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From the editor

It's a rather sombre note on which to start, but memories fade all too rapidly and I don't want to miss this moment of reflection. It was shocking to hear the news of the skiing accident that led so swiftly to the death of the actress Natasha Richardson back in March. That was the month in which we had run David Joyce's authoritative article on sports-related concussion, and what a grave underlining it was of his warnings about head trauma care and follow-up. Never mind the new features, you could do far worse than start out this month by revisiting SIB 87 and re-reading David's article.

It's a short hop from our own professional education to the job of educating others, and this is the subject of a letter published this month on page 9, in response to Cameron Reid's feature in SIB 86 about

the lack of fitness and injury-awareness among many amateur sports teams. Sarah Couchman, a reader from Oxford, UK, has been working with young people on this subject and confirms their lack of awareness of sport-related fitness and good nutrition.

Education is an intrinsic part of the job of any sports and fitness support professional. But do we, any of us, consistently give it the attention it requires?

On to other things. Chris Mallac has done a tiny detour in his terrifically educational series on gym injuries. Although his brief focuses on the more hazardous of popular gym exercises, he was very keen to do the Romanian Deadlift this month, mainly because it is such a good gym exercise and a safe alternative to other more risky extensor exercises – but only when taught and executed properly. Anyway, as always, this issue's instalment is highly informative and will probably have you reaching for the

barbell to remind yourself how and why this neglected exercise really delivers.

Jane Johnson brings us part 2 of her overview of stretch techniques. She covered most of the mainstream ones with confusing acronyms in SIB 87, so Part 2 strays just beyond the conventional, reporting on the less evidence-based practices of cryostretch and neural stretching.

Sean Fyfe is also on top form this month, sharing the benefits of the work he is doing with elite tennis players in Australia these days. Sean's theme – how to assess and monitor the workload of an elite athlete – will be familiar to regular SIB readers, but is becoming *de rigueur* among conditioning and rehab staff, so if you work with serious athletes and haven't got on top of this subject yet, you'll need to do so very soon. Start here.

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Gym injuries: no 4

The Romanian deadlift

Chris Mallac continues his series on the injury risks of everyday exercises

The Romanian deadlift (RDL) is not a true deadlift, because the weight is not lifted from the floor and therefore is not a dead weight. The weight moves from knees to hips, not from floor to hips. Legend has it that the exercise is not even very Romanian: a solitary Romanian powerlifter performed this type of lift many decades ago at a competitive meet and the American competitors liked what they saw, so they 'borrowed' the idea and started training with this exercise. It has since become a boutique exercise used by strength athletes. It is, in fact, much safer to perform than regular deadlifts.

Training aim

The basic goal of the RDL is to lower a weight from the hips down to the knees and back again to the hips. This is achieved by bending from the hips (and slightly from

the knees) while holding the bar with elbows in full extension and scapulae retracted in the initial set position. The force for the lift comes from:

- the powerful hip extensors, such as the gluteals and hamstrings
- the lumbar and thoracic extensors.

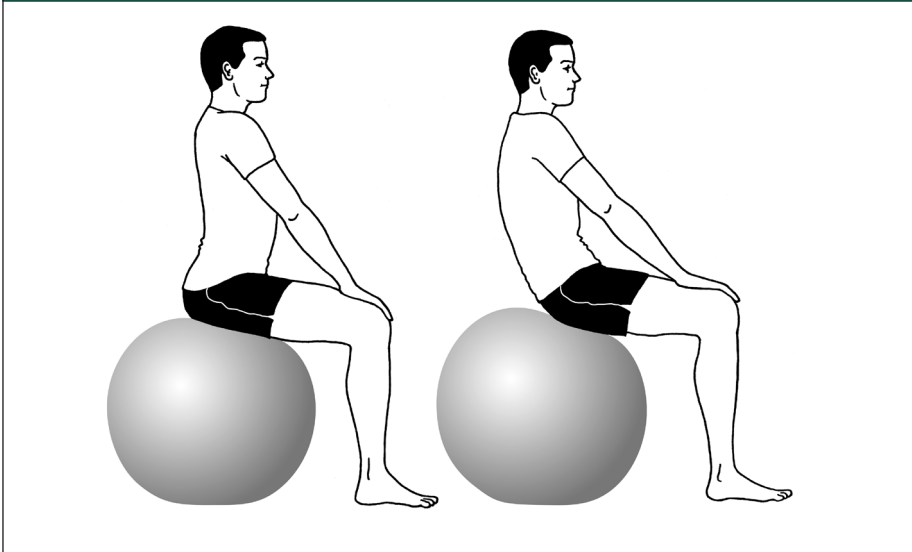
Main training uses

In contrast to the traditional deadlift, which uses multiple joints and therefore falls into the category of 'compound' exercise, the RDL is an isolation exercise that only really uses movement at the hips. However, along with traditional deadlifts, the RDL is grouped under the 'hip dominant' or 'posterior chain' list of exercises. The regular deadlift also involves knee bending and is therefore less 'perfect' than the RDL as a hip-dominant exercise.

Too often strength athletes only perform 'quad dominant' exercises such as squats, leg presses and step ups. In these exercises the quads take a large portion of the stress of the movement and receive a disproportionate level of training stimulus. If the 'quad dominant' movements were all an athlete ever performed, they would develop an imbalance between the quads and hip extensors. The injury manifestations of this can be as simple as strained hamstrings to something complex like chronic discogenic (disc) back pain. Hence the importance of hip dominant or posterior chain exercises.

For the average gym-goer or non-strength athlete, the RDL probably represents a better and safer alternative to deadlifts for training the posterior chain muscles, mainly due to the different types of muscle contraction involved in executing the two lifts.

Fig 1: Pelvic tilt technique with Swiss ball



Because the RDL starts from the hips and the bar is lowered to the knees, tension is gradually built through the first part of the downward phase. This is an eccentric contraction, in which the muscles are assisted by passive tension as they elon-

gate. The tension in the hamstrings and erector spinae is thus shared between the active and passive tension components, so the muscles are in effect not contracting as hard as they would in a deadlift, and there is less compressive load on the lumbar

spine. The upward (concentric) phase is then completed on the back of a lot of stored elastic/passive tension in the hamstrings and erectors.

In the regular deadlift the initial contraction is isometric, as the lifter exerts some upward pressure on the bar, progressing to a predominantly concentric muscle contraction. Because the lift is not preceded by an eccentric contraction, no passive tension has been generated in the muscles, and the resulting compressive load on the spine from the concentric muscle contraction is massive. Coupled with this, the initial 'dead' weight of the bar represents a significant amount of inertia, which must be counteracted with a greater initial muscle force. Once the bar is moving and the body is straightening, the regular deadlift gets easier in terms of the metabolic cost to the muscle.

Technique: how to get it right

I have spent many hours trying to teach injured patients and athletes RDLs over the years; it can be frustrating. Some bodies find it very difficult to dissociate (separate out) hip, knee and back movements.

