

EXPLORING THE MANAGEMENT OF THE IN-SEASON SWIMMER'S SHOULDERS

– Written by Andrew Delbridge, Britt Caling, Craig Boettcher, Australia

WHAT IS SWIMMER'S SHOULDER?

Swimmer's shoulder, a condition that affects a significant proportion of swimmers and often impacts performance, is a prevalent and ongoing challenge in sports medicine. Most swimmers will suffer shoulder pain at some point in their competitive career¹. Hence, as a clinician, you are highly likely to be confronted with the question of "how do I manage" the painful shoulder in a swimmer who needs to train through a competitive season. A good starting point is to understand what swimmer's shoulder is and the key factors that contribute to its onset.

To date, the collective understanding suggests that swimmers' shoulder is essentially tendinopathy, not only of the supraspinatus as often quoted in the literature, but equally prevalent in the subscapularis tendon and to a lesser extent, in the long head biceps and infraspinatus tendons. Several imaging studies have confirmed the high prevalence of tendinopathy relative to other

pathoanatomical changes in swimmers' shoulders².

Recent literature investigating the etiology of tendinopathy cites the role that mixed tendon load (tension, compression and shear) plays in the pathogenesis of cuff tendinopathy³. So, it is essential to understand that mixed tendon load is unavoidable during the swimming stroke. This is primarily due to the local anatomical arrangement of the shoulder structures and the range of motion required through the swimming stroke. Anatomical, imaging, biomechanical and arthroscopy studies demonstrate that the rotator cuff undergoes compression externally under the coracoacromial arch and internally against the glenoid labrum (normal physiological contact in hyper-elevated shoulder positions), along with tensile and shear load throughout the swimming stroke^{4, 5}. (Figures 1-6). Typically, swimmers perform 30,000-40,000 strokes per week, making it no surprise that tendinopathy (both symptomatic and asymptomatic)

is so prevalent. Furthermore, ultrasound studies have demonstrated acute changes in tendon thickness following swim sessions, and these changes appear to take longer to normalise in individuals who have experienced shoulder pain⁶.

WHAT FACTORS LEAD TO THE ONSET OF PAIN?

It's a complex issue, and the exact causes are not yet fully understood!

Over the past 50 years or more, studies have examined a raft of impairment and basic load-related factors thought to be associated with the onset of pain in swimmers' shoulders. To date, there is a relatively low certainty that any single factor alone has a causal relationship with the onset of pain in the swimmer's shoulder.

Feijen⁷ performed a prospective study to establish predictive factors for shoulder pain in youth swimmers. The strongest predictors were:

1. Competitive level (higher level more likely to develop pain)



2. Acute to chronic workload ratio
3. Posterior shoulder muscle endurance
4. Hand entry error

McKenzie⁸ identified inconsistent training load, low posterior shoulder muscle strength/endurance, and stroke technique as significant and highly modifiable factors.

Developing a comprehensive management plan that starts with the most supported and modifiable factors is a prudent approach.

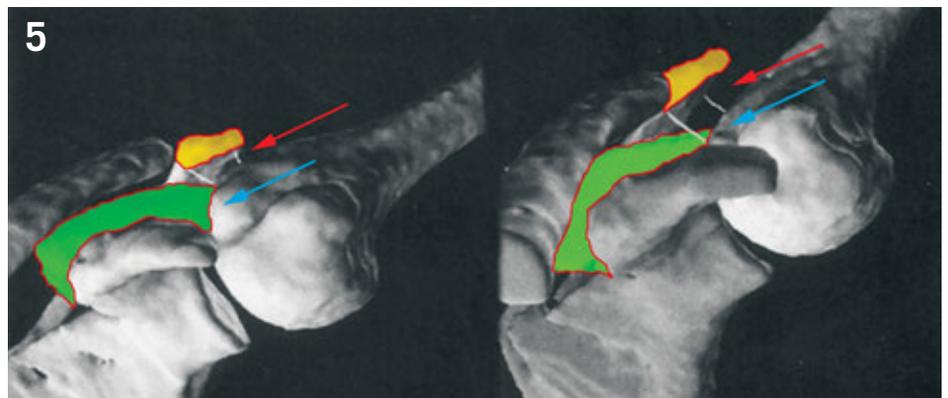


Figures 1-4: Highlighting the hyperelevated positions required for elite-level swimming.

