Training for RUGBY

A SPECIAL REPORT FROM

PEAK PERFORMANCE

The research newsletter on stamina, strength and fitness

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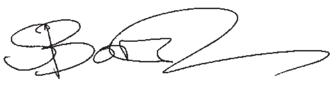
From the editor

Ten years ago, in 1995, Rugby Football Union turned professional worldwide. The sport, synonymous with big beer drinking men, was about to be catapulted at a Rokocoko-like speed away from its amateur ethos and into an era of super fit electrifying athleticism. No sport, in terms of fitness and coaching, has progressed in the last decade like rugby has. Therefore Peak Performance felt it time to produce a special report that will benefit rugby players in their training and understanding of the modern day requirements to succeed in rugby.

The aim of this special report is not to teach everyone how to play rugby or to provide training schedules and exercises for current rugby players. It is a collection of scientific reports and articles that all students of rugby should read, absorb and put into practice if they want to master their sport.

There should be something for every player of every position and every age group. The first three chapters look at the different training approaches for different positions. There's weight training advice for youth players (and their parents…) from a rugby conditioning expert. One chapter, which Neanderthal men should ignore at their peril, is the training diary of a woman's World Cup season. Another report focuses on injuries in rugby and how to avoid them. Coaches will be pleased to see there's also an article to help them with Underperformance Syndrome (who'd heard of that in 1995?).

For all you budding British Lions, All Blacks, Wallabies and Springboks I hope this helps you on your way. For those who think that ship has sailed, it's never too late to learn and improve. I hope you enjoy this special report.



Sam Bordiss
Editor

Super 12 stats help show rugby players how to train to suit their specific position

This article focuses on how rugby players should train to reflect the varying energy demands of their field positions. The research is based on findings from the Super 12. With a better understanding of what is physically required for certain positions, it is easier to devise more suitable and more effective training programmes.

Sports scientists classify team sports like rugby as 'intermittent sprint sports' because, in the course of a match, players will alternate between fast running or sprinting, walking, jogging and standing. Rugby matches are a bit like random interval workouts – except that they also involve non-running activities, such as rucking, mauling and scrummaging. These are game-specific tasks, during which groups of players push against the opposition; and, like fast running and sprinting, they are high-intensity activities.

When rugby players perform these high-intensity activities, their anaerobic system provides the required energy, while the aerobic system predominates during the low-intensity activities.

If the high-intensity periods are short (less than 10 seconds) and recovery times between efforts are relatively long (60 seconds plus) then the phosphocreatine (PCr) system will be the key source of anaerobic energy. This is the simplest and most rapid means of energy production, in which phosphate (donated by phosphocreatine) and ADP combine to make ATP – the body's primary energy currency and supplier to all cells. During the low-intensity periods, the aerobic system will replenish PCr stores, ready for the next high-intensity effort.

‘The answers to these questions should help us to understand the key physiological demands on the players so that we can help them train for top performance’

However, PCr stores can provide energy for only about 10 seconds of activity. So, if the high intensity periods are of intermediate length (10-45 seconds) or the recovery times are relatively short (20-40 seconds), then the glycolytic system of anaerobic energy production, involving the breakdown of carbohydrate within muscle cells to release energy, has to comes into play. Similarly, short periods of high-intensity work, interspersed with recovery times that are too brief for complete replenishment of PCr stores also bring the glycolytic system into play.

From the physiological point of view, there are two interesting questions about rugby:

- What are the ratios of high-intensity to low-intensity activity?
- Does the work:rest ratio vary with player position?

The answers to these questions should help us to understand the key physiological demands on the players so that we can help them train for top performance.

Early research on rugby suggested that players spend only 5-10% of match time involved in high-intensity activity (1) and the researchers concluded that the PCr energy system would be the most important. However, this study did not analyse the ratio of high-intensity to low-intensity activity, which makes this conclusion unsound. Another study of under-19s matches analysed individual players, focusing on time spent in various activities and work-to-rest ratios (2). An interesting finding of this study was that forwards performed three times more high-intensity work than backs – 11.2 minutes per match versus, 3.6 minutes per match. This suggests that forwards may make more use of the glycolytic system and backs more use of the PCr system.

The research drawn on for this article is an unpublished study which analysed the time and motion of 29 top-class professional rugby union players, who were filmed during the course of eight professional ‘Super 12’ matches in New Zealand (3).

Players were placed into one of four positional groups:

- front row forwards (props and locks, or numbers 1,3, 4 & 5)

- back row forwards (hooker, flankers and no 8, or numbers 2, 6, 7 & 8)
- inside backs (fly half and centres, or numbers 10, 12 & 13)
- outside backs (wingers and full back, or numbers 11, 14 & 15).

The hooker was placed in the back row group as they have roving role at line-outs and do not push as much in the scrum as other front row forwards. The scrum half position was not analysed, although scrum halves can refer to the statistics of the fly half as they will be similar. One or two players from each positional group were analysed during each match.

The researchers broke down player movements as follows:

- standing still, walking, jogging, side/backwards stepping – all classified as low-intensity activity
- running, sprinting, rucking/mauling, scrummaging and tackling – all classified as high-intensity activity.

They then analysed the amount of time spent in each category of movement and the frequency and average time of each individual activity. The key data are summarised in the table below.

Table 1: intensity of rugby play according to position

	Front row forwards	Back row forwards	Inside backs	Outside backs
Average number of high-intensity efforts per match	128.5	113.5	51.5	41.6
Average duration of high intensity effort (seconds)	5.0	5.2	4.2	5.2
Average duration of low intensity effort (seconds)	35	35	88	115

As you can see, both front row and back row forwards complete many more high intensity-efforts per match than backs, with front row forwards performing over three times more than outside backs. While the average duration of high-intensity efforts are similar, at around five seconds, across all four positional groups, the average rest periods for the forwards are significantly shorter. Since both sets of forwards only get to enjoy around 35 seconds of recovery, their PCr stores will not be replenished and so the glycolytic energy system will be very important for maintaining the work rate required.

Backs, by contrast, get plenty of recovery time between high-intensity efforts (88-115 seconds), which is easily enough time to replenish PCr stores. The PCr system will, therefore, be most important for backs.

The researchers also found that the type of high-intensity activity varied between positional groups. Front row forwards spent less time running and sprinting than the other three groups. Overall backs spent more time running than forwards, with back row forwards and inside backs completing an average of 7 sprints per match and outside backs an average of 11.

By contrast, forwards were involved in many more rucks, mauls and scrums than backs. Front row forwards, for example, were involved in an average of 75 rucks/mauls and back row forwards in 57, while inside and outside backs were involved in only 11 and 7 respectively.

This research data leads to the following conclusions about the key differences between forwards and backs:

- The type of high-intensity activity forwards perform tends to be 'physical work', *eg* pushing
- Backs perform less high-intensity activity than forwards, with sufficient rest between efforts for the PCr system to predominate
- Running and sprinting is the commonest high-intensity activity for backs.

What are the implications of this research for rugby training?

Clearly, forwards need to develop good anaerobic fitness, specifically targeting the glycolytic system. The best way to train this system is through interval training, making sure that work periods are sufficiently long (20-40 seconds) and rest periods long enough to allow athletes to repeat the work but not recover completely (40-90 seconds). A good example would be 10x200m fast running, with 60 seconds rest.

However, as forwards tend to perform more high-intensity 'physical work' than running, performing intervals on a rowing machine might be a better – *ie* more sport-specific – choice; for example, 5 sets of 4 x 200m fast rowing, with 30 seconds rest between reps and 2 minutes between sets.

Even more specific to the demands of match play would be interval workouts that combine 'physical work' with running. This would prepare players to work intensively and make appropriate transitions between upper body/trunk strength tasks and running. Players could work in pairs to push or wrestle with each other and then run a fixed distance, with the combination of push/wrestle and run counting as one interval rep; for example, 20 x 5 seconds of push/wrestle + 50m shuttle run, with 30 seconds rest between reps. This kind of workout would provide a close match of both the energy system and physical task demands of forwards' match play.

Backs, by contrast, need high anaerobic power, targeting the PCr energy system. Interval training is also a very effective route to PCr fitness, but the work intensity must be higher and the rest periods longer than with intervals targeting the glycolytic energy system; 5-8 seconds reps and 60 seconds rest periods would be highly appropriate, *eg* 10 x 50m sprints with 60 seconds recovery. For backs, this sprinting workout would be highly sport-specific, reflecting the amount of high-intensity running they perform in matches.

Aerobic fitness is important for both backs and forwards, since the aerobic system will provide most of the energy for movement and replenishment of PCr stores during all low-intensity activities. In addition, research has demonstrated that players with high aerobic fitness are able to perform more high-intensity efforts during a match than those with lower levels of this type of fitness because of the aerobic system's influence on recovery. Forwards will also use their aerobic systems to provide energy for the longer high-intensity or shorter recovery, providing valuable back-up for the anaerobic glycolytic system.

'players with high aerobic fitness are able to perform more high-intensity efforts during a match than those with lower levels'

As far as aerobic endurance training is concerned, the rowing machine may still be the best activity choice for forwards, with running best for backs. A combination of continuous steady state training and intervals workouts would be an effective approach; for example, 20 minutes running or rowing at 75% of max heart rate, or 8 x 400m running with 60 seconds rest between each rep, or 6 x 500m rowing with 2 minutes rest between each rep. More specific workouts could be developed by performing shuttle runs instead of straight runs as intervals to increase the agility running component for backs. In addition, sessions incorporating circuit exercises to develop pushing and wrestling strength would be useful for forward players.

To summarise, this time-and-motion analysis research of professional rugby union play sheds some interesting light on both the physiological demands of the game and the differences between individual positions.

Specifically, forward play involves many high-intensity activities, which tend to involve physical strength and work performed on others, and players need good aerobic and very good anaerobic fitness of the glycolytic system. Back players also need good aerobic fitness but, unlike forwards, do not rely on the anaerobic glycolytic energy system. Instead, because they perform high- intensity running and sprinting, they need very good anaerobic running power, using the PCr energy system.

Training programmes for rugby should reflect these different physiological demands and activity profiles, with the example workouts recommended in this article being good starting points.

Raphael Brandon

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How rugby players, especially forwards, can improve their sessions in the gym

In November 2003, shortly before his 35th birthday, Neil Back, the 1.78m flanker, played a leading role in England's 2003 World Cup victory. One of the main factors that enabled the 'small, ageing' flanker to have such a role was his dedication and ability in the gym. There is a lot of pressure on forwards to develop maximum strength. Back, a self-confessed fitness obsessive is a perfect role model for forwards looking to strengthen up. However few have the mentality of Back, and may struggle to get the best out of their sessions in the gym, or simply get bored. This article offers advice on how to make the most out of your sessions in the gym, without actually increasing anything.

All forwards in search of that elusive extra edge in strength and power look to resistance training in one form or another. Often they think they need a new exercise to sharpen them up. But what they may not realise is that considerable improvements in training outcomes can be achieved without changing the content of their routines but simply by altering the sequence of exercises and varying the rest times between exercises. It should however be noted that players must have a reasonable routine to start with!

In this article I want to expand further on both these topics with examples of how different sessions can be devised with specific outcomes in mind by changing the sequence and rest times between sets. All the sessions I will describe are based on just five exercises: bench press, bench throw, bench pull, the squat and the squat jump.

How much rest is enough?

So far research has not come up with a definitive answer to this question. This is partly due to the varied training levels of subjects used in the studies. In a study of untrained college students, rest periods of 30 and 90 seconds between sets were compared to determine which was most effective at increasing strength or muscle mass [1]. After 12 weeks of training, both groups were found to have increased strength and muscle mass by comparison with non-training 'controls', but the improvements in strength were most marked in those who rested for just 30 seconds.

By contrast, a study on trained subjects found that five minutes rest was better than one or two minutes for increasing the amount of total weight that could be lifted over four sets of the squat and bench press at an 8RM load [2].

Of course, an increase in strength is desirable, but another study found that the downside of short rest intervals (one minute compared with three minutes) when doing heavy training sessions (10 sets of 10 reps at 65%1RM) may lead to greater muscle damage, affecting the athletes' ability to perform on the following day, and may also affect the immune system in such a way as to increase susceptibility to illness [3].

'The rest intervals of one and two minutes led to a significant reduction in performance by comparison with the longer intervals'

Yet another group of researchers compared the effects of rest intervals of one, two, three, four and five minutes on three sets of bench press performance at 90% 1RM and 60% 1RM, and also of one, two, five, seven, 12 and 15 minutes at 85% 1RM [4,5,6]. They considered not just the objective impact of the rest intervals on performance but also the athletes' subjective preferences.

The rest intervals of one and two minutes led to a significant reduction in performance by comparison with the longer intervals. And, interestingly, the intervals of 3-6 minutes, which resulted in most improved performance, were also those most preferred by the athletes. The researchers concluded that trained subjects might be best placed to identify the optimal amount of recovery needed for the work they perform.

However, while a longer rest interval seems best for trained subjects performing high-volume, strength-based workouts, a shorter rest may be appropriate when performing complex training sets, where an explosive exercise like the squat jump is performed after a strength exercise like the squat.

No significant differences in jump performance were found after intervals of one, two and four minutes in a study of 21 US college athletes who performed sets of 5RM squats followed by five countermovement jumps [7]. This has practical implications in terms of fitting sets into training sessions. If too much rest is taken between exercises, then less overall work can be performed within the time available.

