted based on the patient response. An approach similar to this has been described as being helpful by individuals with lived experience of RCRSP (Powell et al., 2023). This approach makes space for a plurality of exercise and movement types and parameters to be trialled depending on the individual's symptom irritability, preferences, and feedback. The level of physiotherapist supervision will be an important conversation between the clinician and patient, and in the absence of robust evidence to sway clinical decision making one way or the other, this will depend on the specific clinical scenario. However, physiotherapists are encouraged to transparently communicate the equal effectiveness of supervised and unsupervised exercise for RCRSP and allow the patient to come to their own decisions. When it comes to pain during exercise, rather than dogmatically allowing or avoiding pain, the clinician is encouraged to gently explore the nature of any pain experience with a particular exercise or movement (Table 2), assuming a therapeutic alliance has first been established. The information derived from this exploration may be used to facilitate the collaborative construction of a tailored exercise programme (Powell et al., 2023). This 'Darwinian' approach to exercise selection means that only the most appropriate exercises for an individual with RCRSP will survive and make it into a programme.



FIGURE 1 Clinical uncertainty of delivering therapeutic exercise for rotator cuff-related shoulder pain.

TABLE 2 Questions to help clinicians navigate shoulder pain during an exercise experiment.

Example questions	Possible information gathered from questions
Question: Is the pain you're experiencing during this exercise familiar, or does it feel different?	This could help decipher whether the pain is related to a 'muscle burn' or is provocative of their familiar (normal) pain. If the pain is more related to a 'muscle burn', the exercise need not be dramatically modified, provided the patient can tolerate the intensity
Question: Does the pain settle when you stop the exercise? Follow-up Question: How long after?	This can help guide decision making about whether the patient can tolerate this exercise, done this way, at this time. Typically, it is advised that their familiar pain return to baseline levels within 30 min of performing the exercise. Some delayed onset muscle soreness should be expected in the following days
Question: What are your thoughts and feelings during this exercise?	This question may reveal whether there are unhelpful beliefs about movement and pain, which could lead to further discussion about whether these beliefs are impacting their recovery or how well they correspond to known evidence
Question: Do you think your pain is changeable? What happens to your pain if we: <ul style="list-style-type: none"> • Change the load? • Change the ROM? • Change the lever (moment arm)? • Change the plane of movement? • Change the contraction type? • Try in a different position? (e.g. side lying vs standing) 	This part of the exercise experiment is important and may provide information about the movements and loads your patient can tolerate at this time. This information can subsequently guide creation of a tailored exercise programme. Experiencing a reduction in pain by adjusting movement, load, or context could reinforce to the individual that their pain is modifiable, perhaps leading to renewed confidence of a positive outcome
Question: How does your pain respond with more repetitions of exercise? Does it get better, worse, or stay the same?	Pain that gets better with more repetitions could indicate low symptom irritability and might greenlight a larger exercise dose. Pain that worsens with more repetitions might mean a lower dose exercise programme is needed in the short term. Unchanging pain could be amenable to either, in a trial-and-error approach
Question: Would you feel confident performing this exercise, with this level of shoulder pain, unsupervised at home? Follow-up question: Would you feel confident progressing/regressing the exercise based on the evolution of your symptoms?	These questions can give you an insight into the depth of understanding and self-efficacy an individual has about a particular exercise programme. Ideally, the individual will feel empowered and confident to take control of their exercise programme and recovery and be able to engage with the programme unsupervised

As the pain settles, the clinician and patient might start to think about using exercise to enhance the physical function and performance of the shoulder, perhaps to facilitate a return to work or a recreational pursuit that demands moderate use of the shoulder. In this clinical scenario, it is logical to start thinking about exercise from a classical biomechanical standpoint. Is there a certain level of shoulder strength required for their job, sport, or recreation? If so, extra thought might be given to principles of strength and conditioning, such as exercise intensity, volume, and frequency. Will the shoulder be required to tolerate repeated loads? If so, perhaps more thought should be directed towards contraction type, including plyometric type exercise. What kinds of movements will be expected of the shoulder? Various combinations of pushing, pulling, lifting, raising, rotating, and carrying can be incorporated into an exercise programme to best prepare the shoulder for return to work, sport, or recreation. Rehabilitation can also include the kinetic chain (Richardson et al., 2020). A useful heuristic to help guide exercise-based rehabilitation for clinicians is that specificity of exercise type, intensity, volume, and contraction type seems to matter little for reducing the experience of shoulder pain but might matter more for enhancing shoulder function and performance.

9 | CONCLUSION

Exercise therapy is a versatile and for many an effective treatment option to use in the management of RCRSP. Crucially, exercise appears to largely satisfy the right care criterion and can be delivered in a timely and unsupervised fashion, which may demarcate it from other common musculoskeletal treatments. However, as this critical review has highlighted, uncertainty underpins much of the delivery of therapeutic exercise, and it may not be suitable for everyone. There is uncertainty about the optimal anatomy of an exercise programme, but this does not preclude action. The use of exercise experiments may help guide exercise selection in a way that naturally tailors an exercise programme appropriate for an individual. We recommend the continued consideration of exercise therapy for appropriate individuals with RCRSP governed by a shared decision-making process and acknowledge the considerable research to be done to improve our understanding of the role exercise plays in helping individuals with RCRSP.

AUTHOR CONTRIBUTIONS

Jared K. Powell, Ben Schram, Jeremy Lewis, and Wayne Hing conceived and designed the manuscript. Jared K. Powell was the lead author. Jared K. Powell drafted the manuscript, and all authors were

involved in the subsequent editing process and approval of the final version of the manuscript.

ACKNOWLEDGEMENT

Open access publishing facilitated by Bond University, as part of the Wiley - Bond University agreement via the Council of Australian University Librarians.

CONFLICT OF INTEREST STATEMENT

JKP and JL have received remuneration for the provision of continuing professional development courses on shoulder rehabilitation.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no datasets were generated or analysed during this study.

ETHICS STATEMENT

Not applicable to this review.

OFAC STATEMENT

All authors of this review are acting exclusively in a personal capacity.

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How to cite this article: Powell, J. K., Lewis, J., Schram, B., & Hing, W. (2024). Is exercise therapy the *right* treatment for rotator cuff-related shoulder pain? Uncertainties, theory, and practice. *Musculoskeletal Care*, e1879. <https://doi.org/10.1002/msc.1879>