In my experience, to perform an adequate RDL the most fundamental skill you need to grasp is how to pelvic tilt. Failure to initiate the exercise with an anterior pelvic tilt almost always leads to poor performance of the lift.

Step 1: Teach anterior and posterior pelvic tilt
Pelvic tilt technique can be shown on the Swiss ball to start with (see Fig 1, above left) and then progressed into standing. The cues for anterior tilt (Fig 1, left image) are:

- stick your bottom out
- increase the arch in your lower back.

Cues for posterior tilt (Fig 1, right image) are:

- tuck your bottom under
- try to flatten your lower back.

See box on page 4 for a detailed biomechanical explanation of the pelvic tilt.

Step 2: The waiter's bow

Perform the movement by initiating an anterior pelvic tilt and bending forwards from the hips, while keeping the lumbar spine in neutral (straight or even slightly extended). I find it best to keep one hand on the stomach and the other on the lower back (see Fig 3, opposite right).

Step 3: Broomstick RDLs

The next stage is to hold a very light bar or broomstick in the hands and attempt the

Fig 2: Muscles of the back

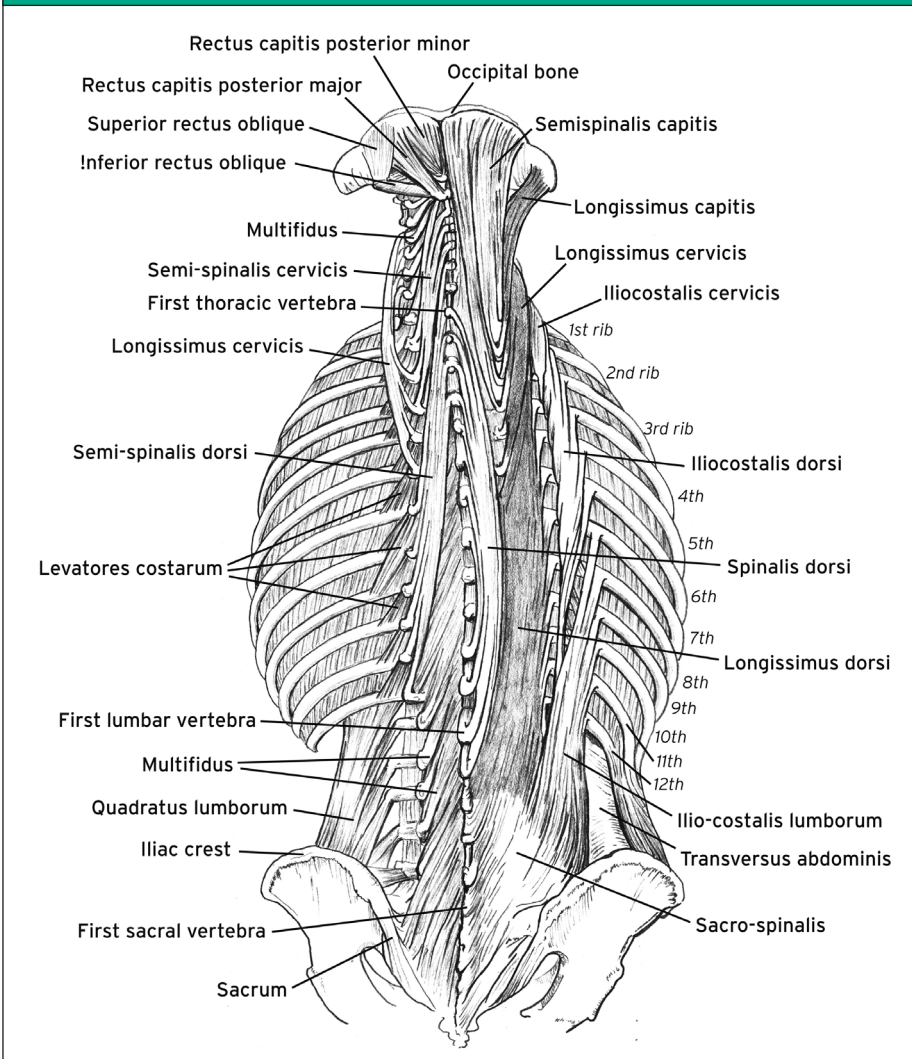
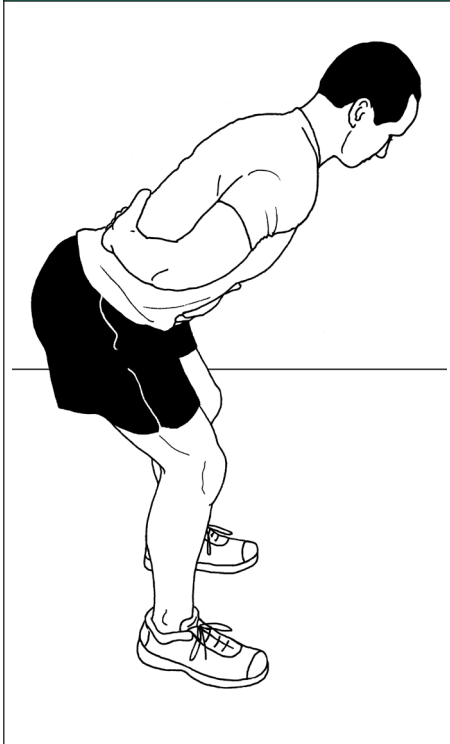


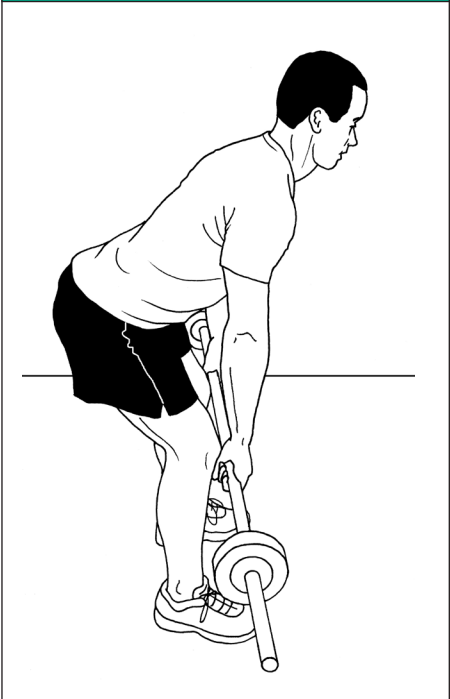
Fig 3: The waiter's bow



movement. Again, use an anterior pelvic tilt to initiate the exercise. The key technique points are:

- stand up tall at the start, with chest out and shoulders retracted
- look directly forward
- initiate movement with an anterior tilt. Knees should be slightly bent (up to 5°), as locking out the knees causes the trunk to start to flex and the weight ends up being much too far in front of the body

Fig 4: Bottom of movement



- slide the bar down in front of the thighs (without touching them) towards the knee
- look forward and keep the chest out. Take care to avoid any hyperextension of the neck and lower back
- bend the knees slightly as the lift progresses (no more than 10°, depending on the lifter's height)
- at the bottom of the movement (Fig 4, below left) the lifter should feel a stretch sensation in the hamstrings.