Those same researchers also found that one-minute rest intervals were best for trained subjects performing two sets of 1RM squats [7]. So it appears that briefer rest intervals may be appropriate for some power sessions using lighter loads, such as body weight, or when performing very low-volume, but high-intensity lifts.

Does sequencing matter?

How important is the order in which the exercises are performed? Very – if you are trying to achieve the most effective workout with the least amount of work. For example, performing squat jumps after squats makes for effective training in experienced athletes, but not their recreational counterparts [8]. This is because recreational athletes find the squats tiring and are less able than trained athletes to activate the potentiation response, whereby one exercise enhances the impact of the next one.

That same effect has been demonstrated, again for trained subjects, with upper body exercises using the bench press and bench throws [9]. This study, involving strength trained rugby players, used six reps of 65%1RM bench press, followed by three minutes' rest, then five bench throws of 50kg. Power output was shown to have increased after the bench press, by comparison with a control group who just performed the bench throws.

But what happens if you put plyometric exercises (eg jumps) before strength exercises (eg squats)? That's what a team of US researchers set out to consider with 12 experienced subjects who performed 1RM squats after a warm-up of five submaximal sets of squats [10]. The study compared the effects of three different sessions: in the first, the subjects performed the normal warm-up, and in the second and third they performed either two depth jumps or two countermovement jumps after the warm-up and 30 seconds before attempting their 1RM.

‘Research has shown that power may be enhanced by working the antagonist muscles before the agonist muscles’

The researchers found that performing the depth jumps increased the 1RM by an average of 3.5% by comparison with the countermovement jump or no jump at all. The explanation for this improvement is speculative (because no measurements of neuromuscular activity were made), but it is likely that the prime muscles involved in the squat exercise were prepared for maximal effort by the depth jump.

This enhancement is likely to have taken the form of increased muscle fibre recruitment and rehearsal of movement patterns. The fact that only two jumps were performed ensured that fatigue was not a factor. It is important to note that no similar research has been carried out with untrained subjects, and care should be taken before extrapolating these results to them.

Interestingly, further research has shown that power may be enhanced by working the antagonist muscles before the agonist muscles. The researchers found that performing the bench pull immediately before the bench throw lent more power to the latter movement [11]. It seems that when a power exercise is preceded by an opposite movement, the antagonist muscles can be educated into relaxing more during the subsequent exercise. Again, however, this effect has been observed in only one study, and this was on trained subjects.

One further factor to consider when deciding the order of exercises in a session is the impact of overall fatigue. The order of exercises may be carefully designed to promote power or strength and you may have planned in rest periods at the optimum times, but if the session lasts as long as 45 –60 minutes the quality of work at the end is likely to be lower than at the beginning.

In a study looking at a sequence of six different exercises, using three sets to failure, with a 10RM load and two minutes’ rest between sets, the researchers found that the last two exercises produced significantly fewer reps, an effect which persisted when the sequence of exercises was reversed [12]. In other words, of the six exercises performed, only four were performed with sufficient load; the last two had fewer reps, so less work was done and less strength gained as a result.

One implication of this finding is that, when designing your sequence of work, it is important to put the most important movements at the beginning of the session. If all the movements are considered important, it is probably better to split them into different sessions, allowing for adequate recovery and adaptation between sessions.

So, a power training session for experienced trainers might look something like table 1 *(below)* with one set of squats followed by one set of squat jumps, repeated twice more, then the bench pull, bench press and bench throw performed as a sequence, then repeated twice more.

And a strength training session for experienced trainers might look like table 2 *(overleaf)* with the squat jumps and squat performed in sequence, then the bench pull, bench throw and bench press as the final sequence.

Less experienced trainers would benefit from establishing a strength base before performing explosive exercises with weights. A good rule of thumb is that you should be able to squat your own body weight before considering progression to more advanced leg exercises. Failure to establish a strength base could not only put you at risk of injury but also hinder long-term gains in power.

Table 1: power training session for experienced trainers

Exercise	Load	Reps	Sets	Recovery (mins)
Squat	60% 1RM	5	3	1
Squat jumps	30% 1RM	5	3	4
Bench pull	85% 1RM	3	3	3
Bench press	60% 1RM	5	3	1
Bench throw	10% 1RM	5	3	3

As a starting point, you could use the strength session set out in table 2, but leaving out the squat jumps and the bench throw.

Table 2: strength training session for experienced trainers

Exercise	Load	Reps	Sets	Recovery (mins)
Squat jumps	30% 1RM	5	4	1
Squat	80% 1RM	5	4	3
Bench pull	80% 1RM	5	4	3
Bench throw	10% 1RM	5	4	0.5
Bench press	80% 1RM	5	4	3

Technical guidance

All the exercises described in this article should be performed with care and not without prior coaching.

- *Bench press* – Lie face up on an exercise bench, lower the exercise bar to your chest and then push up
- *Bench pulls* – Lie face down on a higher-than-normal exercise bench, pull the exercise bar up to your chest from the floor, then lower it
- *Bench throws* – Using a Smith machine or other guided tracking device for safety, lie face up on the exercise bench, lower the exercise bar to your chest, then throw it up as quickly as possible, catching it as it comes back down
- *Squat* – Standing up, place the exercise bar across the back of your neck on your shoulders, bend your knees until your thighs are parallel with the floor, then return to start position
- *Squat jump* – As for the squat, but instead of returning to a standing position, jump up as high as possible and land safely.

Jargonbuster

- *RM (repetition maximum)* – The maximal amount of work that can be performed for a given number of repetitions. For example, 1RM is the most weight that can be lifted once. 8RM is the most weight that can be lifted 8 times consecutively

- *Plyometric exercise* – An explosive form of exercise, often involving jumping movements, that utilises the muscle's ability to stretch then contract rapidly to produce more force
- *Antagonist/agonist muscles* – An agonist is the muscle that contracts to allow movement, and the antagonist is the opposite muscle that normally relaxes to allow this movement.

James Marshall

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A mixture of conventional and alternative agility training methods for backs looking to break those tackles

Brian O'Driscoll is able to swerve around opponents from seemingly standing starts. Matt Giteau has the uncanny ability of looking to throw a pass one way, then cutting through a gap at a completely different angle. Joe Rokocoko's awesome try-rate is largely down to his swerving running out wide whilst moving at full pace. These abilities are a combination of the well known concept, agility, and the lesser known concept, rotational power. Developing these specialist skills relies not just on innate ability and technique, but also on specialist conditioning drills and methods. In this article I will consider such skills as turning, turning to sprint, turning and passing, and turning to kick the ball, from both stationary and moving positions.

Core strength is crucial to the rugby player. Firstly, players' back and abdominal muscles must be conditioned to shrug off a crunching tackle and secondly, they must be effective at delivering rugby power to where it is needed. The core acts as a conduit, transferring power between the limbs. To put this in the context of a rugby skill that needs both agility and rotational power, imagine that you're in full flight, one man to beat and you need to swerve past a defender. You step onto your right foot and make to move inside. Unfortunately, you collapse to the ground, as your core shows about as much resilience as a wobbly jelly, as it attempts to transfer your body's linear motion into a curvilinear one. Your core literally holds you together and provides strength and balance during sport's skill performance. A weakness in the area will result in ineffective skill delivery, though perhaps not quite as dramatic as in the example I provided.

So how can you make your core rugby strong? You'll need to perform varied exercises that strengthen all regions, at different speeds.

Basic exercises like the sit-up and crunch do have a foundation value. These should regularly be performed, but there are much more specific exercises that will develop more dynamic specific core strength:

1. Lying bent knee twists

Lie on your back and stretch your arms out to your sides to assume a crucifix position. Pull both your thighs in toward your chest and hold your lower legs parallel to the floor. Keeping your head and shoulders on the floor rotate your legs over to the left and then back across to the right.

Do not allow your inside knee to contact the ground on either side of your body. Begin performing the exercise with control and at slow speeds. As your strength and confidence develops over a number of workouts, increase the speed of your repetitions.

Ultimately you will want to be able to whip your legs to one side of your body and 'catch' the movement with your trunk and sides to rotate your legs equally quickly back across your body to the other side.

Do: 4 sets of 20 repetitions – vary your recovery and perform the exercises 3 times a week.

2. Medicine ball sit-up and throw

Medicine ball exercises offer a multitude of dynamic core strength training options.

You'll need a training partner to get the most out of this exercise (your partner by catching and throwing the medicine ball back, will also develop valuable condition, particularly during the catch when, due to the ball's weight, they will have to absorb the impact through their core). Take hold of a medicine ball and assume a sit-up position. Your feet should be flat on the floor and your knees bent to a 90-degree angle. Hold the medicine ball on your chest with your hands to the sides of it. Lower your back toward the floor and then using your abdominal muscles pull your trunk forward dynamically. Near the top of the movement throw the ball to your partner using a chest pass action. Your partner should catch the ball and toss it back, just as you are sitting back ready to perform your next rep.

Do: 4 x 10 repetitions, frequency as above

Variation: Perform the exercise in a similar way to just described, but this time hold the ball over your head and throw and catch it from this position.

Note: your partner should stand further away from you as you should be capable of throwing the medicine ball further this way.

Straight line speed versus multi-directional speed

It is often assumed that athletes who are fast when travelling in a straight line will be fast in any direction. However, research suggests that this assumption may be erroneous. Young and associates researched the impact of straight-line speed training on rotational/change of direction speed, and *vice versa* . Thirty-six males were tested on a 30m straight sprint and were given six change of direction tests, the latter involving 2-5 tangent runs at various angles. These tests took place before and after a six-week training period, in which one group focused on 20-40m straight-line sprints and the other on 20-40m, 100° angle change of direction sprints.

'It is often assumed that athletes who are fast when travelling in a straight line will be fast in any direction'

What did the researchers discover about the impact of this training on performance? Not surprisingly, the straight line sprinting training improved straight line sprinting performance. However, this increased zip did not translate into speedier turns. In fact, the researchers discovered that the more complex the change of direction/turning task, the less the transference there was from straight line speed training.

Similarly, the turning/change of direction training gave a major boost to turning/change of direction performance, but had no impact on straight line speed.

These findings have important implications for athletes and coaches in sports like rugby, where players have to constantly rotate in order to make up the ground to perform their various sports specific skills. It seems that the ability to rotate the body at speed is a highly specific skill requiring specialist conditioning, and that being fast in a straight line is just not enough. Some of the exercises at the end of this article can be used to condition such players' 'rotational muscles'. (They will also benefit from specific agility training.)

Rugby agility

Avoiding a collision in rugby is a great skill, think of Jason Robinson, pirouetting out of a tackle or bamboozling opponents with his dazzling footwork.

In sport, agility is characterised by fast feet, body co-ordination during change of direction and sports skill performance, and reaction time/ability. It is an amalgam of balance, speed, strength, flexibility and co-ordination. Although a performer's agility, relies heavily on the acquisition of optimum sports technique, it can also be enhanced by specific conditioning.

A variety of performance-enhancing agility drills, systems and items of equipment are available to the sportsmen of today and their coaches. The 'science' of agility (and speed and power) training has made rapid strides recently, especially in terms of its accessibility to the mainstream sporting world.

Essentially, agility training dissects a sports skill: a skill like the fast stepping ability required of a rugby player is broken down into its constituent parts, which are then specifically trained. It's all about patterning and conditioning a heightened physical, neural, sport specific response.

Let's consider in more detail the process involved in developing fast feet. One of the major tools available for this purpose is the floor-based rope ladder. This piece of kit is a key element of the Sports, Agility and Quickness® system; (SAQ

International is the world's leading company for packaging and marketing sports specific training and has been used by England's Rugby World Cup winning squad.)

A wide variety of running, hopping and jumping drills can be carried out in all directions, using the rungs of this ladder, which is laid flat on the ground. Such drills enhance foot speed and upper body agility, just like any other aspect of sports performance, by progressive overload. England rugby wing Ben Cohen was specifically singled out as a player whose feet have been rendered especially fleet by means of extensive use of the rope ladder and other agility training methods.

'England rugby wing Ben Cohen was specifically singled out as a player whose feet have been rendered especially fleet by means of extensive use of the rope ladder and other agility training methods'

Speed through a floor ladder can indicate much about a player's quickness. A time of less than 2.8 seconds (male) and 3.4 seconds (female) for running the length of a 20-rung ladder, one foot in each rung at a time, is regarded as 'excellent' for college athletes.

Agility training also utilises numerous other drills and items of specialist kit; these include balance drills, slaloming in and out of cones and stepping over and around small hurdles. To make the transference of the agility skill even more sport specific, an actual sports skill can also be introduced. This could take the form of receiving a rugby pass while stepping through a foot-ladder.

Obviously companies like SAQ International claim their systems get results and improve players' agility. But is their confidence justified? Polman and associates looked at the effects of SAQ ® techniques on intermittent sport players over a 12-week period. The players were divided into three groups, two performing SAQ training, while the third carried on with their normal conditioning programmes. The results were as follows:

1. All three interventions reduced the participants' body mass index (-3.7%) and fat percentage (-1.7%), and increased flexibility (+14.7%) and VO2max (+ 18.4%)
2. However, the SAQ groups showed significantly greater benefits from their training programme than the other group on a sprint-to-fatigue test, a 25m sprint and left and right side agility tests.

Working to improve the agility of a dynamic sports performer (like a footballer or rugby player) by means of SAQ and similar techniques seems highly appropriate, relevant and valuable.