MANAGEMENT PRINCIPLES

1. Understanding subgroups of swimmer's shoulder
2. Multidisciplinary - "first and foremost"
3. Settling and treating the cuff
 - Monitoring tolerance to force production
 - Load management
 - Managing cuff capacity
 - Pharmacology
 - Manual therapy

We regard these as the overarching principles for managing swimmers' shoulders mid-season. Below, we discuss how these principles can be implemented in different case scenarios.



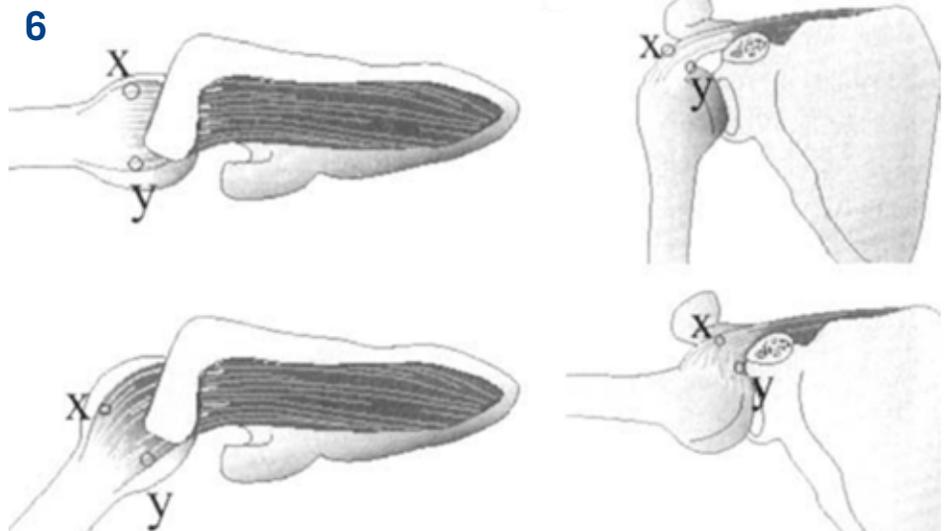
UNDERSTANDING SUBGROUPS OF SWIMMER'S SHOULDER

Appreciating the type & stage of presentation is essential in developing an appropriate management plan for the swimmer. In our experience, there may be three broad presentations you will face:

1. Young adolescent swimmer with acute onset of shoulder pain (10 -18 yrs)
2. The senior elite with acute-on-chronic tendinopathy (18 - 35 yrs of age)
3. Master's swimmer - (35 - 90 yrs of age)

1. MANAGING THE YOUNG ADOLESCENT SWIMMER

In the continuum model of tendinopathy proposed by Cook and Purdam³, acute tendinopathy in younger swimmers (those in late teenage years or younger) likely



Figures 5 and 6: Demonstrating internal compression of the cuff against the glenoid in shoulder elevation (> 120° elevation)⁴ and intratendinous shear and strain of the cuff tendon in different positions⁵. Reproduced with permission.



Figures 7-10:

Demonstrate dynamometry in several testing positions.

- 7) Neutral External Rotation
- 8) Neutral Internal Rotation
- 9) Supine Extension
- 10) Supine Flexion

reflects the continuum's reactive phase. In this phase, the integrity and organisation of the collagen matrix are typically well maintained.

In cases of acute onset, it is crucial to identify the cause of the sudden symptom exacerbation. Often, it is due to a change in load in the lead-up to a competition, where the young swimmer consciously or unconsciously increases the volume and/or intensity in their training, or a return to training after a break, or when a change of coach results in different training sets or technique changes.

A swimmer with this clinical presentation will likely respond favourably to a period of relative deloading, 2-7 days out of the water, followed by a graded return to the pool over several weeks. Recovery can also be aided by a short course of non-steroidal anti-inflammatory drugs (if not contraindicated), which have been shown to inhibit tenocyte expression⁹. Appropriate dry land cross-training is reasonable to maintain adequate cardiovascular stimulus

and strength, with careful consideration of upper body loading.

Practical steps in transitioning back to swimming

- Deloading and return to swim strategies:
 - Use of fins
 - Use of a pool buoy without a band
 - Short intervals - 50 or 100m repeats
 - Reduced volume and speed
 - Reduced days in the pool if needed (once per day or 2nd daily)
 - A change in stroke
- Dynamometry assessment

There are several tools and methods for evaluating the shoulder complex (dynamometry, force frame, and ultrasound). Assessment using hand-held dynamometry (HHD), a valid and reliable method¹⁰ is, in our view, the most convenient method of assessment on the pool deck. It offers the greatest utility in the rehabilitation pathway for tracking tolerance to load and guiding decision-making. In other words,

HHD informs how sensitive the shoulder is to a force-producing task.