Step 4: Weighted RDLs

Once the lifter has mastered the broomstick RDL, they can move on to a weighted bar. Start with an Olympic size bar at about 20kg, and progress upwards from there as strength and proficiency allow. It is not uncommon for very strong athletes to perform RDLs with 150+kg.

Lifting tips for instructor use

- To encourage a chest-out, scapular-retracted position, ask the client to rotate the clavicles (collarbones) upwards.
- Tell the client to pick a spot on the wall directly in front of their eyes and look at it throughout the lift.
- When sliding the bar down, encourage the lifter to aim for a spot just above the knee cap. This cue is normally enough for them to understand that the bar moves directly downwards, not sliding down the thigh itself – as that would prompt too much knee bend.
- If the client is struggling to limit their knee bend, you can either tape the knees to stop flexion or hold them to guide the right level of bend.

The injury risk

The primary musculoskeletal area susceptible to injury from incorrect lifting technique is the lumbar spine.

In my previous coverage of the regular deadlift (SIB 86), I pointed out an inability to hold the pelvis in a neutral or slightly anterior tilt leads to the lumbar spine moving into relative flexion during the exercise. Because of the way the extensor muscles are organised, that slightly flexed spinal posture significantly affects their ability to produce force.

The thoracic components of longissimus and iliocostalis attach to thoracic vertebrae and ribs (see Fig 2, opposite left). They have short fibres with long tendons to the sacrum and iliac crests. The fact that the tendons are superficial (run near the surface) gives these muscles a significant leverage or pulling advantage, enhanced by

Fig 5: Too much knee bend

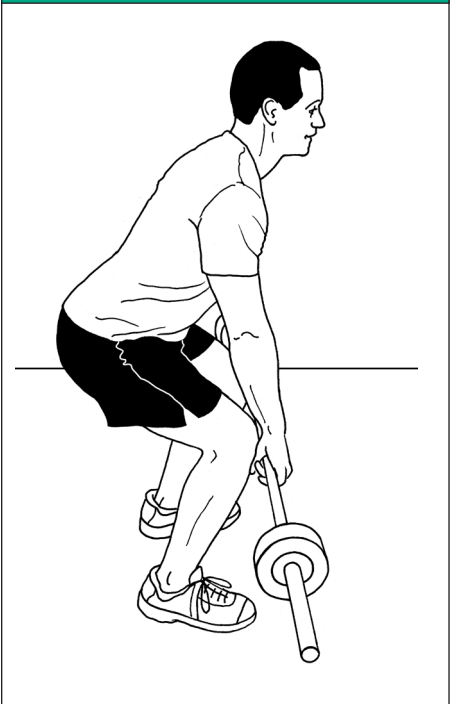
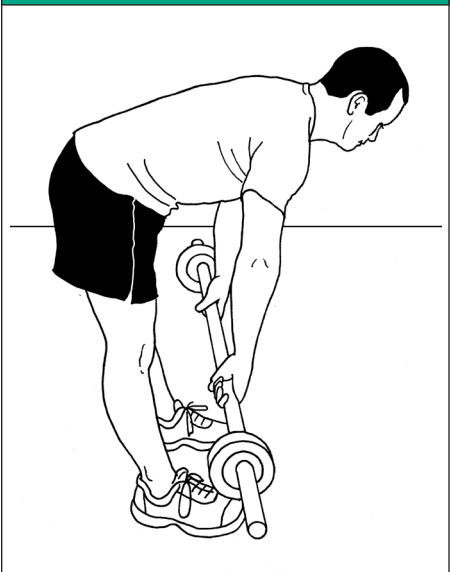


Fig 6: Knees too straight



the composition of the fibres being 75% slow twitch. These are, therefore, the most efficient extensors.

The lumbar components of longissimus and iliocostalis attach to transverse processes of lumbar vertebrae and insert onto the sacrum and iliac crests. The fibres are aligned posteriorly, so they produce a posterior shear force on the vertebrae as well as an extension moment (force). When the trunk is flexed from the hips and the spine stays in its neutral lordosis, these fibres prevent anterior shear (forward slippage) of the vertebrae in forward bending. If the spine loses its neutrality and goes into flexion, these fibres lose their line of action and can no longer work against the anterior shear force.

Biomechanics of the pelvic tilt

The direction of pelvic tilt changes the dynamics of any squatting movement or posture, however slight. The pelvis can tilt along a continuum from anterior to posterior. In summary, pelvic tilt movements work as follows:

Anterior tilt

The anterior superior iliac spines (ASIS) are pushed forward (anteriorly) and downwards (inferiorly). Key features are:

- ilium anteriorly rotates
- lower lumbar spine moves into relative extension
- facet joints engage so the spine is passively locked into a stable position
- long dorsal sacroiliac ligament is taut, so the sacroiliac joint (SIJ) is locked into a stable position.

Posterior tilt

The ASIS bones move backward (posteriorly) and upwards (superiorly). Key features are:

- ilium rotates posteriorly
- lower lumbar spine moves into relative flexion
- facet joints disengage so the spine has no bony support
- long dorsal sacroiliac joint ligament is loose, so the SIJ is unlocked into a relatively unstable ligamentous position (this does not mean that muscles are not supporting it).

Biomechanical effects of anterior vs posterior tilt in squatting

Biomechanical effect	Anterior tilt	Posterior tilt
Hip flexion	Increases	Decreases
Hip flexion moment	Increases	Decreases
Dorsiflexion	Decreases	Increases
Forward knee movement	Decreases	Increases
Lumbar spine flexion moment	Increases	Decreases
Quadriceps activation	Decreases	Increases
Hip extensor activation	Increases	Decreases

Multifidus are small dense muscles that span one to three vertebral segments. They are too deep and close to the axis of rotation to provide significant extensor torque; however, they appear to compress one segment on another, providing some stability against shear. They probably control the amount of extension at each vertebral level.

Technique fault 1: Too much knee bend (see Fig 5, previous page)

The most common technique fault is to bend the knees too much and slide the bar down the thighs to the knees. Although not particularly damaging to the lumbar spine, this position represents an inefficient technique that resembles something halfway between a deadlift and an RDL. Mixed techniques lead to mixed results, so it's best to correct this fault early on.

The fault is usually down to poor motor control and patterning. The body cannot dissociate hip from knee from pelvis. To correct this, try any of the following:

- tape the anterior knee to prevent any more than 10° knee flexion
- constantly alternate between a weighted RDL and the waiter's bow. The repeated

reinforcement will 'groove' the correct motor pattern

- stand sideways in front of the client and demonstrate the movement as they perform it
- keep on reinforcing the 'chest out' and 'head forward' cues.