Selected examples of floor ladder agility drills

The permutations of floor ladder agility drills are virtually limitless. I have provided some basic rugby related examples:

1. One foot in each rung fast feet drill

Simply run through the floor ladder, using a low knee lift, as fast as you can.

Incline your body slightly forward and pump your arms as fast as possible to achieve greater leg speeds. The drills can be made really rugby specific by holding a ball, either with one or two hands and perhaps performing a kick or a pass a few paces after you have exited the ladder.

2. Side stepping one foot in each rung fast feet drill

Stand sideways onto the ladder, feet just beyond shoulder-width apart. Drop your butt toward the ground, keep your arms outstretched in line with your shoulders and remain 'light' on your forefeet as you sidestep through the ladder.

Obviously, you will need to practice progressing through the ladder with your left and right side leading. This drill will provide a foundation for making lateral change of direction movements and cuts.

3. Diagonal bounce lower limb agility conditioning drill

Stand facing the ladder and perform a two-footed, straight leg jump into the first rung and then spring diagonally to your right, just outside of the ladder and in line with the second rung. Next, from the two footed landing position, spring diagonally back into the third rung. Now, spring diagonally to the left, opposite the fourth rung and jump back into the fifth. Continue as described until you have travelled the length of the ladder.

This drill conditions lower limb agility and power, which will facilitate numerous ruby related movements.

Progression: a) perform the exercise on one leg at a time; b) perform from one leg holding a rugby ball.

For all given floor ladder drills, perform 4 repetitions of each exercise, take a walk back recovery between each and two minutes between each variation.

Dynamic conditioning drills

Below you'll find are some examples of dynamic conditioning drills in keeping with the theme of this article, some of them quite unusual. Although they are performed at various velocities, all develop the muscles used in rotational movements in a highly sports specific way.

Weights exercises

1. Russian twist

Sit on the floor with your knees bent to about 90° and get a training partner to hold you down by the ankles. Holding a weights disc with both hands over your chest, lower your trunk to a 120° angle, rotate left and right, stopping the weight 10-15 cm from the floor. If specialist equipment that supports the body off the ground is available to perform this exercise, you will be able to rotate even further as the floor will not impede the distance you are able to rotate.

The Russian twist will provide a great foundation of specific abdominal core rotational strength.

2. Reverse trunk twist

Lie on a weights bench face down, having positioned a barbell across the back of your shoulders. Again you'll need a training partner to hold your ankles down.

Rotate your torso left and right, while keeping your hips in contact with the bench. Again, some gyms may have specialist equipment designed for this exercise.

The Reverse trunk twist will provide a great foundation of specific (lower) back rotational strength.

3. Cable chop

This exercise uses a high pulley machine and a triangular attachment to develop rotational power in the shoulders and trunk. Stand facing forward with feet slightly more than shoulder width apart. Hold the attachment with both hands, over your right shoulder. Pull the cable across your body to just beyond your left hip. Complete your designated number of repetitions and repeat on the left side. This exercise can also be performed from a kneeling position.

The cable chop, like the two previous exercises is a great rotational core strength foundation builder. The movement engages all the major core muscles, as well as developing shoulder strength.

Resistance/Plyometric drills

Plyometric drills are a crucial weapon in the rotational (and agility) sports power-conditioning armoury. They lead to explosive power development, utilising the stretch/reflex mechanism in muscles to develop and release greater energy. A concentric (shortening) muscular contraction is much more powerful when it immediately follows an eccentric (lengthening) contraction of the same muscle, and this is the basis of plyometric training. During a plyometric drill, muscles operate a bit like elastic bands; if you stretch the band before releasing it, a great deal more energy is generated as it contracts, but when there is no pre-stretch the energy output is more 'flop' than 'pop'.

There are a number of plyometric exercises that can be used to boost the power capacity of the trunk (and other body parts), some of them requiring specialist items of kit.

1. The twister

Place a small medicine ball between your legs. Holding your arms out straight at shoulder height, take small hops and rotate your knees to each side so that you land at an angle, first to the right and then to the left. The greater the degree of rotation, the greater the amount of work the obliques (the muscles of the outer abdominal area) will have to perform. These muscles play a key role in dynamic rotational sports skill performance.

2. The medicine ball toss

This is a more familiar plyometric trunk move, in which the performer stands side-on to their training partner (or a wall). The move develops the plyometric stretch/reflex in the obliques when the performer catches the ball with two hands and then rotates away from and then towards the partner/wall before throwing the ball back.

3. Tornado ball wall chop

This piece of kit – a polyurethane ball on a length of sailing rope – was specifically developed for generating rotational power. The 'wall chop' can be performed kneeling, sitting and standing, and with varying angles of 'chop'. For the standing version, position yourself about one metre away from a wall, with your back to it. Hold the tornado ball with two hands, then rotate and swing it, either to your left or right, so that it hits the wall. It will, of course, spring back towards you with great force. You need to be braced and ready to control this reaction so that you can swing back into another chop immediately. It is this rapid transference of power that evokes the plyometric response.

4. Depth jump with sprint

The purpose of this drill is to develop dynamic off the spot agility and acceleration and through the progression rotational power.

Stand on top of a sturdy 50cm high platform. Holding a ball, either with one hand or both, step off the platform. Land on your forefeet and immediately sprint 10m. The crucial component of this exercise is the first step after landing (just as this is in most rugby situations) as the game can be opened up by a movement that may only take place over a couple of metres.

Progression: sprint 10m at different tangents and curves after landing.

John Shepherd

Further Reading

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A training diary from one player's international season; it's not just for girls!

In May 2002 the England women's rugby team reached the World Cup final in Barcelona, losing 19-9 to the mighty All Blacks. Here, one of the fitness trainers helping some of the players from the team describes the fitness and conditioning training of one of them (player A) over a nine month period. At the time of writing the team was mid-way through the Six Nations season, which, as with the men's competition, ended in April.

This article is not primarily for women. It is an interesting insight in how to prepare throughout the duration of a big season, especially for non-professionals who are seeking optimum performance.

Phase 1 – pre-season

The preparations for the World Cup started in July 2001. For two months before the start of the club season in September the players completed a 'general preparation' phase of training. During this period the coaching staff aimed to boost maximum strength, especially in the upper body, gaining muscle mass and improving VO2max.

During this period a typical week's training for Player A was as follows:

Monday	resistance workout
Tuesday	30-minute steady state jog
Wednesday	interval session on rowing machine
Thursday	resistance workout
Friday	30 min jog or rowing interval session
Saturday	30 min jog and resistance workout
Sunday	rest

As you can see, this microcycle focuses solely on endurance and strength, comprising four units of endurance training, of which one or two were high-quality interval workouts and three resistance workouts. Complete rest on the Sunday allowed the player to recover mentally and physically in order to maintain her effort during this demanding pre-season training phase.

The Interval workout on the rowing machine was used because the player was suffering with a slight hamstring strain which prevented her from running fast: otherwise the interval session would have involved running. The rowing workout itself involved 8x500m row, with two minutes rest between efforts. The target time for each 500m row was under 2 minutes, which was tough and meant Player A was working close to her maximum heart rate. These kinds of sessions are very effective at boosting VO2max fast, without requiring a high volume of steady state training. It is well documented in the sports science literature that strength and endurance training are incompatible in that too much endurance training inhibits gains in strength. The major benefit of using the high-intensity interval workouts with a games player is that the volume of endurance can be kept relatively low, enabling improvements in both endurance and strength.

The resistance workout during this pre-season phase was as follows:

Barbell squats	3 x 8
Barbell one-leg squats	3 x 8 each side
Bench press	3 x 8
Single arm row	3 x 8
Incline dumbbell press	3 x 8
Machine-assisted pull-ups	3 x 8

The weights were selected so that the first set was moderately heavy, followed by 3 minutes rest. For the second set the weights were increased and Player A completed as many repetitions as she could, followed by 3 minutes rest. If she completed 8 reps or fewer, the weight for the third set remained the same and she attempted as many repetitions as possible. If she achieved more than 8 reps on set 2, the weight was increased for the final set.

This intensity of work together with the length of the rest period ensured the effectiveness of the training for developing strength. From a psychological point of view, Player A was motivated by being able to see improvements in strength every week, as she was able to either push more weight or perform more repetitions.

Sets of 8 repetitions were selected to strike a balance between maximum strength gain and muscle hypertrophy. Ideally sets of 5-6 RM are used for max strength development, whereas bodybuilders tend to favour sets of 12 RM with shorter recoveries; 8 RM is the happy medium.

In the final few weeks of the phase, some of the exercises in the resistance workout were varied to avoid staleness and maintain motivation. In addition, Player A completed a core stability and trunk strength routine 4-5 times a week.

The results from this phase of training were very favourable: at testing, Player A reached the squad VO2max and strength targets; her percentage body fat was reduced and she had gained 2 kg of lean body mass.

Phase 2 – club season

The club league season ran from mid-September to January, with a match every Sunday. However, for England players the Six Nations did not start until February and so the coaching staff wanted the players to continue their strength development training, maintain endurance and gradually introduce power training. They reasoned that, since the main goal was to peak in May for the World Cup, some general training must be maintained, like an extended pre-season. This extension in the strength development phase seems to have had positive benefits, as the squad now looks very powerful compared with the other Six Nations' teams.

A typical week's training for Player A during the club season was as follows:

'This extension in the strength development phase seems to have had positive benefits, as the squad now looks very powerful compared with the other Six Nations' teams'

Day	am	pm
Monday	rest	rest or 25-minute steady state jog
Tuesday	20-minute jog	heavy resistance workout
Wednesday	rest	club training
Thursday	20-minute jog	resistance workout
Friday	20-minute jog	speed/power workout
Saturday	rest	rest
Sunday	–	match

As explained above, this microcycle consists mostly of strength and endurance training, with some speed and power work. Because Player A had achieved a good VO2max at the beginning of this phase, we decided she could simply maintain her fitness with 20-minute steady-state jogs 3-4 times a week, which would not interfere greatly with her strength and speed development. The club training and weekly match now counted as the high-quality workouts in the microcycle.

The resistance training was designed so that the main workout with more volume was at the beginning of the week (Tuesday), allowing the player to recover and perform well at the weekend.

Tuesday's workout was as follows:

Exercises	Oct to mid-Nov	mid-Nov
Barbell lunges (back)	3 x 8	3 x 6
Barbell one-leg squats	3 x 8	3 x 6
Barbell one-leg jumps	3 x 8	3 x 6
Dumbbell press	3 x 8	3 x 6
Dumbbell press	3 x 8	3 x 6
Shoulder press	3 x 8	3 x 6
Lat pull-down	3 x 8	3 x 6

As in the pre-season phase, Player A aimed to achieve her 8 repetition max on the second and third sets, using the adjusted rep max system described above. This intensity was increased to 6 RM after mid-November to ensure the programme was progressive and the athlete achieved gains in maximum strength. A second progression was the use of more 'functional' exercises for the legs, including lunges, which require more stabilisation, and squat jumps, which require more power than the squat. By using these exercises, Player A should expect to see greater gains in match performance as well as strength.

The other new element of training in this phase was a weekly speed and power workout performed each Friday. This workout included the following elements:

1 Dynamic flexibility warm-up
2. Agility drills – focussing on side-step skills and acceleration technique
3. Resisted sprinting – power training using an elastic resistance rope attached to a belt to add resistance to the sprint running action
4. 10 x 30m sprints.

The main aim of the workout was to improve Player A's ability to accelerate and cover short distances quickly. This is more important in a game like rugby than the development of maximum speed over 60-100m. The resisted sprints are very effective at improving running technique and leg power, as they add resistance to the running action, working the running muscles most specifically.

The results of this phase were again successful, with Player A achieving further gains in strength, big improvements in leg power and a slight increase in VO2max.

Phase 3 – England Six Nations season

The training aims now are much more competition-specific, with the emphasis on building leg power and speed while maintaining strength.

A typical week's training if there is no England game would involve:

Day	am	pm
Monday	rest	speed workout
Tuesday	20-minute jog	Leg power + upper-body strength
Wednesday	rest	speed workout
Thursday	rest	Leg power + upper-body strength
Friday	rest	agility + speed workout
Saturday	–	England training
Sunday	–	England training

In this microcycle, the player completes only one steady-state run per week to maintain endurance, but keeps training volume to a minimum, as the emphasis is now on high- quality and high-intensity training only. If there is an England match, a full day's rest is taken on either side.

The leg-power workouts in the gym combine power-oriented weights exercises with plyometric-type exercises. A typical workout is as follows:

Power cleans	4 x 6, 5 mins rest
Crouch-start single-bench hop	2 x 6 each leg, 3 mins rest
Bench-to-bench drop jumps	5 x 5, 3 mins rest
Tuck jumps	3 x 10, 3 mins rest

As you can see the volume is low, but intensity high. The rationale for using both weights and plyometric type exercises in one workout is to employ different speeds of movement. Some movements in rugby, such as driving in a ruck or trying to break a tackle, involve high forces and are performed at moderate speed; others, such as sprinting free with the ball, involve lower forces and maximum speed. I therefore chose some exercises with weights, such as the power clean, which requires maximum power to overcome a moderate resistance, together with body weight plyometric-type exercises, which involve maximum speed during the movements. The crouch-start single-bench hop was considered particularly rugby-specific, as it involves jumping on one leg over a bench from a low start position – an action similar to driving in a scrum or starting low from a ruck or maul.