We advocate recording force production only to the onset of pain (P₁), as an index of the shoulder's current load tolerance, rather than the maximum test. The P₁ score on the symptomatic shoulder and the measure taken on the contralateral side (normal side) allow for a quick and easy percentage calculation. If the athlete has bilateral shoulder pain, then calculations can be made using pre-season measures when the athlete was asymptomatic.

The P₁ test is less likely to precipitate a flare in symptoms, which, in our experience, is easy to do in a maximum effort test. Furthermore, we pay close attention to the directions of movement in which pain occurs, i.e., internal or external rotation, pushing, pulling, or raising (Figures 7-10). The movement directions with the lowest P₁ scores will guide exercise choice and prescription parameters for the swimmer's rehabilitation program.

In our opinion, when scores return to

greater than 60-70% of the contralateral side, a return to the pool can be considered.

The swimmer's pain profile, response to loading, and changes in P1 scores are used to guide further progression in the pool using the above strategies.

2. MANAGING THE SENIOR ELITE SWIMMER – “MOST CHALLENGING”

The elite senior swimmer with shoulder pain presents the most significant clinical challenge of all. They have only one goal: to be the best they can be, which requires a relentless commitment to the highest training standards, leaving little room for load management or lengthy tendon-loading programs. Furthermore, elite swimmers have an increased likelihood of already having chronic, irreversible tendinopathic changes in their rotator cuff³, which further complicates the challenge of managing them in season.

Here is how it can be done!

Understand the pathology – acute on chronic!
Given the association of rotator cuff tendon pathology with age, competition level and years of swimming^{2, 7, 11}, swimmers in this subgroup are likely to have a reactive response overlying degenerative tendinopathy (Figure 11). This is consistent with the dysrepair or degenerative stages of the continuum model³. The collagen matrix will be more disorganised, with increased type III collagen, which is structurally weaker and less able to resist load.

Multidisciplinary approach – “first and foremost”

An interdisciplinary team approach is advantageous in achieving optimal results for athletes at all levels; however, it is essential and needs to be implemented thoroughly at the highest level of swimming. This includes regular collaboration between the athlete, coach, and the support team, facilitating prompt best care and minimising disruption to the athlete's training program. Keeping all parties on the same page is a challenge. Priorities will vary depending on whose lens we are looking through. The athlete will be full steam ahead, and the coach may perceive that missed or modified sessions will compromise the athlete's preparation. In contrast, the sports medicine team may see these as necessary to achieve the optimal outcome for the athlete's shoulder recovery and performance. Without a team

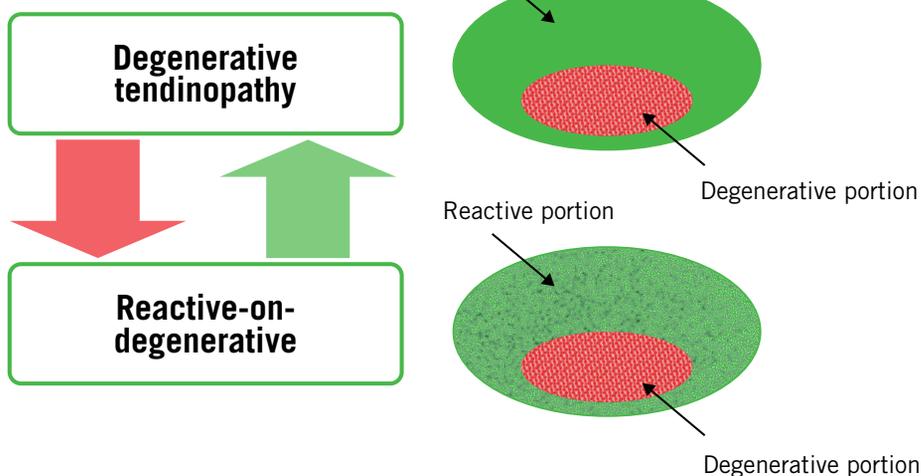


Figure 11: Demonstrating the acute reactive-on-degenerative tendinopathy³.

approach, the athlete's prospects for an optimal outcome diminish.