Technique fault 2: Failure to maintain anterior pelvic tilt

By not initiating the movement every time with anterior tilt, the risk of the lifter falling into posterior tilt is greatly increased. The danger here is that the lumbar spine will assume some segmental flexion, placing the disc under increased pressure. This can be very dangerous to lumbar spine discs.

Technique fault 3: Knees too straight (see fig 6, previous page)

This is possibly the most dangerous fault. With the knees locked out, the hamstrings are immediately placed under stretch by the knee extension component. When the lifter begins to lower the weight, the hamstrings reach their stretch limit very early and the pelvis is thrown into posterior tilt. This slackens off the hamstrings a

bit to enable the downward movement to continue. But, as already explained above, the shift into excessive posterior pelvic tilt and lumbar flexion places the lumbar spine discs in a position of extreme vulnerability to injury.

Alternative exercises

Other exercises that prioritise the posterior chain/hip dominant muscles include:

Hyperextension

The hyperextension is normally performed on a 'Roman chair'; the horizontally aligned and prone (face-down) body moves into flexion and then back into extension while pivoting around the hips. The spine is ideally kept straight, with all the movement taking place at the hips by recruiting the gluteals and hamstrings. The erector spinae work isometrically to hold the spine in neutral.

Reverse hyperextension

The reverse hyper is performed lying face-down on a high bench with the upper body supported and the legs hanging free. The legs are raised to horizontal, again using the hamstrings and gluteals, with a significant contribution from the pelvis to anteriorly tilt and counteract the tendency of the spine to flex as the legs are raised.

One-legged bench bridge

The client lies supine on the floor, with the heel of the working leg placed up on a bench and the other leg bent with foot suspended off the ground. They then slowly lift the body upwards until the heel, knee, hip and shoulder are diagonally aligned. This recruits the gluteals and hamstrings heavily.

Rehab uses for the RDL

The RDL is a fantastic exercise for clients with lower back pain to commence learning, once they are out of the acute stage of their injury and pain has resolved. Not only does it strengthen the important extensors of the lumbar spine, but in functional terms it is a much better way for back pain patients to lift from knee level (as you would if you were picking up boxes off a pallet). Learning good RDL technique trains back-pain patients how to protect their spines when lifting.

The RDL is also useful in the rehab of hamstring muscle strains, especially in sports that involve forward bending while running at speed. Think of an AFL player going fast, picking a ball off the ground.

Next issue: Dips

Assessment techniques

How to measure workload

Get scientific about measuring your elite athlete’s training or they will suffer the consequences, says **Sean Fyfe**

The training of elite athletes is increasingly being informed by sports science research, allowing support staff greater opportunities to be proactive in injury and illness prevention. Sports injury practitioners working in elite sport, with individual athletes or teams, are very much a part of this world, and it is no longer acceptable in these environments just to diagnose, treat and rehabilitate the injured. To remain injury-free and healthy is essential so that an athlete can build on their training foundations without interruption from physiological or psychological problems.

Our ability to monitor training effectively has improved substantially, and sports injury practitioners need to be familiar with the options so they can implement strategies and interpret information as it applies to their athletes.

Key definitions

Overtraining syndrome is a ‘complex condition characterised by a variable group of symptoms and pathophysiologic abnormalities that always include performance incompetence refractory to regeneration cycles. It is frequently observed in response to sustained high intensity/high volume athletic training, particularly coupled with other stressors in the individual’s life’⁽¹⁾.

Overtraining has also been described as a physical and psychological state that takes several weeks or months to recover from. Foster⁽¹⁾ states that there is a compelling case for recognising an overtraining ‘syndrome’, for two reasons:

- i. the clear relationship between training load and performance encourages athletes to attempt progressively heavier training loads
- ii. the instinctive response of most athletes (and many coaches) to unfavourable competitive or training results is to increase the effort or load of subsequent training sessions.

These two points are really very important: support professionals are often in a position to influence what is occurring in training, as part of their work to prevent or help an athlete deal with an injury. In instances like this, it is imperative to have proof of what training has been done so that reliable conclusions can be drawn about training

Table 1: Session RPE values

Rating	Descriptor	Possible athlete interpretation...
0	Rest	Rest
1	Very, very easy	Really easy
2	Easy	Easy
3	Moderate	Moderate
4	Somewhat hard	Sort of hard
5	Hard	Hard
6	*	Harder
7	Very hard	Very hard
8	*	The coach tried to kill us
9	*	I feel like death warmed up
10	Maximal	Oh s---

and performance. We look below at how monitoring can help provide this.

Overreaching: an accumulation of training stress and non-training stress, resulting in a short-term drop-off in performance. It is often referred to as the early stage of overtraining and may take anything from several days to several weeks to recover from. By monitoring the workload, the support professional should be able to detect a state of overreaching and put in place recovery strategies (for example, increased rest, sleep, massage, hydrotherapy etc) at an early stage, with the aim of restoring the athlete to a state of balance. Ways to test the athlete’s recovery and readiness for training load are explored below.

Stress: ‘an unspecific reaction-oriented syndrome that is characterised by a deviation from the biological homeostatic state of the organism’⁽²⁾.

Recovery: ‘the process that allows the re-establishment of psychological and physical resources and states that allow the taxing of these resources again’⁽³⁾.

Supercompensation: the body’s adaptive response to training stress, which leads to it achieving a higher performance capacity.

How to monitor training

There are many ways to monitor training, some of which suit certain sports better

than others. As with any practical implementation of research, the possibilities are always limited by time, budgets etc, so a knowledge of the options will help support professionals work out their most effective strategies for their available resources.

We can divide the elements of monitoring training into five categories:

- training indices
- questionnaires
- hormonal/Immune system measures
- biomechanical measures
- other.

Training Indices

Probably the simplest and most common form of monitoring training is the **Session Rate of Perceived Exertion scale** (Session RPE; see Table 1 above). This measures the intensity of a training session, according to a 0-10 rating made by the athlete at the end of the session. Alternatively, the athlete could rate each exercise or activity separately and then take an average. But Session RPE has been shown to be remarkably accurate as a reflection of intensity, cross referenced against heart rate data, cortisol measurements and resistance training loads.

A second training index is **training load**. The training load of a session is found by multiplying the Session RPE by the total number of minutes of the session. Thus a 90-minute session with a Session RPE of 5 will give a total training load of 450.

Training load is very helpful, not just for post-session monitoring but also for plan-

ning ahead. It allows the coach to regulate the athlete's workload precisely, and to set out daily/weekly/monthly training load targets for a training block. And by collecting end-of-session RPE data, you can also keep tabs on the actual work done versus the planned load.