Regardless of type of exercise, in order to develop power and avoid fatigue, the athlete must take long recoveries between sets, and each attempted repetition must be of maximum intensity. At the same time she must make a conscious effort to recruit the muscles as quickly as possible, accelerating the movement as fast as she can. Athletes who attempt to do this with each rep have the best chance of recruiting their biggest and fastest-twitch muscle fibres, thus developing more power.

The speed workouts comprised the following:

1. Dynamic flexibility warm-up
2. 6 x 10m starts, 1 minute's rest
3. 8 x 40m, 3-min recovery

The aim of this workout was to practise sprinting at maximum effort, with adequate recovery. As with power training, high intensity of effort without fatigue is required for speed development; if the rest periods are too short, the workout turns into a speed endurance session, which is a different training goal.

The agility and speed workout was similar to the one above, including more rugby-specific movements. The aim is to improve the players' ability in a match situation, which does not always involve running in a straight line; therefore, each week Player A practises side-stepping at speed, sprinting with the ball, sprinting and catching, picking up the ball and sprinting, sprinting curves, sprint cutting movements etc, to develop as much rugby-specific skill as possible.

'You can see how the training has been purposefully phased over nine months to optimise performance in the World Cup'

Phase 4 – World Cup preparation

There will be a few weeks between the end of the Six Nations and beginning of the World Cup, when the goal will be to bring the players to a peak in terms of power, agility and speed. The training will be similar to that used in Phase 3, but progressing to even higher intensity. Players will want to work on some elements more than others in order to fine tune their performance; for Player A, this will consist mostly of speed and agility work, which is most important for her playing position.

Summary

From this case study of the training of a member of the England women's team, you can see how the training has been purposefully phased over nine months to optimise performance in the World Cup. Starting with a general base of strength and endurance training lays the foundations for greater power and speed later in the season. Schoolboys and/or youth rugby players, who have a long season and need to be at their peak in the second half of the season when competition gets harder, may also benefit from retaining some general endurance and strength training for the first half of the season. The same applies to high-level amateur and rugby players.

You should also see how the exercises and workouts in this case study have been chosen to be 'rugby-specific'. Strength and power exercises need to focus on the specific movements and, if possible, the speed of movements involved in the sport. For example speed exercises for games players need to prioritise acceleration over max speed, and also emphasise agility and sport-specific skills while running at speed.

Raphael Brandon

An English Premiership strength and conditioning coach provides help for future stars

Parents and coaches continue to express concern about the suitability of strength training for children and adolescents despite mounting evidence that it is both safe and beneficial. Paul Gamble homes in on the advantages for youngsters – particularly would be rugby footballers

Through my work as strength and conditioning coach to the London Irish Rugby Football Club and involvement with our regional academy and Elite Player Development Group, I have become aware of concerns expressed by young players and their parents about whether it is appropriate for adolescent athletes (aged 12-16) to train with weights.

The benefits of youth resistance training are well documented and almost universally accepted among health professionals, particularly in the United States [1, 2]. However, public recognition of these benefits has tended to lag behind and misunderstanding and misconceptions abound.

Historically, concerns about youth resistance training stem from a perceived risk of potential damage to growth plates and consequent interference with normal growth.

In fact, such damage has never been documented in connection with youth strength training programmes administered and supervised by qualified professionals, while studies using appropriate youth resistance training report a very low incidence of any type of injuries [1].

The most frequent causes of injuries to young people working out with weights include incorrect lifting technique, attempts to lift excessive loads, inappropriate use of equipment and absence of qualified supervision. But these factors should not apply with properly administered training.

Naturally young players, like any inexperienced lifters, should only take part in strength training programmes prepared by qualified coaches, using safe equipment and supervised by qualified instructors. If these conditions are met, there are no grounds at all to restrict their participation.

The reality is that children are exposed to far greater forces – and for longer periods of time - during sports and recreational physical activity than with strength training, even if that training were to include a maximum lift!

Of all resistance training exercises, the Olympic lifts probably impose the greatest forces on the growing musculo-skeletal system. Even so, research suggests that competitive weightlifting is one of the safer activities engaged in by young athletes.

‘Relative strength gains from resistance training in prepubescent subjects are of similar magnitude to those seen in adolescents, although the latter seem to exhibit greater absolute strength gains’

Benefits of strength training

It is now becoming recognised that young people can experience the same benefits from strength training as adults. Previously, the presumption had been that strength training before puberty was not viable or effective. But now it is known that prepubescents exhibit scope for strength gains far beyond those attributable to normal growth and maturation [1].

Relative strength gains from resistance training in prepubescent subjects are of similar magnitude to those seen in adolescents, although the latter seem to exhibit greater absolute strength gains.

Improvements in various motor performances have been observed following resistance training in children. These include vertical jump, standing long jump, sprint times and agility run times.

Resistance training has also been recommended as a preconditioning aid for youngsters. Habitual levels of physical activity in children are declining, reflecting changes in modern lifestyles. As a result, the physical condition of many children leaves them ill prepared for competitive sport. Resistance training offers a means to prepare them for participation in other sports and recreational activities, thereby also preventing overuse injuries [2].

This injury prevention aspect of youth resistance training is an important consideration for young athletes – particularly rugby players. Strengthening muscles via resistance training will increase the forces they are capable of sustaining, making them more resistant to injury, while improved motor control and coordination will also improve balance and joint stability.

For adolescent athletes in particular, structural adaptations to resistance training are vital to injury prevention. These effects include increased strength of supporting connective tissues and passive joint stability, as well as increased bone density and tensile strength, which are particularly useful in collision sports like rugby football.

'For adolescent athletes in particular, structural adaptations to resistance training are vital to injury prevention'

As well as protecting against injury, youth resistance training also seems to accelerate rehabilitation after injury, with evidence that resistance trained young athletes recover more rapidly and return to training sooner than those who do not use this kind of training.

And, far from stunting growth, it now appears that resistance training, in combination with proper nutrition, has the potential to enhance growth within genetic bounds at all stages of development.

Mechanisms for strength gains in young athletes

Before puberty, low levels of circulating anabolic hormones limit the contribution of hypertrophy (lean tissue growth) to strength gains, and the changes to muscles that do occur appear to be qualitative rather than quantitative. Neural effects thus appear to underlie the benefits of resistance training in these younger boys and girls.

Such neural adaptations are thought to include improved recruitment and activation of the muscles mobilised during the relevant training movements. Enhanced motor coordination, both within and between muscle groups, is also thought to contribute to strength gains following training.

By their very nature, such training adaptations would appear impermanent. And indeed, prepubescent athletes do seem particularly susceptible to detraining effects if resistance training is discontinued. However, modest maintenance programmes (1-2 days per week) should be sufficient to sustain strength gains.

The greater hormonal response to resistance training in adolescents leads to structural changes to the muscles and associated connective tissues. As a result, marked changes in terms of muscle hypertrophy and gains in fat free mass are seen in this older age group.

Demand for strength training in young rugby football players

In collision sports like rugby, physical size is a determining factor for participation at higher levels. Young players are naturally predisposed to – and selected for – particular playing positions on the basis of their anthropometric (height and body mass) characteristics and strength capabilities [3].

As with other collision sports, such as American football, rugby union players' body mass and muscularity has risen at a disproportionate rate over the past 25 years, particularly with the advent of professionalism [4]. These days, the physical characteristics of professional players in these sports place them increasingly at the margins of the populations they are taken from.

'For young players who aspire to play at the highest level, participation in strength training is no longer optional'

The importance of lean body mass in rugby union is illustrated by the observation that it differentiates between playing grades in the sport, with players at higher levels of competition exhibiting a greater proportion of lean body mass than those participating in lower leagues. Body mass was also shown to correlate with the respective performance of national teams in the World Cup competition, with the heavier playing squads progressing further in the competition [4].

As a consequence, for young players who aspire to play at the highest level, participation in strength training is no longer optional. Without experience of systematic strength training, young players are unlikely to have developed the physical characteristics likely to recommend them to scouts and coaches in the regional academy system.

Strength training recommendations for young rugby players

Guidelines vary according to chronological age and, more importantly, biological age. Any resistance training programme should be geared to the physical and emotional maturity of individuals in the group.

In general, if a child is ready for participation in organised sports, he or she is probably ready to undergo instruction in resistance training. However, for children with known or suspected medical conditions, medical clearance should be sought in advance.

When young athletes are first introduced to resistance training, light loads and high repetition schemes (12-15 reps) are most appropriate. At early stages of training, progression should be achieved by increasing the number of sets performed and the number of exercises in the workout. The number of training days can then be increased at a later stage.

Adequate rest and recovery is a key component of successful youth resistance training. And because young athletes may need more recovery time between sessions in order to maximise the effectiveness of training and reduce the risk of injury, training on non-consecutive days is recommended for younger individuals.

It has been suggested that before puberty the focus of the programme should be on improving motor control and coordination and developing proprioception (awareness of limb position and orientation of the body). However, at this stage developing strength is still seen as a primary programme goal.

Given that many of the benefits of strength training in this population stem from improved coordination, balance and proprioception, exercise modes that favour the development of these qualities should be emphasised. Thus

'Exercises should be selected with their sport specific benefits in mind, taking account of the skill levels and training experience of the young athletes concerned'

callisthenic exercises and free weights may be better than resistance machines, although users are likely to require closer supervision.

In this context, it is worth noting that resistance machines need to be tailored to the dimensions of their users, and that some apparatus cannot be adjusted sufficiently for use by children.

With advances in training experience, exercises like structural multi-joint lifts (bench press, variations of the barbell squat and deadlift) can be introduced, although the focus throughout should be on proper lifting form, with loading limited until the athlete has mastered the appropriate technique.

Experienced young lifters can integrate Olympic-style lifts into their strength training programmes. These should be taught initially using a broomstick or empty barbell. For prepubescent athletes, in particular, the loads used for these lifts should be kept light, with the emphasis on the quality of the lifting movement.

As with adults, exercise specificity influences young athletes' responses to strength training, with greatest transfer of training effects observed with performance measures that are similar to the movements featured in training. Exercises should therefore be selected with their sport specific benefits in mind, taking account of the skill levels and training experience of the young athletes concerned.

For young rugby players, a sport specific exercise programme should feature multi-joint lifts that incorporate triple extension of the hips, knees and ankles, generating force from the ground upwards, since this is the principal biomechanical action common to many movements in rugby (5). In addition, the shoulders should be targeted for specific strengthening and hypertrophy, as these are a common focus for impact forces during collisions with other players.

Periodisation can be incorporated into youth resistance training programmes by means of systematic variations throughout the training year, taking account of the timing and duration of the playing season as well as the players' concurrent training and practice schedules.

Strength training jargon buster

- *Resistance training* – any form of training that involves an action performed against resistance
- *Strength training* – resistance training specifically geared to developing muscle function and/or growth; typically involves free weights or resistance machines
- *Preconditioning* – training designed to build a base level of conditioning to prepare the body for participation in sport or physical training
- *Hypertrophy* – growth of lean tissue (particularly muscle) in response to training
- *Neural adaptations* – developments in the ability of the central nervous system to recruit and activate muscles for movement
- *Lean body mass* - body mass excluding fat
- *Proprioception*– awareness of the position of your limbs and body in three-dimensional space
- *Periodisation* – planned variation of training over an extended period.

What strength training does for youngsters

The documented benefits of resistance training for youngsters include:

- Significant strength gains, particularly in adolescents
- Improved motor performance
- Injury protection
- Preconditioning preparation for sports participation
- Beneficial structural adaptations, including increased bone density
- Accelerated rehabilitation after injury
- Potential to enhance growth
- Health benefits, including reduced risk of heats disease and diabetes
- Favourable effects on body composition
- Enhanced self-esteem

Sample workouts table

Beginners **15 reps, 1-3 sets**	**Intermediate** **12 reps, 3 sets**	**Experienced** **8 reps, 3 sets**
Unloaded squat Hands on head, squat until thighs parallel with floor	**Dumbbell (DB) squat** Dumbbells held at side, descend until thighs parallel with floor	**Clean pull with empty barbell** Start with barbell hanging down at arm's length, then propel explosively upwards by pushing through floor in a jumping action, pulling barbell to chest height, keeping elbows over bar
Modified push-up Performed resting on knees	**Decline push-up** Standard push-up position, with feet raised up on bench	**Incline dumbbell bench press** Sit back on an incline bench, dumbbells resting by chest below shoulder level, then press until arms extended with dumbbells finishing directly above face
		Requiring spotter
Unloaded walking lunge Hands on head	**Seated cable row** Feet resting against blocks, torso upright, pull cable handles to chest level	**Barbell back squat** Standard back squat with barbell resting across shoulders, descending until thighs parallel with floor
Unloaded step-up Step up onto bench or box, alternating lead leg	**Dumbbell step-up** Light dumbbell or hand weights held at sides, step up onto bench or box, alternating lead leg	**One-arm dumbbell row** Left knee and hand supported on a bench, right foot planted next to bench, dumbbell hanging in right hand, pull DB upwards to finish next to rib cage. After 1 set repeat with other arm
	Standing dumbbell shoulder press Light dumbbells or hand weights on shoulders, then pressed until arms extended directly over crown of head	**Assisted chin-up** Standard chin-up on suspended bar, with manual assistance from spotter
		Dumbbell lunge Dumbbells held up at shoulders, lunge forward with right or left leg, then return to start by pushing off lead leg. Alternate lead leg with each rep.

