‘New Moves’ in preventing and managing swimmer’s shoulder!

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Workshop outline

• Background
• ‘Old moves’ / ‘Where are we now’ - with current perspectives
• Video analysis
• ‘New moves’
• Practical/demonstration/questions
What is swimmer’s shoulder?

‘An inflammatory condition caused by the mechanical impingement of soft tissue against the coracoacromial arch’

Kennedy, Hawkins and Krissoff, 1978
The Athlete’s Shoulder,
Eds. Wilk, Reinold and Andrews, 2009
Prevalence

• Competitive swimmers
  40% incidence (McMaster et al. 1993)
  as high as 91% (Sein et al. 2010)

2013 - survey of 109 Australia’s elite swimmers

• 34 (31%) no history of pain
• 75 (69%) with history of pain

Of those with history of pain

• 23 (31%) had pain at time of questioning
• 30 (40%) described as an ongoing problem
• 25 (33%) had to cease training due to symptoms
• 38 (51%) had to modify training due to symptoms
Where are we now?

First theories

• **Nature of the sport**
  • Repetitive shoulder elevation causing microtrauma and ‘wringing out’ of the sub-coracoacromial structures (Rathbun & Macnab, 1970; Neer, 1972)
  • Approx 15-20,000 individual arm elevations/wk ie. up to a million per year
  • Monitor workload and training changes.

Term ‘swimmer’s shoulder’ originated
Management

- Pre-practice stretching
- decrease yardage (hand paddles)
- ice packing after swimming
- oral anti-inflammatory agents
- judicious use of steroid injections
- As a last resort, surgery

(Richardson et al. 1980)
Current perspective

• volume and intensity are factors
  - not the only factors
  - unlikely to change

Sein et al. 2010

>15hrs/wk twice as likely
>35km/wk four times more likely to develop supraspinatus tendinopathy than those training less

‘Survey’ 50% 20-40km/wk group reporting shoulder symptoms

• ‘Predisposing factor + mileage = injury’
• Training errors/changes in workload a factor
A significant move forward

Identification of specific ranges important for swimming!

- Blanch and Popov - AIS
- What are the requirements of swimming?

(Blanch, 2004)

Concept: injury prevention = performance enhancement
Tests

Combined elevation test (CET – 5-15°)

Internal and external rotation at 90° (IR/ER - 40°-50°/90°)

Abduction and internal rotation test (ABIR - 150°-170°)
Thoracic rotation (>70°)

Hip extension (>10°)
Current perspective

• measures remain relevant
  Walker et al. (2012) – increased risk of shoulder pain with limited or excessive ER
  Bak and Magnusson (1997) – trend toward effects of limited IR
  Increased importance of thoracic rotation

• must be relevant to the individual
  Consider event and technique – more not better
  Value of screening

• others tests worth considering
  Impingement tests measure (20°-30°)
Techniques for improving ranges

• Combined elevation test
  TP/release/needling lats and teres, mobilise T/S into extension, release abdominals, strengthen shoulder retractors, thoracic roller

• Internal and external rotation at 90°
  TP/release/needling cuff, teres, pecs, lats, post deltoid, athlete self massage esp. ERs

• Abduction and internal rotation test
  TP/release/stretch ERs, teres and lats

• Thoracic rotation
  joint mobilisation in various positions, ‘fascial hold’ with rotation, self roller and ‘dome’, ‘archer’
Techniques for improving ranges

• Hip extension
  TP/release/stretch hip flexors

• ‘Impingement’
  TP/release/needling posterior deltoid, sleeper stretch

• Important to instruct the swimmer on appropriate self management
Further progress

Core control – specifically periscapular muscles and abdominals.

- ↓ EMG activity in serratus anterior
  (Scovazzo, Pink et al., 1991)
- Altered timing in scapular muscles in swimmers with impingement
  (Wadsworth & Bullock-Saxton, 1997)
- Increased awareness of the importance of scapula to the function of the shoulder
  - Kibler, Cools
- Core for power in the stroke – “elite swimmers propel themselves with the muscles of hips and trunk, not the arms and shoulders” (Bob Prichard, 1993)
Current perspective

- getting good scapular position with correct postural alignment is difficult for swimmers
- training induced scapular dyskinesis (Madsen, Bak et al., 2011; Su et al., 2004)
- ensure repeated or loaded movements to assess thoroughly
- middle trapezius weakness (Tate et al., 2012)
- consider humeral head and scapular position (McKenna et al., 2012)
• use of ‘wings’ as a test of scapular rotators

• scapular dyskinesis primary cause or secondary to pain?
Current perspective

• increased importance of core with current techniques

• theory of core strength loss with years in relative weight-free environment (‘astronauts in training’ – Carolyn Richardson; Tate et al. 2012)

• core exercises to include rotation and those in some degree of body extension
Glenohumeral stability