A third training index is **monotony**. Variability within a training schedule is just as important as training load in improving performance and preventing injury and illness. If an athlete does not have sufficient variability over a given period, we know that they will fall short on the need to go through a cycle of stress and recovery and will therefore fail to progress. Training variability also has massive implications for the athlete's psychological wellbeing in terms of motivation, freshness and life balance. Monotony is calculated by taking the daily mean (average) load and dividing it by the standard deviation of the load.

A fourth helpful training index is **strain**. This is the product of the weekly training load and monotony. For example, if the weekly training load was 3725 and the monotony was 1.44, the weekly strain on the athlete was 5397. Ideally, the weekly strain should vary within any training period. Strain can be a particularly useful tool to monitor the effectiveness of a taper before major competition.

Questionnaires

This is the second type of monitoring tool. Questionnaires can be used to reflect the stress and recovery process. In the past the most commonly used questionnaire was Profile of Mood States (POMS), which was designed to identify and assess transient, fluctuating affective states. A more recent development is the Recovery-Stress Questionnaire. Kennta and Hassmen⁽⁴⁾ state that it is 'one of the few psychometric instruments that attempt to address the full complexities of stress and recovery'.

Other questionnaire-type information often collected independently to help determine the physical and psychological state of the athlete covers:

- sleep quality
- appetite
- irritability
- energy levels.

Hormonal/immune system measures

The most commonly used hormone markers are testosterone and cortisol. Both blood and saliva measures can be taken. Testosterone is an anabolic hormone which is important for muscle hypertrophy

and increasing muscle glycogen synthesis. Cortisol (the 'stress' hormone) can be a marker of physiological stress associated with exercise: 'Elevated cortisol concentrations lead to increased binding at the glucocorticoid receptor, which results in reduced protein synthesis and concomitant losses in muscular force'⁽⁵⁾.

Cortisol and testosterone respond to exercise in opposite directions. Ideally, the ratio of anabolic to catabolic hormones should be as high as possible, to indicate that positive training adaptations are taking place. An imbalance results in a decreased ratio of the two hormones when training load is increased. But the jury is still out on the accuracy and validity of using this ratio as a measurement tool.

Salivary immunoglobulin (S-IgA) is the most prevalent immunoglobulin in mucosal secretions providing the body's defence against pathogens. Research has shown that athletes who train intensively over many years run the risk of chronically suppressing their salivary immunoglobulin levels. This is a concern, because the S-IgA level has an inverse relationship to the number of upper respiratory tract infections: in general terms, the athlete will fall prone to more such infections if their S-IgA is decreased.

S-IgA is therefore a predictor of infection. Athletes can be tested regularly during heavy training; any decrease in levels would indicate a possible need to lighten the training loads.

Testosterone, cortisol and S-IgA are the immune-system markers most often used in monitoring training. For further reading on other markers, search for:

- glutamine
- cytokines
- creatine kinase
- growth hormone.

Biomechanical measures

Power output measurements are often used to monitor an athlete's physical status as we know that if an athlete is stressed, their power output level will be decreased relative to when they are in a recovered state. The support professional must ensure they take accurate baseline measures when the athlete is in a non-fatigued state. Tests should be repeated at the same time of day on each occasion.

The most widely used biomechanical test is to assess jumping. There are various options, but the easiest is vertical jump. This can be either:

- static jump (SJ) – starting with knees bent), or

- countermovement jump (CMJ) – down then up quickly from a standing position). Jump height can be measured in centimetres or, if the resources are available, with a force platform and linear displacement system, which will give you an impressive range of data such as height, force, total power output, peak force and power output and rate of force development. You can take any of these measures as your indicator(s). If these resources are available, an exercise such as bench throws as an upper body test can be measured and used. (Bench throws are a kind of bench press using a Smith machine; they involve rapid lowering and lifting of the bar plus a release of the bar at the top of the concentric phase to eliminate deceleration and increase the power output required.)

You may also come across eccentric utilisation ratio (EUR), which is the ratio of CMJ to SJ performance (CMJ/SJ). This has been advocated as a useful measure of the body's ability to use elastic energy. This is based on the understanding that when the body is fatigued, the neuromuscular system will be compromised or not functioning optimally, which would affect the CMJ more than the SJ, causing a reduction in the EUR figure.

Range of movement testing also falls into this category. It is suggested that if an athlete has undergone heavy training, the muscular system will have been significantly stressed, resulting in certain muscle groups being shortened. The resultant change in ROM from baseline measures can be used to help assess training load intensity. Further research is required in this area before it can be advocated as a practical tool.

Other

Other forms of training monitoring can be used, again depending on the sport. Some sports track repetitions of a certain action. For example, in cricket, fast bowlers are limited to bowling a certain number of balls in any practice session. The use of GPS units is commonplace in elite team sports such as AFL and rugby league, to monitor running distances and speeds. Such units have been used for a while in training; this year they are being used for the first time in matches in the Australian Rugby League competition and the NRL. Heart-rate monitors have been around for a long time to monitor cardio intensity. The job of support staff is to be aware of the options and select measures that work best for the athlete(s), sport, training goals, budget and any other constraints and contexts.

How to use the data

There's no point in monitoring unless you are going to act on the information you are gathering. Knowledge of training indices should help staff to plan programmes and then amend them along the way to take account of what is actually happening. Questionnaires can be administered to profile the athlete to pick up any trends within a group or detect any changes in an individual athlete over time. Hormonal/immune system testing will alert you to signs of overtraining, to enable early changes to the programme. Biomechanical testing is helpful on a week-to-week basis: if on Monday morning power output is down, then you can decrease the athlete's training volume for the week accordingly.

If an adjustment to training is required, rest or reduction is only one option. Others include increasing massage, pool recovery, sleep between sessions, a change in diet or alteration of training/life balance.

Are they under-training?

It is important to remember also that your monitoring should detect whether the athlete's training loads are in fact too low. The opportunity to train harder may exist, and you can oversee this increase safely, enabling the athlete to improve their rate of progress.

Finally, the monitoring data can help the sports therapist understand whether

and in which ways an athlete's training schedule may have contributed to an injury. This is invaluable for ensuring effective rehab and avoiding a future recurrence.

Case study

Let's finish by looking at a case study of a runner who, two years ago, suffered a stress reaction in the tibia. Unfortunately no monitoring had been done prior to that injury, but since then we have been monitoring the runner's training using Session RPE and time to calculate training load, monotony and strain. The runner's total running distance is also calculated every week using a GPS unit. The aim here is to use the monitoring specifically as a proactive approach to preventing a similar overuse injury.

During one six-week block of heavy training, at Week 4 the indices revealed high monotony and strain scores. The runner also reported feeling particularly tired, lethargic and sore. In the context of this runner's injury history, training index scores and physical status reporting, we decided the best course of action was to reduce training levels for the fifth week of the block. Three running sessions were dropped and replaced with massage and pool recovery, and the athlete was advised to get extra sleep. In the sixth week the athlete was able to train according to the

original plan, having reported a return of energy levels.