Paul Gamble

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A general guide to injury prevention, followed by specific management of shoulder and groin injuries

Injuries are a major problem in the professional era. It is becoming more and more frequent that we hear of players taking seasons out for surgery. Johnny Wilkinson is the obvious high profile case. It is important for players to train hard, but not in a manner that is more likely to cause injury.

This chapter is designed to help rugby players remain injury free. In Part 1 there is an article on injury prevention in general. Part 2 looks very technically at keeping the shoulders injury free (how many of you can say you've never experienced a problem with your shoulder…?) Part 3 helps out with groin problems, which are becoming more and more frequent in the modern game due to its increased dynamism.

Part 1: Injury prevention tip – how to readjust your training programme so it allows two days' rest per week

Rest and recovery are as important for performance as training. Periods of heavy training need to be followed by rest to allow the body to adapt and grow stronger. Rest and recovery are also important for preventing injury. Many overuse-type injuries (*eg* Achilles tendinitis, shin splints, anterior knee pain, tennis elbow, rotator cuff tendinitis, etc.) are caused by too much volume of training or too much intensity. The body is unable to cope with the stresses of the

‘Learning your personal limit of training volume is as important in preventing injury as are the strength, flexibility and stability exercises that you do’

training load and injury results. If the same athlete had trained at a lower volume or intensity and progressed gradually, the injury risks would have been reduced.

For example, I work with one recreational runner who can complete a reasonable 25 miles a week injury-free. In the past, when we attempted to increase the weekly mileage, she suffered from low-back and hip pains.

Now we know that, for her to train continuously, the upper limit on weekly volume is 25 miles, focusing on high intensity workouts. During the last 18 months she has been injury-free and, touch wood, this should continue to be the case.

The three-one-two-one microcycle

Learning your personal limit of training volume is as important in preventing injury as are the strength, flexibility and stability exercises that you do. A practical way to ensure that you incorporate sufficient recovery into your training week is to follow a three-one-two-one microcycle.

The term ‘microcycle’ refers to a week’s training plan. The week’s training is often a repeatable series of training sessions within a larger phase (eg a month). It is common for athletes to train for six days and then rest for one within the weekly cycle.

To increase the recovery time within the week, I suggest readjusting your training programme so it fits a weekly cycle involving three days’ training, one day’s rest, two days’ training, one day’s rest. This allows you to work more intensely on the training days, but gives two days’ recovery instead of one.

Programmes for a rugby player

Here are two weekly programmes for a rugby player in season. There are club games each weekend and the total number of training sessions is the same for each weekly routine.

There are the same total number of training sessions (nine) in each week; however, by training two or three times on Tuesday, Thursday and Friday and shifting the power session to a Monday the athlete is able to rest on Wednesdays and Saturdays instead of just once on the Monday.

1. Six-one weekly cycle		
Day	**AM**	**PM**
Sunday	–	Match
Monday	–	–
Tuesday	Strength training	Endurance + Club training
Wednesday	–	Power training
Thursday	Strength training	Club training
Friday	–	Endurance
Saturday	–	Sprints

2. Three-one-two-one weekly cycle		
Day	**AM**	**PM**
Sunday	–	Match
Monday	–	Power training
Tuesday	Strength training	Endurance + Club training
Wednesday	–	–
Thursday	Strength training	Club training
Friday	Endurance	Sprints
Saturday	–	–

The effect should be to increase the quality of training on the five work days as well as giving the body more recovery periods to heal and grow stronger. Hence the double benefit of improved performance and reduced injury risk.

Everyone has his or her own limit and different athletes can tolerate different training loads. My suggestion here should not be taken as a golden rule, but instead it is an idea worth trying that may help you. It does not matter what sport you are involved in; simply look at the total number of training sessions per week and try to organise them so you can take two rest days.

If you feel that a six-one cycle is fine for you, then so be it. Paula Radcliffe works to a seven-one cycle during hard training phases and can obviously cope with this well (slight understatement!). Each athlete is different, and experimenting to find what works for you best is important. For example, I work with another rugby player who prefers a five-two cycle, giving her two days' rest before Sunday's game.

The take-home message is that recovery is vital. You may find that more recovery, rather than more training, leads to improved performance. Less time spent injured means more continuous weeks in training, even if those weeks are slightly lower in volume than you may think is best.

Raphael Brandon

Part 2: Here are the five main ingredients for keeping shoulders injury-free

There is perhaps no joint in the human body as complex, fascinating, or baffling as the shoulder. It can leave clinicians scratching their heads, wondering why a problem they have solved many times before is this time so stubborn. And shoulder problems can certainly be stubborn! That's why, in every case, prevention is so much better than cure. Rarely is a pain that has surfaced a simple matter of applying some ice – it is more likely to be the tip of an iceberg!

An athlete's shoulder is either a joint that they have never given a second thought to, or it is ever-present in their minds – it is either no problem, or a problem they cannot ignore. It has been said that the design elements that make up the shoulder are either near perfection, or near disaster! However, it is rare for rugby players not to carry at least a niggling pain, while many have a history of a significant shoulder problem.

This article takes a good look at the big picture of shoulder injury management, and will try to empower and educate rugby players with some DIY home injury prevention and performance enhancement techniques.

Preliminary precautions if you have a shoulder injury and would like to try to treat yourself, please remember:

It would be wise to rule out structural damage first, via X-rays, CTScan, US Scan or MRI, particularly if your shoulder joint experiences sharp catching pains, locking sensations, clunks, pins and needles or numbness, looseness or laxity, or the history of the injury was in any way traumatic, involving body contact or a fall.

The length of time it took to develop your problem will give you some indicator of how long you will need to persist with correcting the faults before the results will be felt. Don't forget, as I've said, that the pain is often only the tip of the iceberg, directing you to the real issue.

However intelligent and self-aware you are, you will probably need the help of professionals – for treatment, guidance, feedback and motivation.

Some treatment 'pain' is allowed, but only really what is associated with muscle fatigue as opposed to soft tissue strain (therapeutic massage is an exception: no pain no gain!).

If you are already training and competing at high levels and have no difficulties with your shoulder, then be extremely careful how many new exercises you take on during the competitive season. It's better to wait until the off-season to make sure you don't overload your shoulder or throw it off balance by adding new demands.

'The most important principle of shoulder management is: start working on it NOW. Don't wait until your shoulder starts to hurt!'

Treatment, prevention and performance enhancement

The advice that follows relates to the prevention and treatment of overuse injuries of the shoulder, not the management of acute or traumatic injuries such as glenohumeral dislocation, clavicular fractures, or tears of the labrum ('cartilage'). However, the broader principles of rehabilitating a shoulder that has been surgically repaired, or been stuck in a sling for four weeks, are no different, although there may be restrictions and time constraints imposed by orthopaedic surgeons.

The most important principle of shoulder management is: start working on it NOW. Don't wait until your shoulder starts to hurt! But, in addition, the preventative measures outlined below are guaranteed to improve your performance – they will genuinely improve the way your shoulder works, and thus it will be stronger, more coordinated, reach further and last longer before fatigue sets in. All the experts say it: injury prevention equals performance enhancement.

Some simple anatomy of the shoulder complex

The shoulder joint actually comprises four joints – see if you can feel them on yourself:

- Sternoclavicular (SC) joint (between the sternum and the collar bone) – this is actually the only bony connection that the shoulder has with the main skeleton;
- Acromioclavicular (AC) joint (between the collar bone and the point of the shoulder called the acromion, which is part of the scapula or shoulder blade);
- Glenohumeral (GH) joint between the glenoid part of the scapula – the socket – and the head of the humerus (HOH) – the ball; and the
- Scapulothoracic (ST) joint (the 'false joint' between the scapula and the rib cage that it rides over). The GH joint is the most susceptible to injury as it is entirely dependent on non-bony connections for integrity. Whereas the hip joint (also a 'ball and socket joint') has a deep socket formed by the bone of the pelvis, the GH joint relies on the balance, strength and control of muscles, ligaments/capsule and labrum (cartilage) to function properly. The labrum acts like the edges of a skateboarding rink in preventing the HOH from spinning/sliding too far from the centre as it acts to deepen the socket. In an attempt to describe the delicate balance of the HOH sitting on the scapula, the GH joint has been likened to a seal balancing a ball on its nose.

The rotator cuff muscles

Without learned muscle control, any overhead activity, let alone just lifting the arm, would be impossible – the GH joint would dislocate or the HOH would jam under the arch of the acromion. The muscle group we rely on for this control is the rotator cuff (RC) muscles – the infraspinatus, supraspinatus, teres minor, and subscapularis muscles (an anatomy book will show where they lie). They all originate from the scapula and are coordinated together to keep the HOH spinning/rotating as close to the centre of the glenoid as possible with movement. The long head of biceps tendon running over the front of the GH joint also has a stability role to play in conjunction with the RC, especially with the throwing action.

The muscles primarily designed to position the scapula for overhead movement are the trapezius (especially lower trapezius), and serratus anterior – called therefore the 'scapular stabilisers' – with counterforces being produced by levator scapulae, rhomboids and pec minor muscles.

The larger and more powerful muscles that generate movements of the arm are the deltoids, latissimus dorsi, and pectoralis major. So while the RC muscles coordinate the proper positioning of the HOH by acting close to the centre of the joint (the 'inner core'), the larger muscles with long lever arms move the arm with speed and force (the 'outer core').

The five ingredients: balance through control

Let us now unpack what could be considered the five most essential ingredients for keeping shoulders injury free:

1. Sports-specific technique
2. Flexibility
3. Core stability
4. Rotator cuff control
5. General strength

The primary goal of these five areas of intervention is, in a word, balance. And the way to achieve it? Control. The higher your levels of performance, the greater the control required to maintain balance – just as a Formula 1 car needs much higher levels of balance and control than does a standard road car. A deficit in any one area will ultimately cause muscle imbalances to develop, which lead to soft-tissue breakdown and later even joint degenerative change.

The more elite the performer, the more committed they need to be in getting professional help to fulfil and maintain these principles. You will also save yourself much time and anguish if you seek experienced help as a preventative measure, rather than only asking for treatment once the problem has surfaced. Having a regular tune up/ service can be done in the form of screening, where a sports-experienced physiotherapist will run you through a series of tests to find out if any of the areas below are not being adequately dealt with.

1. Sports-specific technique

Poor performance and shoulder pain very commonly originate in bad habits of technique. Often they are only clearly seen when muscle fatigue sets in. However, a good coach will be able to pick up when this is happening and realise it's time for rest and recovery. For rugby players it is normally poor technique in the gym that leads to shoulder problems on the pitch. It could be poor technique in resistance training, or it could be that your workout develops one muscle group (*eg* biceps), but not the antagonistic group (triceps). This will lead to an imbalance and therefore stress on the surrounding joint (shoulder).

'There are many ways to find out if your technique is faulty, but one of the best is video recording in order to slow down the action and break it into smaller components'

As a general rule, technique work should be done after a thorough warm-up (or even as part of a warm-up), while the muscles and the brain-connections are still fresh and strong. On the other hand, when fatigue sets in, it can occasionally be a good time to do specific drills that do not load the shoulder, yet will reinforce good movement patterns. The only proviso is that one must be extra diligent to see when compensation strategies are setting in, and call a halt immediately.

Without wanting to state the obvious, practice is the key! Once you have mastered a new aspect of technique it must be repeated around 10,000 times before it becomes engraved on your brain, in other words, the point at which the movement pattern becomes subconscious and feels 'natural'.

There are many ways to find out if your technique is faulty, but one of the best is video recording in order to slow down the action and break it into smaller components. The better the technology, the better the result, but for real value it comes down to the experience of the person evaluating the picture. Using a mirror is rarely effective since the position of the head focusing on the mirror can greatly affect the shoulder position. The two most important sources of feedback in this regard are your coach and a biomechanist, and often a sports physiotherapist who has had a lot of experience in rugby and rugby injuries.

2. Flexibility

The purpose of flexibility varies for the different muscles around the shoulder. For the major power muscles, it is important that flexibility allows freedom of movement for the pelvis, trunk, scapula, and humerus. For the rotator cuff, the critical issue is the balance of forces centering the head of humerus, and to a lesser degree, freedom of movement. It is more critical that the internal and external rotators are equally flexible, rather than how flexible they are.

A warning: to have too much flexibility at the expense of strength and control can be dangerous because of the excessive shear forces causing wear and tear in the joint. This is particularly true of the glenohumeral joint where the primary source of stability is the rotator cuff muscles working in conjunction with other soft tissue structures such as the capsule, ligaments and cartilage. Too much flexibility (especially if you are a front five forward) at the expense of muscle control puts strains on the soft tissues and causes injuries such as rotator cuff tendinitis and degeneration, labral tears, subluxations and possibly even a dislocation.

Do not begin a flexibility programme until you have seen a sports doctor or physiotherapist:

- if your shoulder has ever had an episode of instability, such as rapidly popping out and in again, or if it has ever dislocated;
- if you have other joints in your body that are very loose, or double-jointed, eg, your elbows bending too far back, or
- if your shoulder clunks or pops excessively.

Stretching

Stretching to increase flexibility should never be done prior to training or competition, but instead done during ‘down’ times in the week. This is because of the suppression of the 'stretch reflex' that takes place during sustained passive stretching of muscle tissue (*ie*, repeated holds of 20-30 seconds). If one were to do rapid forceful movements such as long passing straight after such passive stretching, there would be an increased chance of muscle and tendon tears. For flexibility every muscle needs to be stretched three to four times at 20-30 seconds each, and repeated three to four times per week.