Monitoring tolerance to force production

Along with questioning the athlete regarding their pain response to swimming, HHD, as discussed above, is used to measure P1 (1-3 times a week, depending on irritability) to evaluate the tolerance of the shoulder. These swimmers are likely to experience fluctuations in symptoms over time, depending on the current training phase and the loading demands. The goal is to align the training load as closely as possible with the swimmer's shoulder tolerance, thereby facilitating as much training as possible while working to contain and, if possible, alleviate the swimmer's shoulder symptoms. Any sudden drop in P1 value (interpreted as a reduction in tolerance) indicates that an adjustment to training load is required.

Load management

Traditionally, training load has focused on the distance swum in training. This is partly due to the challenges involved in measuring other variables, such as swimming speed and acceleration, within a training session (see the article in this issue). Recent studies examining changes in cuff tendon thickness in response to loading suggest that these changes are more significant with high-intensity, low-volume training loads compared to high-volume, low-intensity loads¹². Furthermore, persistent increases in cuff tendon thickness may increase the

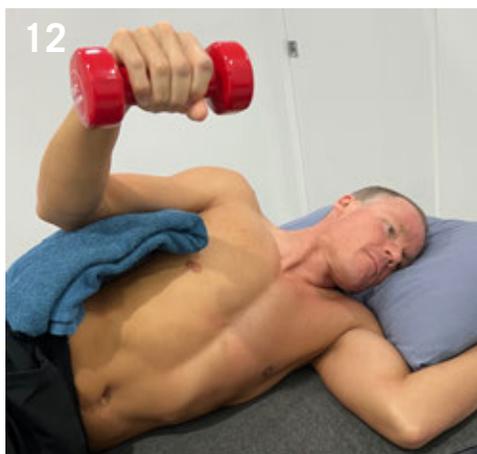
likelihood of developing shoulder pain^{13, 14}. Therefore, monitoring the volume of high-intensity training is prudent when implementing management strategies for the athlete, rather than relying solely on volume.

We advocate using an irritability-based load management approach, where low levels of pain (< 3/10 on VAS) that resolve within short time frames, preferably within hours, are acceptable. As HHD scores start to improve, along with symptom behaviour, an increase in swimming can be considered.

Guidelines for swimming progression should consider the type of stroke, intensity, and overall volume of training. The stroke that is most aggravating may vary from one symptomatic swimmer to another.

Kick sets have long been used as a strategy for lowering swimming load; however, when performed with the shoulders in a sustained hyper-elevated position, this increases the time the tendon is under compression. Therefore, 'kick sets' should be performed with a snorkel or on the side, with the symptomatic arm by the side.

Entering swim competitions with an athlete experiencing mid-season shoulder pain should be given careful consideration, as these events require a peak force generation and introduce a significant risk if the competition load represents a substantial change in the athlete's acute-to-chronic workload. If competing in sprint events, the associated peak forces are of most concern.



Figures 12&13: Demonstrate short mid-range external and internal rotation (can be isometric, but if isotonic, the amplitude might be only be 10-15cm).

Managing cuff capacity

Current evidence advocates the use of a graded tendon loading program in the management of tendinopathy^{15, 16}. Mid-season management is a far greater challenge, as traditional loading programs may require many months to complete. So, what do we do as a rehabilitation exercise?

There is support for isometric loading in mid-season management of tendinopathy. Rio¹⁷, demonstrated the analgesic effects of sustained isometric tendon loading in volleyball players with patellar tendinopathy. As such, there has been a trend towards using isometric loading in the mid-season, as it is better tolerated. Further, the position, direction and range of the exercise may also influence the load at the tendon insertion site. The elite swimmer is stressing their tendons to high levels, close to, or if not exceeding, their current tolerance; therefore, thoughtful clinical reasoning is required when prescribing rehabilitation.

Exercise variables that influence tendon load include:

- contraction type - isometric versus isotonic, fast or slow
- range of motion - inner, mid or outer and small or large
- hold time - longer or shorter
- resistance – light, moderate or heavy
- shoulder position - neutral versus elevated.

Ideally, we aim to achieve heavy, low-volume, slow resistance that is efficacious for tendon adaptation over the medium to longer term¹⁸. We recommend implementing exercises through a short mid-range of motion (see Figure 12 demonstrating isometric neutral mid range external rotation). In our experience, commonly prescribed full-range generic external

rotation loading exercises, in both neutral and abducted arm positions, are poorly tolerated by swimmers with supraspinatus and infraspinatus involvement. Conversely, in the anterior cuff (subscapularis involvement), isotonic short mid-range loading in neutral is well tolerated (Figures 13 & 14).