We cannot say for sure whether any injury or illness was averted by this intervention, but over a longer time period data for an individual or team can be turned into statistical trends, to determine if the implementation of training monitoring and subsequent programme adjustments are effective.

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Therapeutic techniques

Hold, contract, release and bounce (II)

Jane Johnson concludes her overview of stretching

In SIB 87 I compared and contrasted several forms of stretching commonly used in the rehabilitation of sports injuries: active (static), passive, active (ballistic), PNF, MET and soft tissue release⁽¹⁾. I looked at the advantages, disadvantages and key uses of each of these stretching modalities. This time I am covering two more forms of stretching: cryostretch and neural stretching.

Cryostretch

Described well by Knight⁽²⁾, this form of stretching is used specifically to increase flexibility that is limited by muscle spasm. Similar to PNF stretching, cryostretch has the added advantage that the affected muscle is numbed prior to the stretch, making use of the anaesthetic effects of the ice to reduce the spasm and improve pain-free range of movement (ROM).

How to do it

For a hamstring cryostretch, the hamstrings are numbed using an ice bag, commercial ice pack or ice massage. Timing protocols vary with each of these cooling methods. A simple rule of thumb is for the ice to be removed once the athlete reports that the muscle is numb, and not to exceed the recommended application time.

Preparatory phase: With the client supine, the therapist passively lengthens the hamstrings by taking the limb into the Straight Leg Raise (SLR) position, to around 70-80% of full ROM (as this is not a torn muscle, it is safe to take the limb into SLR). The athlete is then asked to return their leg to the table while the therapist offers minimal resistance – necessitating a hamstring contraction. This SLR-contraction sequence is repeated three to

four times, with the therapist applying increased resistance each time. The purpose is to enable the athlete to practise contracting the agonist – the muscle with spasm – in the SLR position.

Cryostretch phase: The therapist passively stretches the hamstrings in supine, stopping when the athlete reports discomfort/stretch. This position is held for 20 seconds. The client is asked to build up to a maximal hamstring contraction, which they hold for 5 seconds, resisted by the therapist, and then gradually release again. After this isometric contraction the therapist gently stretches the hamstrings, taking the limb into an improved point of hip flexion and holding for 10 seconds. The entire cryostretch section is repeated two to three more times. The cryostretch section should be performed with the

muscle numbed, so it may be necessary to reapply the ice.

Note that this is a very specific use of ice. The ice is being applied to a specific site on the muscle in order to cool it. It does not follow that immersion of the lower limb in iced water, for example, would have the same beneficial effects.

Advantages

- Ice is known to reduce pain and muscle spasm.
- Combining ice and stretching is more beneficial than employing a single technique.
- It is relatively inexpensive.
- It is relatively easy to perform.

Disadvantages

- It can be messy as the ice starts to melt.
- Some people find ice painful.
- It is contraindicated for some clients (e.g. those with Raynaud's).
- There may be increased pain four to eight hours after treatment.
- There is risk of muscle tear if the static stretch is performed to quickly.

Key benefits

For use with muscle spasm and muscles that are stiff from prolonged disuse. Be aware, though, that little research has been done into the effects of cryostretch.

Neural stretching

An article on stretching would not be complete without at least mentioning this treatment modality. Factors such as trauma, scar tissue and arthritic joint changes may affect the mobility of nerves as they run their course through muscle and fascia in the body. Many readers will be familiar with neural tension tests, used by physiotherapists to assess this mobility. Neural mobilisation refers to the use of these tests (sometimes modified) for the purposes of treatment rather than assessment.

Examples of neural mobilisation tests include:

- straight leg raise (SLR)
- prone knee bend
- slump test
- upper limb tension test.

As mechanically stressing neural structures could result in altered nerve function in some clients, there are considerable precautions and contraindications to the mobilising of nervous tissue.

As with cryostretch, there is a dearth of research in this area, with many questions remaining unanswered. For example:

- Do clients with positive neural tension tests need stretching?
- Does repeated use of the test actually stretch neural structures?
- If so, is it the stretch of these structures that contributes to improvements in pain or function?

One of the tasks facing researchers is to clarify the use of the terminology being used by therapists themselves. As mentioned, neural tension tests imply that tension is applied to neural structures, whereas neural mobilisation, a term also used in the literature, could either be used to describe a neural tension test that is being used as a treatment modality, or it could refer to neural gliding⁽³⁾. With neural gliding, the treatment aim is to facilitate movement of a possibly tethered nerve without tensioning it. Now we have the term neurodynamics, used to embrace the concepts of both tension and glide.

In a study that set out to determine the effect of slump stretching on pain and disability in people with low back pain⁽⁴⁾, 30 subjects with a positive slump test (but a negative SLR) completed several self-reporting measures, including a body diagram and numeric pain scale. They were then randomly assigned to receive lumbar spine mobilisation and exercise, or lumbar spine mobilisation, exercise and slump stretching.

After three weeks of twice-weekly intervention, the outcome measures were reassessed. Patients who received slump stretching demonstrated significantly greater improvements in disability, pain and centralisation of symptoms than patients who did not.

To investigate why slump stretching might be therapeutic in the management of Grade 1 hamstring strains, another study examined the effect of slump stretch on sympathetic outflow to the lower limbs of 10 normal, elite track and field athletes⁽⁵⁾ (along with other things, sympathetic nerves cause constriction of blood vessels in the skin and widening of blood vessels in muscles, and may be involved in the process of muscle healing).

Telethermographic images were taken at four locations before and after stretching, on both stretched and unstretched lower limbs. These images show up changes in skin temperature in response to reflexes. Increased skin temperature in the stretched limb suggested that a significant cutaneous vasodilator effect occurred in this limb, while the unstretched control limb showed a slight decrement in temper-

atures. The authors concluded that slump stretching may have a sympathetic inhibitory effect, which could be the underlying physiological mechanism for the therapeutic effect of slump stretch in Grade 1 hamstring strains.

Cadaveric (dead body) studies indicate that the positions in which limbs are placed during neural tension tests do indeed place strain on neural structures. In one study of four fresh, intact bodies, digital calipers were used to assess nerve excursion (movement of the nerve) and a microstrain gauge measured the strain when upper limb neural tension tests were applied.

Results showed that the median nerve tension test caused strain (ie, a lengthening or tautening) in the median nerve of 7.6%, and the ulnar-nerve tension test caused a strain of 2.1% in the ulnar nerve⁽⁶⁾. Yet even if you believe that nerves need to be tensioned in order to bring about an improvement in musculoskeletal condition, it is still something of a leap in faith to state categorically that because the tests themselves may be valid, they work as treatments.