The most important areas for regular flexibility sessions are:

- Infraspinatus/teres minor (posterior rotator cuff and capsule)
- Pectoralis major/minor
- Latissimus dorsi
- Biceps/triceps
- Thoracic spine (between shoulder blades)
- Upper trapezius/ scalenes/ levator scapulae
- Gentle nerve stretching (oscillations)

The best way to learn how to stretch the above areas is to be taught by a sports physiotherapist, sports conditionist or personal trainer.

It is important not to stretch the ligaments of the shoulder, which in due time can cause laxity of the joint and potential instability. The most common example I see? Athletes stretching their pec muscles and ending up with their arm behind them against the wall, but with their shoulder rolled forward, feeling the stretch on the front of the point of the shoulder. What are being stretched here are the anterior ligaments ('capsule'), not the muscle, which is better stretched by pulling the scapula back and twisting from the trunk away from the shoulder (hand still on the wall). One then feels the stretch a lot more down on the chest area where it should be.

Warm-up practice and theory

The shoulder should be warmed up thoroughly with gradually increasing movements – big circles, across body movements, trunk twists, shoulder blade rolls and forward and backward squeezes. The purpose of this is to increase blood flow and temperature, thereby increasing the elasticity and 'give' in the soft tissues. A series of short duration stretches (*ie* 5-10 seconds) of all the main muscle groups should follow and then finally a session of more sports specific drills. These are used to warm up the brain's connection to the muscle, *ie* to reinforce correct motor patterns, and also to set the right neural reflexes in the muscle.

Massage: One of the most important functions of massage is to reduce the build-up of 'trigger points' - areas in the muscle that literally seize up due to excessive loading. This may cause a muscle imbalance or be the result of one – either way it must be 'released' via massage. All the muscles described above that are necessary to stretch are susceptible to trigger points and can become tight and/or weak because of them. It is not uncommon for a trigger point to develop in the muscle as the first structure to begin breaking down, slowly dragging other muscles, nerves, and the gleno-humeral joint down into a cycle of pain and inflammation.

The best way to begin is to get a hard tennis ball to do your massage with, and then try these two ideas:

Pectoralis minor/ major 'release': This is a critical muscle to keep loose because if becomes too tight, it binds the scapula forward, resulting in the head of the humerus being thrown off centre, especially in overhead positions. Hold the tennis ball to the soft muscle overlying the chest right at the front of the shoulder. Lean towards a door frame and allow the tennis ball to press against it, with the same side arm half way up the wall, palm facing towards the wall. Search for the tender trigger points, and when you find one, stay with the pressure on to it until it softens and the pain eases.

Rotator cuff 'release': Often accompanying the above condition is tightness and overactivity of the infraspinatus and teres minor, the net effect of which is also to push the head of the humerus forward from its centre of rotation. Hold a tennis ball to the back of the shoulder on the scapula, and press the back and side of the scapula onto the wall. The arm that is being worked on should be cradled in the opposite hand. Allow it to dig deep!

3. Core stability

Core stability has become a whole science in itself in the last decade as all manner of sports professionals have realised how critical it is for the inner core of the body, namely those joints closer to the spine, to be supported by the postural muscles designed to do so. For the shoulder, the critical areas are the lumbar and cervical spine, and the scapulothoracic joint. If these areas are not stable, then significant extra loading and strain will be passed on to the shoulder joint.

'Core stability has become a whole science in itself in the last decade as all manner of sports professionals have realised how critical it is for the inner core of the body, namely those joints closer to the spine, to be supported by the postural muscles designed to do so'

The stability of the lumbar spine is achieved by the combined effects of transversus abdominis and multifidus acting on the thoracolumbar fascia. Pulling in the lower navel area while tensing the lower-back muscles slightly activates the 'corset'. The cervical spine is stabilised by the upper cervical flexors in conjunction with the lower cervical extensors, to achieve a 'tall' neck position with the chin slightly drawn into the neck. Keep in mind that this is easier for some than others, depending on how your body has been trained – for instance, ballet dancers will find the stable position of the neck comes naturally, rugby players may not. Activating the muscles is the first stage of the learning process; practise the position until you are ready to incorporate it into simple movements that are relevant to your sport.

The scapulothoracic joint is the most relevant 'joint' for the shoulder, because the glenohumeral joint is formed by the glenoid (the socket) of the scapula and the humerus (the ball). The muscles most directly responsible for its stability are the trapezius muscle (especially its middle and lower fibres) acting with the serratus anterior muscle – together they act to hold the scapula in a neutral position whether the arm is by the side or above the head. The neutral position is where the glenoid socket is most ideally orientated for the rotator cuff to control the HOH.

Deficiencies of core stability are always found with chronic shoulder injuries, or after surgery or trauma, because pain tends to inhibit the postural muscles so they cannot do their job properly.

The way to activate the lower trapezius/serratus anterior muscles is to sit in a relaxed tall posture, arms relaxed across your thighs. Gently pull the inner borders of your scapula together and down with the minimum of effort, and hold it there for 10 seconds. Don't pull too far back or you will over-activate other muscles that are not designed to be the main core stability muscles – it is always a subtle and relaxed action with a 10 second hold.

When you have practised this for a few days as often as you can, experiment with 'setting' your scapula into the neutral position with your arms out to the side, with your arms on your hips, up behind your head, etc.

Once you have mastered the 'setting', add small movements of your arm while holding the set position, and gradually over a few weeks you can increase the complexity, speed and loading of your arm. Finally you are doing the setting at the same time as you are carrying out the rotator cuff strength and control exercises described below.

4. Rotator cuff strength and control

The rotator cuff muscles are dependent on the good positioning of the scapula for effective control. If the scapula is angled too far forward or downward, for instance, while the tennis player reaches overhead to smash, the RC muscles are biomechanically disadvantaged and may fail to keep the HOH centred. The role of the RC muscles therefore is to maintain the position of the HOH while the prime mover muscles generate power.

As you improve your scapular control, the RC muscles are able to act more efficiently and independently of the scapular control muscles. That is to say that you should be able to hold the scapula quite still in the neutral position while you independently move your arm. This skill is called 'Glenohumeral Dissociation'.

Thus with each of the following exercises, it is assumed that the scapula is being held as close as possible to neutral:

- Internal/external rotation with arm by the side. Standing. Rolled towel held between elbow and ribs. Attach one end of an elastic or theraband to a door knob and hold the other end in your hand with elbow bent 90°. Set scapula. Slowly pull across body at the same time – 3x10 pulling to right, 3x10 pulling to left.
- Internal/external rotation with arm at 90° away from body. Lying on back. Attach one end of an elastic or theraband to a chair leg and hold the other end in your hand with elbow bent 90° resting on ground. Set scapula. Pull hand forward until limit of flexibility and slowly release. 3x10. Opposite movement – pulling hand up above head – 3x10.
- End of range gentle flicks. Standing. Elastic tied to doorknob. Face away from doorknob, holding arm up above head with elastic in hand on tension. Allow arm to slightly drop backwards from elastic tension, pull forward slightly on tension. Repeat slowly, gradually increasing speed and tension over the following two or three weeks. Monitor any shoulder soreness the next day to determine whether you've gone too hard!
- Stand facing wall with ball (Swiss or other) held up on wall at head height. Step back so you're leaning onto ball. Set scapula. Make small circles on the wall with outstretched hand on ball. 5x10 anti/clockwise each. Rest and repeat.
- Squeeze tennis ball in hand. Go through throwing motion slowly while squeezing ball. Set scapula at outset of throw, slowly releasing and doing an exaggerated follow-through with whole body motion. Repeat 10-20 times. Excellent for co-contraction of RC muscles to increase their activity and control of the HOH.

5. General muscle strength

Once the foundational issues of technique, flexibility, core stability, and rotator cuff control are being implemented, we must look at the bigger picture of the 'outer core'. What is the rest of your body like – does it help or hinder the performance of your shoulder?

It is crucial in rugby that the muscle groups are well balanced. There is a 'winding up' and an 'unwinding' that takes place at a rapid speed starting from the legs, progressing through the hips, pelvis, lumbar spine, thoracic spine, shoulder, elbow, and wrist. And each must be taught to absorb its fair share. For example a flanker who starts low in a defensive scrum, will rise and sprint from a static position, then eventually have to stop immediately and get low for the next ruck. This is a chain of movements.

To this end there is a whole section that could be written on the value of plyometrics, the exercise science concerned with harnessing the eccentric strength of muscles to gain greater power. The rotary power of the body is greatly strengthened by developing the eccentric contraction strength between the kinetic links described earlier – and this is where medicine balls, harnesses, and other strength and conditioning equipment come in.

'In those athletes who are carrying an overuse injury in the shoulder, nine times out of ten they have overdeveloped pecs and lats relative to their trapezius, rhomboids, posterior deltoids, and posterior rotator cuff'

Avoid this imbalance

It is clear to most rugby players that a gym routine needs to include strengthening work for the deltoids (three heads), latissimus dorsi, pec major, upper trapezius, and the rectus abdominis because they are the prime movers of the shoulder. Often what is critically overlooked, however, is the imbalance that can develop between the front of the shoulder and the back.

In those athletes who are carrying an overuse injury in the shoulder, nine times out of ten they have overdeveloped pecs and lats relative to their trapezius, rhomboids, posterior deltoids, and posterior rotator cuff. In these situations, flexibility must often be improved, scapular setting must be taught, and the focus of gym exercises changed towards the back. Seated and upright row, dumbbell flies for the back, bench pull, and lat pull downs with the bar behind the head are all exercises that must take greater priority.

During all gym work it must be stressed that scapular setting and the activation of core stability muscles for good posture are vital for injury prevention.

Summary

So there we have it – the big picture of injury prevention and performance enhancement for rugby players. Decide today which one of these issues you might need some more work on, try some of the home exercises, and perhaps seek professional help to maximise the results of your efforts.

Ulrik Larsen

Part 3: Treatment and rehabilitation of groin injuries

Immediate management

Immediate icing of direct muscle tears of the groin and especially adductor attachment tears is beneficial and necessary in the 24-hour period after the injury. Unlike hamstring injuries, however, movement while icing is not necessary and may in fact be detrimental to the turn-around time of adductor injuries. This will be expanded further in the section on stretching.

Soft-tissue therapy

Any therapy that reduces muscle tone in the adductor muscles will be a useful adjunct in the treatment of this injury. This may be any soft-tissue massage (ischemic pressure and longitudinal flush) in the area below the tear or 'trigger point' injection therapy into the adductor muscle belly.

Groin straps

It is common practice in Australia (particularly the Rugby League haven of New South Wales) to use groin straps in the management of adductor lesions. However, they are almost unheard of in the United Kingdom.

The rationale behind the adductor (groin) strap is similar to the Chopart or patella tendon strap. The application of the strap directs force on to the strap and away from the injured tissue. In relation to the adductors, the strap is usually applied high up around the thigh as close to the adductor tubercle as possible. It is placed on quite tight to be supportive but not occlusive to the femoral artery, vein and nerves. This then takes stress away from the adductor tubercle. It will result in an immediate decrease (not abolition) in pain on functional movement and adductor squeeze testing.

The athlete is instructed to keep the strap in situation 24/7, except for showering and sleeping (however, there is no reason why it needs to be removed during sleep). The athlete can continue to wear the strap during rehabilitation and return to sport.

'For some bizarre reason, the adductor muscles are the only muscles that respond POORLY to stretching in the initial post-injury period. There is no plausible explanation for this phenomenon'

Stretching

For some bizarre reason, the adductor muscles are the only muscles that respond POORLY to stretching in the initial post-injury period. There is no plausible explanation for this phenomenon. One possible reason (and this reason does have its flaws) is that the adductor muscle does not operate through a large range of motion during the execution of most sporting manoeuvres. Therefore, stretching of the muscle into end-of-range positions in the initial period may in fact place the muscle in a position it is not used to and comfortable with. This may lead to an adverse tissue reaction that further adds to the stress of the muscle and results in further increases in muscle tone.

The alternative to stretching the adductor muscle group is to use 'isometric stretching'. This is done by squeezing a rugby ball with the ball in between the knees with straight legs. The ball is squeezed to the point of discomfort but not pain. The contraction is held for 10 seconds and the legs are then moved up to the next position, 45-degrees knee flexion. Again, this is held for 10 seconds and the legs are then lifted to the 90-degree hip flexion position and contraction repeated for 10 seconds.

Back down to legs straight and start again. This can be done five times in each position.

Why it works

The theory behind isometric stretching of the adductors is as follows. As the muscle isometrically contracts against a stationary and non-deformable object (the ball), the muscle tissue will undergo a degree of shortening. As a consequence, the tendon attached proximally to the muscle will be required to elongate slightly to keep the entire muscle-tendon complex at the same length. The amount of stretch and elongation we are talking is tiny; however, it is enough to cause a slight elongation in the tendon and tenoperiosteal junction. No other muscle in and around the pelvis responds in the same way to this technique as the adductor muscles.

Another way to isometrically stretch is to have the therapist control the weight of the leg, which is in knee extension. The leg is then lifted into progressive degrees of hip flexion, abduction and internal or external rotation. The patient is then instructed to gently pull into the opposite direction (adduction, flexion and the other rotation). This is very similar to a PNF contract-relax stretch. The leg can then be lifted and placed into more progressive positions based on the feeling of movement blocks (a term those trained in 'muscle energy' will be familiar with). This can be continued into the extreme end-of-range positions of hip flexion, with moderate amounts of rotation and minimal range of abduction.