Use of the force frame, free weights and/or pulleys is preferred, as they are known loads. Resistance bands or tubes offer a variable load throughout their range, making them better suited for athletes who are asymptomatic.

Typical slow resistance cuff loading programs progress from low-load, high-repetition (3 sets of 12 repetitions) to heavy, slow, low-volume loading (4 sets of 6 repetitions).

EMG studies have demonstrated that the anterior and posterior cuff work reciprocally during pull and push movements¹⁹ respectively, so they can be prescribed, as an alternative, to load the cuff when traditional rotation loading is not well tolerated (Figures 15 & 16).

Pharmacology

For swimmers experiencing persistent interfering shoulder pain, despite appropriate load modification and rehabilitation, pharmacological interventions may be considered. The objective is to achieve a breakthrough in pain, providing an opportunity to re-engage with the athlete with load. Some commonly used agents are listed below:

- Non-steroidal anti-inflammatory drugs (NSAIDs)
- Cortisone injections (CSI)
- Platelet-rich plasma injections (PRP)

Short-term prescription of NSAIDs, whose effects have already been outlined



Figure 14: Posterior cuff strength endurance through short range.

earlier in this paper, is effective in symptom management and is commonly used in the management of swimmer's shoulder. Medical screening is recommended before using this medication. Prolonged use is not advised without medical supervision due to adverse effects on renal, gut and cardiac function, to name a few.

Cortisone may be used if the athlete has failed first-line evidence-based treatment; however, it is increasingly controversial in the management of tendinopathy. Although it has a significant short-term effect on pain²⁰ (up to 12 weeks), cortisone should be used judiciously, given its catabolic effects on the collagen matrix²¹ and equivocal or poorer outcomes over the longer term. If



Figures 15 & 16: Push-pull exercises.

used, it should complement a structured graded loading program.

PRP injections are an alternative to cortisone. Randomised controlled trials and meta-analyses suggest that PRP may provide modest benefits in pain relief and function in patients with chronic rotator cuff tendinopathy²². It may be indicated in those who have failed evidence-based conservative management. Compared to cortisone, PRP injections are safer but the effects take longer to appear (weeks or months) and the treatment is more expensive.

Regular communication with the team doctor enables prompt intervention when necessary.

Manual therapy

Although the effects of manual therapy techniques are often only short-lasting and not a stand-alone treatment, some of their demonstrated effects remain valid in managing swimmers' shoulder. These include:

- Demonstration of care: Touch can validate pain, build trust, and enhance therapeutic relationships.
- Neurophysiological effects: Manual therapy may trigger analgesic responses and modulate the nervous system, although the exact mechanisms underlying these effects are unclear.

Positive short-term effects, such as pain modulation, improved range of motion, and increased confidence, can serve to enhance trust, buy-in, and compliance with exercise strategies, whose positive effects often take time to develop²³. Pre-season assessments

can help alert you to any developing range of motion impairments. In our experience, soft tissue management techniques are effective in maintaining the athlete's pre-season range of motion. We pay particular attention to preserving shoulder, trunk, and hip range of motion. We have also found that it helps manage tissues that may compensate for a weakened or painful shoulder.

3. Managing the Masters swimmer

The master's swimmer, aged 35 to 90, trains on average three to five times a week and competes approximately three times a year. Although there is a strong desire to perform well, there are several other key motivations for master level swimmers. These include health and fitness through swimming, stress relief and mental wellbeing, community and social connections, skill development, and lifelong learning²⁴. These benefits rank highly alongside performance, allowing for greater flexibility in management approach compared to their elite counterparts.

The master's level athlete will be more likely to self-regulate load in the pool and engage in graded tendon loading programs, making for a favourable setting to encourage their cuff tendons to adapt and recover slowly. Evidence suggests that older tendons may have a compromised or reduced capacity to adapt²⁵, which should be considered when progressing the athlete's rehabilitation program or setting expectations for recovery.

Overall, swimmer's shoulder is a complex, multifactorial condition requiring

individualised, stage-specific management, guided by tendon pathology, athlete goals, and tolerance to loading.

CASE STUDY – ELITE SWIMMER

30-year-old elite-level female swimmer preparing for the 2024 Paris Olympics in freestyle and butterfly events.