The tests/treatments are likely to strain more than nerves. It may, for example, be the gentle strain on fascial structures that occurs during treatments that is responsible for improvements in musculoskeletal pain, discomfort or function. Or it may be a combination of both neural and fascial strain, with or without some other factor(s). Chris Mallac, in his article last month on the diagnosis and causes of hamstring strains, revealed how his treatment of non-neural tissues resulted in an improvement in a neural test that prior to treatment had been positive for neural symptoms.⁽⁷⁾

There is plenty of positive anecdotal evidence to support neural mobilisation (which may or may not include stretching using neural tension tests) as a treatment modality. However, a quick look at physiotherapy chat rooms on the web reveals there is some evidence of patients having been treated with neural stretching and suffering adverse effects. It's not hard to see why a practitioner might be unwilling to admit to having used a modality that has adversely affected their patient, albeit with the best intentions.

While we are all supposed to be adhering to evidence-based practice, there are no real treatment protocols to follow when using neural stretching. We have a long list of cautions and contraindications to consider prior to the application of treatment, but we do not know, for example, for how long or with what amplitude to stretch

neural structures when treating musculoskeletal conditions.

Ellis and Hing, in their systematic review of randomised controlled trials⁽⁸⁾, looked at whether neural mobilisation was effective as a treatment modality. Of the 10 trials that met their criteria they concluded: 'There is only limited evidence to support the use of neural mobilisation.' As they point out, and as is so often the case with research into manual therapies, we need a more standardised approach to intervention and more homogenous subject groups.

Conclusion

There are many forms of stretching, including the several 'mainstream' techniques that I covered in the last issue.

Cryotherapy and neural stretching may both be at the far end of the spectrum, in the sense that they have no evidence-based treatment protocols governing their use, but both can serve to stimulate our thinking on this subject.

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Letter to the editor

Unhappy amateurs

From Sarah Couchman

I am writing in response to the article by Cameron Reid in SIB 86 (February 2009), on the lack of 'prehab' training for amateur team sports enthusiasts.

It was refreshing to read your views and insights into what is a growing problem in amateur sport – and one which, according to current research, is affecting younger and younger sports players.

I wanted to share with you something I have been working on for the last 18 months in relation to this problem of overuse injuries in the amateur competitive game.

I am a sports injury practitioner of 14 years' experience, working in Oxford, UK. My background is in osteopathy and naturopathy. I see overuse injuries often. In the last few years particularly, I have noticed a growing incidence of structural problems in younger players, which are certainly more common than they were 10 years ago.

Remarkably, with all the information and tools available, attitudes on how to maintain biomechanical fitness remain almost unchanged among this age group. Students continue to display limited understanding or awareness of how good posture can have a positive long-term effect on minimising overuse injuries. Instead they choose to endure months, sometimes years, of pain or discomfort every time they go out to compete.

I understand that being dropped from the team is a major blow and the thought of this happening overrides any thought of making adjustments to help deal with the problem.

However, I also see the difference in performance levels when students decide to follow a simple combination of techniques and advice. They realise that their previous approach had been adopted out of ignorance rather than logic, and would have led to them playing fewer competitive games in the long term.

Without a sound biomechanical structure, balance and co-ordination skills, a successful long-term sporting career can only ever be a dream. An underdeveloped spine and poor posture will inevitably collide with a competitive amateur sports environment.

A typical 11- to 13-year-old is more at risk of sustaining long-term weakness and structural change after a few years of competitive sport if their basic structure is out of alignment. And this is not just about posture, but issues like technique, protective clothing, warm-ups, cool-downs, stretching and nutritional health, too.

In the past year I have been attempting to highlight with local state and private schools/sports academies the potential problems that may arise if nothing is done to enhance students' education about biomechanical function from the start of their sporting careers. The aim here is to share specialist knowledge and techniques at a time in their lives when it could be most beneficial. This could then reduce the incidence of overuse injuries, which in turn would have a positive effect on reducing the waste of good talent often seen by the age of 16.

Sports champions commonly describe how they began developing their sport while at school: this is where opportunities are either nurtured or dashed. For this reason, I invited a number of schools to take part in a feasibility study, for the purpose of highlighting the students' current levels of self-awareness and knowledge about biomechanics and nutritional health care, and what actions they might take to address pain and injury.

The parents and PE teachers all agreed that a feasibility study (less than half the cost of treating one injury per sports student in the real world) should prove a positive experience and should make a significant difference to student's attitudes and sporting achievements in the short and long term.

The end product of this is the development of an 'online self assessment programme' to inform school students about good biomechanical support. I feel passionate about sharing the information and experience I have gained over the years with students from all backgrounds – not just those who can afford private treatment. Time-starved coaches and PE teachers could also use this tool to encourage and support, as well as check on the status of, students who have been injured.

However, in the current financial climate this has proved an uphill struggle. To attempt such a project, ethical approval needs to be sought; a programme such as this would have to be carried out by either

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Research Review

by Nick Grantham

Stiff little shoulders

Rotator cuff roll

How can a towel improve your shoulder rehab? Researchers in sunny Florida have recently rolled up their beach towels and put them to good use (Implications for specific shoulder positioning during external rotator strengthening. *Strength and Conditioning Journal* 2008; 30 (4) 12-16).

The rotator cuff muscles work to stabilise the shoulder joint, prevent shoulder impingement during arm elevation and individually to execute specific shoulder movements. Exercises to strengthen the rotator cuff are routinely prescribed as part of prehab, rehab and general conditioning programmes. Two of the most popular are the standing and side-lying external rotation movements.

The US researchers have proposed specific recommendations for shoulder positioning during these two exercises. They recommend passively positioning the arm in approximately 30° abduction with a towel roll or wedge placed between the arm and torso during the strengthening exercises. These recommendations are based on three considerations:

Anatomy: The external rotator musculature consists of infraspinatus, teres minor and (as a secondary function) supraspinatus. Research shows that an adducted position of the humerus compromises circulation to the rotator cuff because of a narrowing or 'wringing out' effect of the arteries. A towel roll, used to maintain an abducted position of approximately 30°, can prevent this, allowing better blood supply to the rotator cuff muscle tendons.



Neurology: When left to their own devices, clients often compromise their exercise technique by actively raising or abducting the arm (compensatory abduction), recruiting larger muscle groups in the shoulder instead of focusing on the smaller rotator cuff muscles. The towel roll passively abducting the arm may also be helping by forcing the adductors to contract to hold it in place. Reciprocal inhibition may prevent compensatory abduction through this contraction of the adductors, allowing the client to place less emphasis on the larger muscle groups and more effectively target the smaller, stabilising muscles of the shoulder girdle.

Biomechanics: Rotator cuff injuries are often a result of impingement in the subacromial space. Previous studies have found that contraction of the adductors (required to keep the towel roll in position) produces a slight downward movement of the humerus, increasing the subacromial space. Tension is also increased in the rotator cuff muscles when the arm is adducted to the side, compared to the 30° abducted position, which decreases rotator cuff tension and so may be more comfortable.