- anteroinferior laxity of the capsuloligamentous structures (McMaster and Troup, 1993; Rupp et al., 1995; Bak and Fauno, 1997)
- Poor active control of hypermobile joint or atraumatic instability as a result of repeated movements into end range elevation
- rotator cuff imbalance - generally considered as relative weakness of the ERs?
- leads to secondary impingement
- related to general hypermobility
- potential injury to other structures eg. labrum
Current perspective

- Research variable
  - +ve findings of instability in symptomatics using clinical tests (Rupp et al., 1995; Bak & Fauno, 1997)
  - Non-significant finding using applied force glenohumeral displacement measures (Borsa et al., 2005; Walker et al., 2012)
  - Significant correlation between laxity and extreme pain using sulcus test and laxometer (Sein et al., 2010)
- Scapular position critical to reduce humeral head anterior translation/prevent humeral elevation behind plane of scapula
Technical Errors

• crossing midline on hand entry
• crossing midline/wide during pull phase
  late breath
• insufficient thoracic rotation
• degree elbow flexion during pull
  related to event
• poor timing of hip rotation
• timing in all strokes

Note

• suggested changes should be discussed with and initiated by
  the coach
• no two coaches have the same idea on ‘perfect technique’
• come at it from a predisposition to injury angle
• no swimmer has the ‘perfect technique’
Video!
Don’t forget specific pathologies

- Cervical dysfunction!
- TP referral
- A/C joint
- Labral changes
- Suprascapular neuropathy (Arriaza et al., 2013)
- Thoracic outlet syndrome
- Visceral referral
Summary of current causes and management

• Training errors
• Limitation of ranges specific to swimming
• Lack of core control
• Insufficient glenohumeral stability
• Technical errors
• Specific pathologies  ... combination of 2 or more!

What can be done about the recalcitrant shoulder?
Where to now?
Dynamometry

• Measuring swimmers past 4 years including Australian swim team members
• Almost 200 individual swimmers measured and recorded on multiple occasions
• Australian team members measured at team camps, post selection trials and at end of major competitions
• Reliability of shoulder testing using HHD: good to excellent intra- and inter-tester reliability (Dollings et al., 2012)
Previous research

Falkel et al. (1987) – isokinetic dynamometer subjects prone and supine (1.6:1 ratio)

Beach et al. (1992) – isokinetic dynamometer subjects prone, found reduced endurance in ERs of symptomatic swimmers (1.4:1 ratio)

McMaster et al. (1992) – isokinetic dynamometer subjects standing arm adducted, increased IR strength in swimmers compared to controls (1.9:1 ratio)

Rupp et al. (1995) – isokinetic dynamometer subjects supine, significantly higher IR strength swimmers compared to controls but no correlation to shoulder pain (1.3:1 ratio)

Ramsi et al. (2004) – HHD subjects prone, found increasing IR strength throughout 12 week high school swim season without comparative ER increases (1:1 ratio)
Dynamometry technique

- bilateral shoulder testing
- internal and external rotation force production tested randomly
- subject standing in stable position with feet parted and knees flexed, upper body upright and good scapular position
- subjects asked to resist a gradual increase in force and not push into dynamometer
- gradually increased over approximately 3 seconds
- pressure continues until the arm begins to move
- 3 repetitions and the maximum used for analysis (Rod Whiteley)
3 symptomatic groups indentified:

- Reduced IR force production.
- Reduced ER force production.
- Changes in force production relative to BW.

- Asymptomatic ratio IR:ER of 1.46 (+/- 0.17)
Reduced IR force production (Ratio <1.2)

Which muscles are activated during this test?

1 – s/s  2 – i/s  3 – ut  4 – mt  5 – lt  6 – sa  7 – ad  8 – md  9 – pd
10 – lats  11 – pec  12 – u/subscap  13 – l/subscap
Shoulder rotation EMG findings:

Rotator cuff muscles can act as major torque producers for shoulder rotation (Boettcher et al., 2010).
• subscapularis musculotendinous unit pathology believed to be main source of chronic IR force production loss due to overload
• swimmers identified with subscapularis pathology
• AIS research (Kylie Holt) reinforces findings – swimmers tested weekly over 6 months, those describing pain had significant reduced IR force production on testing
• Bak and Magnusson (1997) found relatively reduced IR force production with isokinetic testing in 7 symptomatic swimmers
• Pink and Tibone (2000) recommended strengthening of subscapularis given past EMG study results
Group of swimmers with limited internal rotation force production

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<tr>
<td>ER</td>
<td>10.2</td>
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Figures in kilograms of swimmer presenting with right shoulder pain.
Implications of this finding

• Distinct clinical sub-group within ‘swimmer’s shoulder’
• Distance swimmers most affected?
• Need for monitoring (dynamometry) to avoid chronic overload
• Seem to respond well to rest if identified early – notify coach
• Need to strengthen IR and not just ER
• Massage and self release subscapularis
Reduced ER force production (Ratio >1.6)

Which muscles are activated during this test?