Strength retraining

Initial strength retraining may take the form of 'adductor squeezing' as described above. This can be started almost at day one. The act of performing the adductor squeeze thus serves two functions; isometric stretch and strength retraining. This can be progressed from supine lying positions to wall squat positions. The protocol is the same: aim for 10-second holds and attempt five repetitions in each position.

As adductor squeeze and function improves, the following exercises may be added to strengthen the adductor muscle:

- **Theraband adductions (crook lying):** lying supine with knees and hips bent to 45 degrees. Place theraband around knee and attach to leg of table. Let the leg fall out to position of abduction and contract back to knees together position. This can be progressed into greater range, greater speed and greater resistance.
- **Theraband adductions (standing):** standing with theraband around heel, hold on to chair for support, allow band to pull leg into abduction, contract back to adduction. Perform with the foot in front of the stance leg and foot behind the stance leg. And very important, do both legs. The adductor needs to retrain its movement function as well as its stabilising function.
- **Lunging (around the clock):** feet together, step out in front (12 o'clock) and take weight via a lunge action. Push back to start position. Step out to the side (3 or 9 o'clock position) and back, then step backwards (6 o'clock) and back. Again, do BOTH legs.
- **Lateral step ups**: place a knee-height box or chair about three feet at your side. Step up on to the box sideways and down again. Again do both legs.

Progress by increasing speed

- **Swiss ball squats**: on a Swiss ball, either stand (for the vertically challenged) or perform a partial squat. This is a great isometric-adductor strength exercise.

- **Weights:** A few key principles regarding leg weights need to be laid down. First, perform and be happy with two-legged bilateral exercises before progressing to one-leg unilateral exercises. For example, do two-legged leg press before attempting one-legged leg press. Second, be careful with the progression of load and speed. Adductors tend to work exponentially harder as one approaches the one-repetition maximums. Respect this before progressing loads.

Furthermore, ballistic movements such as power cleans and snatches tend to recruit more adductor activity. Exercises where the feet do not leave the floor are generally safer initially.
- **Functional strengthening:** field activities such as side-stepping and cariocas.

Rehab running/training

This stage has similar progressions to the fitness testing mentioned below. In order to retrain the adductors for functional use, activities need to be presented in a logical and progressive order.

The stages can be progressed from one day to the next, or progressed within the same session depending on presentation of symptoms. The progressions are as follows:

- **Straight line running:** distances can be progressed in pyramid fashion. That is, 10m, 20m, 30m, 40m and so on. Overall maximum distance will depend on the individual athlete's requirements (sport and position). Speed needs to be progressed sensibly and always on the basis of presenting symptoms (pain) and clinical signs (adductor squeeze and palpation). Aim to reach full top-end speed before reaching flat-out acceleration and deceleration.
- **Weave running:** progressed as above but instead of in a straight line, the athlete runs curves.
- **Sideways shuttles:** stand on a line. Sidestep five times to the right and then sprint forward 10 metres. Rapidly stop and then side-step five times to the left. Sprint 10 metres again and repeat the process to the right. This can continue for as many 10- metre segments as desired.
- **Sprint and cut:** sprint forward 20 metres and step rapidly to the left at a 45-degree angle. Walk back and repeat to the right.
- **Cone drills:** place five cones out in a random order over a 10-x-10- metre square. The idea of this drill is for the athlete to sprint to one cone, rapidly stop and reach down to touch the cone, look up at the tester who points at another cone for the athlete to sprint towards. This continues for 20 seconds and can be repeated as many times as desired.

- **Functional skills:** depending on the sport played, this would include (if relevant) kicking, scrums, tackling, jumping etc.

Fitness testing

Those involved with the management of groin injuries (physiotherapists, sports medicine physicians, orthopods and athletic trainers) all have their favourite ways of assessing fitness for competition. Outlined below is a very direct and accurate method of assessing the functional ability to perform in competition and avoid risk of re-injury following an adductor-muscle strain.

The premise of the following fitness testing protocol is that two criteria must be satisfied; first, that the player can perform the testing procedure pain-free and without functional limitation, and second, that the adductor muscle does not 'tone up' two to three hours following fitness testing. This is assessed by palpation of the muscle. It is common for athletes to able to complete such a fitness testing session, and then have all sorts of problems in the few hours following.

As far as timing goes, this type of testing can be done the day before a match or even on the morning of an afternoon match. This is in contrast to hamstring muscle injuries that ideally should be fitness tested 48 hours prior to competition.

Procedure

Assess adductor squeeze (pain and weakness) at three testing positions and feel muscle tone to gain an initial baseline. These should feel good if you have progressed to fitness testing.

- **Ten minutes of general running and stretching**
- **Straight line running**: 5 x 40 metre runthroughs progressed from warm-up speed to full speed. The rate of acceleration is not important at this point; the focus is on reaching full speed before 40 metres. Walk return after each repetition.
- **Straight line acceleration (over 20 metres):** 1 x 20 metre flying start (jog in before flat-out acceleration); 1 x 20 metre upright start (off the mark); 1 x 20 metre 3-point stance start; 1 x 20 metre starting on stomach.

- **Weave running: 4 x 40m:** running in a 5-10 metre channel, the athlete sprints whilst weaving between two parallel lines (the in- goal area of a Rugby pitch is ideal). This is a pure weave (similar to running around a curve) and no side-stepping is involved. For example, the athlete may be instructed to touch the right line and then left line twice each on the first run, three times on the second, and so on. By increasing the number of touches on each line, the angles involved in the weave will become more acute and more challenging for the groin muscles.
- **Cutting manoeuvres:** sprint 20 metres straight line and cut (stepping off) 45 degrees to the left or right (at full speed) and continue to sprint for another 10 metres before decelerating. Complete two to the left and two to the right.
- **Cone drills:** place five cones out in a random order over a 10-x-10-metre square. The idea of this drill is for the athlete to sprint to one cone, rapidly stop and reach down to touch the cone, look up at the tester who points at another cone for the athlete to sprint towards. This continues for 20 seconds. The athlete repeats this for a total of four repetitions with one-minutes rest between efforts.

  The final two efforts are modified in the following way Instead of bending down to touch the cones, the athlete falls to the ground on his/her front. Before the athlete gets back to their feet, the assessor places some pressure on the athletes back so that they need to fight their way back on to their feet before continuing. This continues for 20 seconds (in this time expect the athlete to hit the ground 3-4 times). As a word of caution, this is very fatiguing to do at full speed for a full 20 seconds (if you disagree, try it yourself). Therefore, if testing on the morning of a game the time period may need to be modified depending on the individual fitness characteristics of the athlete/player.
- **Kicking:** if this is a common skill component encountered in the game. Start with short-distance kicking and progress to long kicking and kicking across the body and kicking on the run. Warm down and stretch for 10 minutes.

- **Re-assess adductor squeeze and muscle tone**: immediately after warm down, then again 2-3 hours following fitness testing. It is important that the adductor muscle is not treated in this time period.

The above testing procedure will assess the ability to perform all physical components required for rugby. As I mentioned earlier, the above test should be performed pain-free and without functional limitation. Examples of functional limitation would be the inability or reluctance to turn away from the injured side, holding back on the acceleration component and obvious limping (hopefully the assessor would be wise enough to not even bother fitness testing in this situation).

The re-assessment of muscle tone is also of critical importance. If muscle tone is to increase following such an intense and involved testing session, then it will do so within the first two to three hours following the testing. From a pathological perspective, an increase in muscle tone is an indication that the original source of pathology (whether it be muscle or tenoperiosteal junction) has been irritated and has 'driven' the tone in the involved muscle belly. This is an important indication that the muscle is subject to possible further damage (in the form of a strain) especially under fatigue. The increase in tone will be quite obvious when you palpate if you have been assessing tone on a regular basis during preceding treatment days.

Chris Mallac

How youth coaches are using a psychological questionnaire to deal with 'underperformance syndrome'

In professional sport, coaches are under intense pressure to perform. In the final game of the English domestic Rugby Union season in 2003, Saracens played Leicester, with the winner offered a chance to play in the European Cup the following season, an opportunity worth about £250,000 in extra gate receipts and sponsorship money for the Club. Saracens lost, and the entire coaching staff was sacked, having been in place for just one season.

Coaches have a tendency to tackle poor performance by increasing training load [1], which may actually exacerbate the problem rather than solving it. Underperformance can be caused by a number of factors, including injury, fatigue, loss of confidence or motivation, relationship problems (within or outside the team), and other external stressors, such as exams, career or financial problems.

Two different athletes given the same workload and intensity may respond quite differently to the stimulus. What may be optimal for one may be too much for the other. The same could be said for an individual who responds differently to the same workload in two different training cycles. The key factor here may not be the workload, but something else going on in that athlete's life.

Rugby Union is a sport where the physical demands are high through exertion and from contact. The English domestic season lasts from late August to early May. Keeping players in a physical state that allows for peak performance week after week is difficult [2]; ensuring their physical and mental recovery is even more challenging.

In my role as Conditioning Coach at London Welsh Rugby Football Club, I have had the opportunity to measure and assess the amount of fatigue associated with training and lifestyles and to try to reduce its impact on the players' performance.

Recovery may be most important for youth players as 30% of team sport players aged 16–20 suffer from staleness [3]. Such athletes face often-conflicting pressures from teachers, parents, coaches, peers, relationships, work and training, which can lead to staleness, burnout and injury [4].

What do we mean by these terms? Short-term overtraining, known as 'overreaching', can be seen as a normal part of athletic training and must be distinguished from long-term overtraining that can lead to burnout, staleness, or 'overtraining syndrome' [5]. Staleout can be distinguished from burnout by the athlete's motivation to train; while the symptoms may be similar, a stale athlete is still motivated to train and a burned-out athlete is not [6].

'Training is much easier to manipulate and measure than recovery because of the difficulty of accurately recording and quantifying the latter state'

Because of the many potential causes of poor performance, overtraining syndrome (OTS) has recently been redefined as the "unexplained underperformance syndrome (UPS)". It can be distinguished from overreaching by the fact that symptoms do not diminish after two weeks of rest [7]. However, these terms will be used interchangeably in this article because of their usage in research.

Preventing UPS calls for a careful balance of training stimulus and recovery [8] – the latter defined as 'a well-planned activity that matches the situational needs of an athlete in rest and results in regaining an optimal performance state' [9]. However, training is much easier to manipulate and measure than recovery because of the difficulty of accurately recording and quantifying the latter state.

Nevertheless, having an accurate measure of recovery may be useful to a coach because he or she can then identify any problems that may be preventing the athlete from achieving peak performance.

Any such measure must also be affordable and easy to use in order to work in the coaching environment. This may be especially true when working with youth athletes, where budgets tend to be more restricted.

What measures have been used to date – and how effective have they been? Heart rates which are elevated in the morning, and reduced during submaximal exercise have been cited as indications of OTS [10-14]. But this has not been found in all studies, including those on: judoka [15], cyclists and triathletes [16]; swimmers [17, 18]; and runners [18,19,20]. In one study, individual differences in resting heart rate were found in overtrained runners, calling into question the reliability of one marker as an accurate measurement of OTS [21].

'Psychological measures have been proven to be as effective as physical measures in diagnosing 'training stresses''

This particular marker is also dubious because resting morning heart rates are known to be reduced by a good night's sleep [22] and none off the studies that noted elevated resting heart rate in overtrained athletes took sleep into account as a factor.

Uusitalo *et al* could not find a universal pattern of physiological responses to excessive training, which appears to be the main problem at present: no one physiological marker is reliable for all athletes, while relying on a combination of markers may not accurately distinguish between overreaching and OTS. The only consistent factor is a decline in the athlete's performance [23].

Psychological measures have been proven to be as effective as physical measures in diagnosing 'training stresses' [24]. Could these also be useful for predicting and diagnosing OTS? One commonly-cited tool is the Profile of Mood States questionnaire (POMS), which, as its name suggests, measures moods. However, moods are highly contagious among athletes, with highly motivated athletes and women seeming to be at higher risk. Thus, this may be a less useful tool in a team environment and is also considered unreliable as an indicator of staleness [25].

A more recent psychological tool is the REST-Q – the Recovery-Stress Questionnaire for Athletes, devised by Kellmann and Kallus [27], which asks questions about the athlete's current

'If a player was in a bad physical state, we wanted to know whether this was due to a drop in fitness or other pressures affecting his performance'

state of recovery and stress. This tool attempts to integrate the useful parts of the POMS into a more functional assessment of an athlete's current training status. It uses 19 scales relevant in the recovery process, such as general stress, self–efficacy; and emotional exhaustion and has been demonstrably effective in monitoring training dosages in elite training camps[27,28].

As part of my work with London Welsh RFC, I have been using the REST-Q for the last two seasons to monitor levels of recovery and stress in the Academy players, in conjunction with their physical fitness. My aim was to see if the REST-Q, administered throughout the season at intervals of 6-8 weeks would be useful in preventing underperformance in a semi-professional, part–time training environment, similar to many within the UK.

On the recommendation of the tool's author, we measured physical fitness at the same time as measuring psychological well-being with the REST-Q; if a player was in a bad physical state, we wanted to know whether this was due to a drop in fitness or other pressures affecting his performance. When we looked back on the first season's scores, we saw remarkable differences between those players who had consistent performances and went on to representative honours at age–group level and those whose form slumped, or who suffered from burnout or UPS.