Scapular protraction may also lead to decreased space in the subacromial region and reduced external rotator strength, so the research team also recommended that exercisers keep their shoulders positioned in line with the ear in the frontal plane (so the shoulder does not sit forwards of the ear in side view), preventing abnormal scapular protraction.

The appliance of science

For attention of

Physiotherapists Strength and conditioning coaches Coaches 

Significance

Adds to previous knowledge

Cutting edge

Confirms best practice 

Too early to say

How to use it

These are the rotator cuff external rotation exercises, with the researchers' main teaching points:

Start position (standing)

- Stand with good posture, slight bend at hips and knees, keeping abs tight.
- Grasp handle of cable (or stretchy band) with forearm across body and palm facing into the body.

Start position (side lying)

- Lie on the uninvolved side.
- Bend knees slightly and support upper body/head with the uninvolved arm.

Teaching points

1. Maintain the shoulder at approx 30° abduction with a towel roll/support positioned between the elbow and side.
2. Keep a straight spine with the scapula in a neutral position, avoiding protraction.
3. Maintain the towel roll position throughout.
4. Do not lift the arm away (abducting) during the movement.
5. Maintain the elbow at 90° throughout the movement.
6. Externally rotate the arm to a comfortable position that does not produce pain/discomfort in the front of the shoulder.
7. Return to start position on completion of each repetition.

Grading the deep freeze

Frozen shoulder, or adhesive capsulitis, describes the common shoulder condition characterised by painful and limited active and passive range of motion (ROM). The cause remains unclear, but athletes can be susceptible to it as a secondary condition arising from slow or delayed rehab of a shoulder injury or dysfunction. Conservative treatments include education, stretching, joint mobilisation and corticosteroid injections.

Researchers in Australia have recently put forward a rehabilitation model that matches intervention strategies with levels of irritability (**Frozen shoulder: evidence and a proposed model guiding rehabilitation. *Journal of Orthopaedic & Sports Physical Therapy* 2009; 39 (2) 135-148**). The researchers' assessments include the use of three pain questionnaires: the American shoulder and elbow surgeons' score (ASES), the disabilities of the arm, shoulder and hand questionnaire (DASH) and the Penn shoulder score (PSS), alongside other functional and ROM assessments.



Clients with high irritability should be treated with

short-duration, relatively pain-free stretching and low-grade joint mobilisation to reduce symptoms and avoid increases in pain and inflammation. Exercises found to be too painful or resulting in a prolonged painful response are removed from the programme and reintroduced when irritability reduces. As the irritability level reduces, progressive end-range stretching and mobilisation may be performed. The authors encourage reassessment of motion and end-range discomfort at each session to determine the client's response to treatment. Clients with low irritability should be given longer-duration stretching techniques and high-grade mobilisations, performed with the joint near end range.


In general, the authors recommend that therapists see clients with moderate or high irritability who demonstrate pain reduction and who achieve changes of ROM greater than 10° to 15° in a treatment session more frequently, typically twice-weekly. Clients with low irritability who have achieved pain reduction but minimal changes in motion can be seen less frequently, typically once every one to two weeks, with emphasis on their home exercise programme.

The applice of science

For attention of

- Physiotherapists 
- Physicians 

Significance

- Adds to previous knowledge
- Cutting edge
- Confirms best practice 
- Too early to say

How to use it

The main elements of the treatment strategies recommended in this research are:

High irritability

- Activity modification.
- Short duration (one to five seconds) stretching; pain-free passive and/or active assisted ROM.
- Low-grade mobilisation.
- Client education.
- Intra-articular steroid injections.

Moderate irritability

- Heat/ice/electrical stimulation.
- Activity modification.
- Short-duration (five to 15 seconds) stretching; pain-free passive and/or active assisted ROM to active ROM.
- Low- to high-grade mobilisation.
- Basic functional activities.
- Client education.

Low irritability

- End-range ROM/overpressure, increased-duration stretching, cyclic loading.
- High-grade mobilisations; sustained holds.
- Low-to high-resistance strengthening, to end-range.
- High demand functional activities.
- Client education.

Too passive to help?

As should be clear from the preceding item, physiotherapists frequently use passive joint mobilisation alongside exercise therapy for shoulder problems. So now take stock of this. Australian researchers recently investigated whether the manual therapy actually improved recovery (**Passive mobilisation of shoulder region joints plus advice and exercise does not reduce pain and disability more than advice and exercise alone: a randomised trial. *Australian Journal of Physiotherapy* 2009: 55 17-23).**

Ninety people who had had shoulder pain and stiffness for more than a month took part in the study; all participants received advice and exercise. The experimental group also received passive mobilisation of their shoulder joints.


The experimental group experienced 3% less pain and disability than the control group at one month, and 1% less pain at six months. These results were statistically insignificant, leading the research team to conclude that passive joint mobilisation adds nothing to the treatment regime of advice and exercise for shoulder pain and stiffness.

The applice of science

For attention of

- Physiotherapists 
- Strength and conditioning coaches 
- Coaches 
- Athletes 

Significance

- Adds to previous knowledge 
- Cutting edge
- Confirms best practice
- Too early to say

How to use it

While the improvements from passive mobilisation may not have been statistically significant, if I had a sore shoulder and there was a chance that some passive mobilisations would result in an improvement, no matter how small, I would want to have them included in my rehab programme!

The study did not give exact details of which passive mobilisations were used, but these general guidelines offer an insight into the type of techniques:

1. Graded, passive, accessory movements were directed at glenohumeral, acromioclavicular and/or sternoclavicular joints.
2. Performed either as a passive oscillatory movement or a sustained stretch, with or without tiny amplitude oscillations at the limit of the range.
3. Only low-velocity mobilisations were used.
4. The movements were aimed at restoring structures within target joints to their normal or pain-free positions.

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the NHS or a university. Independent practitioners such as me fall into a grey area, and for that reason would not necessarily get the required support to deliver such a project.

Despite this, our goal remains the same: to provide sporty children with the information and tools to make the right choices and take responsibility for their health. And to do this at the right point in their lives: late enough for them to take on the information, but early enough to prevent otherwise inevitable injuries occurring.

In his conclusion, Cameron Reid advocates greater collaboration between team support staff – trainer, coach, therapist, manager etc. In my experience the expertise is often available, but for whatever reason is simply not utilised. Sadly, the treatment of sports injuries too often turns to the quick-fix model: supports, aids and medications over comprehensive structural assessment.

As more and more gifted young sports people enter the world of amateur competition with their sights fixed on the highest international goals, I fear we may be

pushing them too hard too soon. They peak too early for the sake of a couple of years' competition, ultimately giving way to recurring injuries, which interrupt life both on and off the field.

Until we have tackled this, structural alignment remains just a chapter in any number of sports books. I hope one day the pendulum will swing towards prevention and a better appreciation of basic biomechanics.

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