Consistent with past thoughts on ‘swimmer’s shoulder.”
  • Supraspinatus implicated in force production loss
“Is it all about impingement?”

• Highly repetitive nature of swimming
• Anatomy of the rotator cuff consistent with other insertional tendinopathies. (Cook and Purdam, 2009 and 2012)
• Poor outcomes and findings with surgery (Brushoj et al., 2007; Montgomery et al., 2010)
• Consider that the cuff may act as torque producer.
• Proposed cellular mechanism for swimmer’s shoulder pain. Sein et al. (2010)
  Chronic loading → tenocyte rounding and proliferation → increased proteoglycans → increase in bound water → collagen separation and disorganisation + tendon thickening → impingement and pain → cellular apoptosis → tendon degeneration
Rotator cuff tendinopathy: A model for the continuum of pathology

- Dotted arrow, potentially reversible
- Solid two-directional arrows, reversible
- Solid single-directional arrows, irreversible
- Dotted single-directional arrows, irreversible without going through an intermediate step
Implications for managing the ‘Swimming Shoulder’

• need to consider structure of the tendon
• reactive/early tendon dysrepair or late tendon dysrepair/degenerative (Cook and Purdam, 2009)
• value of imaging
  • ? Hypoechoic regions or, neovascularisation (Lewis et al, 2009; Kardouni et al., 2013) and swelling
• use of Ibruprofen as preferred medication
• need for structured loading program
  → current experiences
Rotator cuff muscles act reciprocally during shoulder extension (anterior cuff) and flexion (posterior cuff) for antero-posterior stability (Wattanaprakornkul et al., 2011)
EMG findings to assist

- Supraspinatus/infraspinatus preferentially activated during bench press
- Subscapularis during row to lesser extent
  (Wattanaprakornkul et al., 2011)
Exercise prescription

• Isometric to begin
• Consider compression minimization
• Pain?
• Flexion with band
• ‘Wall press’
• ‘Circles’
• External rotation with band
  standing and supine
• Prone scapular holds
• Push-up and bench press/band punch-pull

Progress is slow so monitor with HHD to assist loading progression
Case study

- 22 year old male elite level sprint freestyler
- Many years (>4) ongoing bilateral shoulder pain
- ↑ pain with change in squad and ↑ still water training
- Unable to do gym (lat pulldowns and legs only), unable to do push-up
- Initial contact 2011 → ‘exercises aggravate my pain’
- Spoke with physio who could assist him with a graded loading program
- Initially poor compliance with program but concentrated effort end 2012 during modified training
- Started with isometric ER and F with red band 5x10seconds, x1/day then x2/day → built to x30seconds, x2/day
Case study cont’

- Experienced some relief with exercises
- Tried ER in abduction in standing and in lying but inconsistent
- Tried prone scapula hold positions but initially painful
- ‘Progressed quickly around Christmas’ → 45second hold and ‘pulsing’ with bands, and doing prone scapula control and push-up
- Shoulders good since beginning 2013 so program has dropped off but ‘doing more gym’ including weighted chin ups, cable pull initiation, cable rotations, pull ups and push ups/bench press
- Coach comment 2013 ‘he hasn’t complained about his shoulders in months’
Reduced force production relative to body weight

• Expected values relative to body weight:

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<th>IR</th>
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<td>MALE</td>
<td>31%</td>
<td>21%</td>
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<td>FEMALE</td>
<td>26%</td>
<td>18%</td>
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• While ratio of approximately 1.4 may be maintained relative strength is reduced
• Increase in relative load on the muscle
• Are reduced measures due only to symptoms?
  → reduced strength on contralateral side
  → independent of symptomatic group, measures reduced
• Measures normalise if symptom free for >12 months
Implications of this finding

- Monitor cuff load tolerance/force production with HHD
- If measures not back to ‘normal’, shoulder condition not resolved
- Importance of setting good dry land strength program
- Program should be set at age group level (Bak, 2010)
- More measures required on age group swimmers with % calculated from elite older swimmers guide only
- Exercises should include pushing and pulling (ratio pull:push 1.1) as well as shoulder rotation exercises.
- Consider: core (abdominal and scapula muscles) exercises; weights as well as bands; deltoid strengthening exercises (pulley abduction, lateral raises, punch/pull).
Take home messages!

• Use the term ‘swimmer’s shoulder’ judiciously
• Attend to factors contributing to swimmers shoulder pain
  • training errors
  • joint hypomobility
  • core control
  • glenohumeral stability
  • technical issues
Take home messages!

• Use HHD to differentiate possible source of symptoms and to monitor shoulder ‘condition’
• Consider implementing an appropriate tendon loading program for chronic swimmers shoulder pain
• Set up a well structured strength and conditioning program for junior swimmers
Practical

- Dynamometry measures
- Graded loading exercises
- Swimmer assessment tests
- Commonly used exercises
References


Boettcher CE, Cathers I and Ginn KA. The role of shoulder muscles is task specific. *J Sc Med Sport* 2010;13:651-656.