History – repeated episodes of shoulder pain over the previous seven years. These episodes of acute pain were generally easily managed; however, over 2022-23, the episodes of pain became more regular and of longer duration.

Diagnosis – tendinopathic changes in subscapularis, particularly the lower one-third, identified on MRI.

Pain – anterosuperior shoulder, and occasionally into the posterior shoulder, extending to the lateral elbow when most symptomatic.

Aggravating factors – sprint freestyle at race pace was the most aggravating activity. Pain occurred primarily in the early catch phase of the stroke, and when aggravated, also in butterfly.

Weekly training schedule – the swimmer trained nine swim sessions per week, which included high-quality faster swimming sessions on Tuesday, Thursday and Saturday. Gym 3 to 4 times per week, as well as stationary bike, yoga and pilates sessions.

MANAGEMENT STRATEGIES

Multidisciplinary support – the swimmer received physiotherapy, strength and conditioning (S&C), dietitian, sports science, psychology, and sports medicine support. The physiotherapist would communicate



Figure 17: Catch position on the force frame.

with the coach 2-4 times per week to review progress and provide objective feedback regarding training capacity. The physiotherapist met with the S&C staff at least once a week. The sports scientist, psychologist, and dietitian engaged in regular conversations and more formal meetings to discuss significant updates. A physiotherapist attended 3-5 swim sessions per week and at least one full gym session per week.

Monitoring tolerance to force production – the swimmer had regular gym testing performed, which included shoulder IR, ER and catch strength testing on the Force Frame (Figure 17).

During periods of an acute ‘flare’ of shoulder pain, HHD was used to P1, most commonly for internal rotation with the arm in abduction, which was compared to asymptomatic screening values. Testing was performed on Monday and Thursday to provide direction for the quality sessions that followed. Along with subjective reports from the swimmer, this would help guide modifications to training load.

Load management – when P1 measures fell and symptoms increased, feedback would be given to the coach that the swimmer would not tolerate sprint sessions. The following changes were recommended

- 200m freestyle pace rather than sprint,
- Butterfly main set, which in this case was better tolerated than freestyle, or
- High-effort kick sets.

The coach wasn’t really “content” but accepted that aerobic and anaerobic conditioning could be achieved successfully with kick sets or cycling.

Managing cuff capacity – the swimmer was able to continue with push and pull exercises to maximum capacity, performed through a short range. Isometric ER and IR, as well as catch position, were performed regularly, in gym sessions, on a Force Frame at high force and short duration (10-20 seconds). Isometrics of 40-second hold time were utilised before swim sessions, which assisted with symptom modification. Slow, heavy, short-range isotonic exercises were encouraged when tolerated.

The HHD was used both before and after isometric exercise to confirm which position and direction provided the best pain reduction before training.

Pharmacology – the swimmer used Naproxen (under a sports physician’s advice) during acute flares; otherwise, the athlete used paracetamol directly before training in the lead-up to the Paris Olympics. A significant reduction in HHD measures generally coincided with an increase in symptoms. A cortisone injection was considered if measures fell below a threshold level and symptoms worsened, resulting in a meaningful reduction in training.

Manual therapy – the swimmer received two physiotherapy sessions per week. Increased tone in the subscapularis, teres, latissimus and the intercostal were addressed via specific soft tissue work, along with treatment for cervical and thoracic impairments. The swimmer received two general massages per week to aid in recovery.

Outcome – Despite ongoing shoulder pain, the swimmer qualified for the Australian Olympic Team (their third Olympic Games) and swam in three relays and an individual event at the 2024 Paris Olympics, winning one gold, one silver, and one bronze medal.

References

Available at www.aspetar.com/journal

Andrew Delbridge

Regent Street Physiotherapy

*APA Titled Sports and Exercise
Physiotherapist*

*Member of the Australian College of
Physiotherapists*

Britt Caling

*Gold Coast Physiotherapy and Sports
Health*

*APA Titled Sports and Exercise
Physiotherapist*

*Queensland Academy of Sport Official
Physiotherapy provider 2004-2024 and
Swimming program 2021-2024*

*Australian Swim Team physiotherapist
2005-2008, 2022*

Craig Boettcher PhD

Regent Street Physiotherapy

*APA Titled Sports and Exercise
Physiotherapist*

*Australian Swim Team physiotherapist
2008-2015*

Contact: andrewdelbridge67@gmail.com