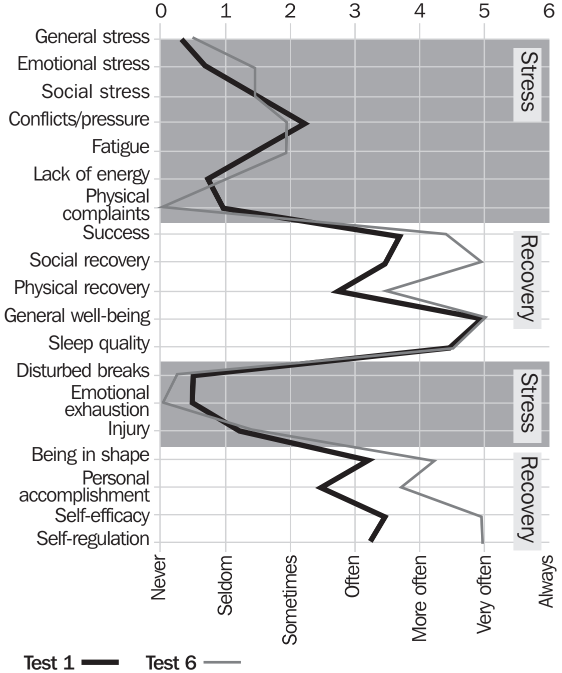
At the end of the season I performed a statistical analysis of the REST-Q scores on the Academy as a whole, looking at stress and recovery scores, injury prevalence, physical fitness and playing performance. This did not produce any significant results.

I then divided the players into four main categories: players who performed well; those who suffered from burnout; those who suffered from performance slumps; and those whose fitness levels and performances were consistent throughout the season, and who didn't get injured. By homing in on individual players in more detail, we hoped to see trends that were common to the groups. Two of the individuals are presented as case histories here: Player A, who performed better than expected, and Player D who suffered from burnout.

Player A's graph *(figure 1)* shows high levels of recovery and low levels of stress at Test 1 and at Test 6 (James – at what stages of the season were these two tests carried out?) He also shows higher levels of success, social recovery, physical recovery, personal accomplishment, self-efficacy and self-regulation at Test 6 than at Test 1. He was selected for the Wales under 19 squad for the Six Nations tournament.

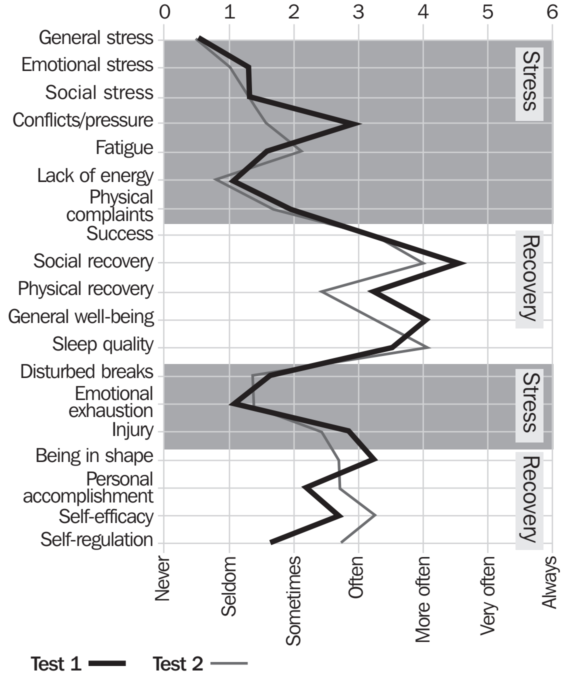
He lived at home, and his Dad attended all the training sessions and matches throughout the season. Social support has been shown to contribute to health and well-being by reducing exposure to stress and enhancing coping efforts [29]. He was studying at school, but did not work to earn money. This may have been a significant reason for his continued success, enabling him to concentrate on his rugby and recover at home.

Figure 1: player A's Rest-Q scores at both ends of the season



Player D's graph *(figure 2)* shows minor differences during the pre-season tests, with Test 2 being carried out four weeks before he dropped out of the Academy. (Again, when were these tests carried out – were they both pre-season and at what interval apart?) Social and physical recovery and general well-being score lower in the second test, but self-efficacy and self-regulation score higher. In a follow-up conversation this player expressed dissatisfaction with his own performance and said he had been consistently under pressure at work as an apprentice. He cited his early morning starts as a main reason for not being able to recover from training the previous evening. He lived with his parents and had few household chores and little homework to contend with, but his parents did not show any overt signs of support

Figure 2: player D's Rest-Q scores in two pre-season tests four weeks apart



for him within the rugby environment. This may have been a significant factor in his decision to drop out from the sport as people who have weak social ties, including those with their immediate family, have been shown to have weaker health than those with strong social ties [8].

Compared with previous research using case studies [26,27,30], this study showed the importance of external influences on each player. For example, Kellmann (2001) used the REST-Q to highlight the relationship between an increase in training dose and increased stress and decreased recovery in rowers. But as these athletes were attending a full-time training camp, external influences would have been minimised.

The two major adverse external influences my research uncovered were living away from home and playing for additional teams. The effects of living away from home could have been due to missing the structure and support associated with both the school and home environments [8, 32, 33]. The influence of non-athletes in the university environment, combined with a new-found freedom and lack of accountability for the first few months could have created a new 'perceived social norm', in which training and good dietary and sleep habits were of secondary importance to fitting in with everyone else. Dishman *et al* [8] discovered five main indicators of adherence to training programmes: training partners, social support, time and opportunities, self-efficacy, and perceived vulnerability. While players at university had plenty of time and opportunities to train and play, as well as access to training partners, their recovery habits were poor, with too little quality rest, inadequate diet and a poor support structure. This led to inconsistent or deteriorating performances that could result in burnout.

Players living at home, either studying for A levels or in full time employment, had less time and opportunity to train, but generally had better social support and recovery habits, which led to more consistent playing patterns throughout the season. Despite their work pressures, players living at home tended to have better strategies for coping with stress than those at university, who had poorer social support and inadequate recovery

'Players living at home, either studying for A levels or in full time employment, had less time and opportunity to train, but generally had better social support and recovery habits, which led to more consistent playing patterns throughout the season'

strategies. These latter players appeared to be under-recovered rather than overtrained.

Playing for additional teams put the athletes under physical and mental pressure. The inability to recover properly between one match and the next led to a decline in fitness and an inability to shake off niggling injuries, while the inability to say no to coaches at either university, school or club led to an increase in stress, which has been shown to affect overall performance (34).

Whilst the REST-Q did not highlight the causes of inadequate performance, it did pick out players who had poor recovery routines and those who were suffering from stress. These two factors were not always concurrent, reinforcing the view that they are different parts of a process leading to underperformance (39). This enabled the coach to have more in depth conversations with the players and to a greater understanding of the motivation and habits of each player. Before using this tool, the coach may not have looked beyond effort or a run of bad form to discern the cause of a change in performance.

However, the use of the REST-Q at intervals of 6-8 weeks did sometimes lead to players being overlooked when symptoms of overreaching appeared between tests, while the logistics of testing a total of 81 players, inputting and analysing the data meant that a quick response was not always available to individual players. Also, the exercise only picked out those players whose profiles changed significantly between tests were highlighted, which meant that some players on the road to UPS were overlooked. The REST-Q is not a substitute for good communication between the coach and his individual players. But we have found it to be very useful for analysing each player and feeding back information which might be affecting performances as quickly as possible to players and coaches.

With one season of players' histories available and a greater understanding of the areas to be monitored, comparisons have been more accurate in the current season. After identifying the main areas of concern, several changes have been made. I as conditioning coach have taken responsibility for educating players, parents and coaching staff on the need for a balance between training and recovery. An eight -week training macrocycle has been put in place, comprising two four-week training blocks, with the last week of each block being a recovery week.

Testing, including the use of the REST-Q, takes place on completion of the second recovery week. Players who have shown significant changes in their REST-Q scores will be recommended to see their doctors to eliminate the possibility of clinical illness. Many of the symptoms of UPS are similar to that of depression [35], so it is important that the Doctor has some knowledge of the syndrome. One case of UPS was diagnosed, and the player in question was rested for four weeks, then eased back into training. He is currently playing well.

A consensus has been reached among the coaching staff that new university students need more support than they received last season, particularly to improving their self-regulation, which may have been largely dependent on parental support previously.

‘Many of the symptoms of UPS are similar to that of depression, so it is important that the Doctor has some knowledge of the syndrome’

Meetings are regularly held with all players to deal with injuries, selection issues and other problems, an approach which has been shown to be useful in alleviating stress [36]. In the previous season, players who got injured did not always continue their rehabilitation or stopped attending training sessions for 5-6 weeks.

The coaching staff have realised that they are as important as physiotherapists to injured players and now play a more active role in communicating with them. This approach has been shown to help restore athletes' confidence and aid their successful rehabilitation [36].

Our hope is that planning the season's training in conjunction with the players' individual training, incorporating a regular recovery week and educating the players on how to deal with stressful situations will not only help them train harder butt also recover more efficiently. We will continue to use the REST-Q alongside physical testing and subjective performance analysis to monitor the success of the training cycle.

With the coaches now considerably more aware of the importance of recovery and the risks of the stress some of the players face, it is our hope that the incidence of underperformance and burnout will be greatly reduced.

James Marshall

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WHAT THE SCIENTISTS SAY

Reports on recent endurance-related studies by Isabel Walker and Nick Grantham

Exercise and recovery in rugby players

The addition of low intensity exercise to the rest period after a rugby match does not hinder physiological recovery and may significantly enhance psychological recovery, according to a small-scale study from Japan.

The subjects of the study were 15 members of one of the top Japanese collegiate rugby football teams. All played rugby for 80 minutes, with an interval of 10 minutes, after which their team won the match 52:12. They were then randomly assigned to two different post-match rest regimens:

- Seven subjects (four forwards and three backs) were assigned to 'complete rest', *ie* no exercise at all
- Eight subjects (four forwards and four backs) performed low intensity exercise in water for one hour during the rest period.

Players were examined just before the match and one and two days later. Blood biochemistry and neutrophil function were measured as markers of their physiological condition. (Neutrophils are white blood cells that play an important role in immune defence.) Scores on the Profile of Mood States (POMS) scale were examined to evaluate psychological condition.

Immediately after the match, muscle damage, decreases in neutrophil functions and mental fatigue were observed in both groups. Muscle damage and neutrophil functions recovered with time almost equally in the two groups, but the POMS scores were significantly decreased in subjects in the low intensity exercise group.

The researchers acknowledge that their study had limitations: it used a small sample, in which backwards and forwards could not be compared with each other; it studied only one game and was therefore not able to measure the physiological and psychological consequences of being on the losing side; and the post-match observation period was quite short.

Nevertheless, they conclude: 'Rugby matches impose both physiological and psychological stress on players. The addition of low intensity exercise to the rest period did not adversely affect physiological recovery and had a significantly beneficial effect on psychological recovery by enhancing relaxation.'
Br J Sports Med 2004, 38:436-440

Does Ibuprofen reduce the painful effects of delayed-onset muscle soreness?

A recent study carried out in Greece lends support to the use of Ibuprofen as a method for reducing the painful effects of delayed-onset muscle soreness (DOMS) that often beset athletes following an intense training session. Nineteen subjects completed the trial which took place over a three-day period. On the first day each subject completed a 1RM strength test on the hamstrings using a universal leg curl machine.

Once an individual 1RM had been established the scientists set about inflicting muscle damage into the hamstring group. Each subject completed six sets of 10 eccentric actions (eccentric work has been shown to induce greater levels of muscle damage compared to concentric work) with a resistance of 100% of the maximal concentric strength (1RM) using the same universal leg curl machine. Each repetition lasted 10 seconds with a 10-second rest between each repetition. At the end of the exercise nine subjects were given Ibuprofen (400mg every eight hours throughout the following 48-hour period) while the other 10 subjects were given a placebo.

How they tested the muscles

A variety of measures were taken to establish the effectiveness of the administration of Ibuprofen:

- Muscle soreness was established (before, 24 and 48 hours after the bout of eccentric exercise) using a questionnaire, with each subject rating the soreness experienced during active movements on a scale of 1-10.

- Knee flexion range of motion (ROM) was determined using a goniometer; three measures were taken and the average value reported.
- Maximal concentric strength was established using a universal leg-curl machine.
- Vertical jump performance was assessed using an Ergojump platform which recorded flight time and calculated jump height.
- Blood profiles were taken at four, six, 24 and 48 hours after the bout of eccentric exercise.
- Creatine Kinase (CK) (indirect marker of muscle damage) and white blood cell count (linked to production of oedema in the damaged muscle, providing a mechanical stimulus for pain receptors leading to the sensation of DOMS) were measured.

The result

The study revealed that, after an intense bout of eccentric exercise, administration of Ibuprofen decreased the perception of muscle soreness and CK activity. As expected, levels of muscle soreness increased significantly following the bout of eccentric activity. However, the Ibuprofen group experienced lower levels of muscle soreness compared to the placebo group at 24 and 48 hours. Significant increases in CK were demonstrated in both groups. The placebo groups CK levels continued to rise through-out the 48-hour period while the Ibuprofen groups CK levels peaked at 24 hours and then started to decrease at 48 hours. The post-exercise response of the white blood cells was similar in both groups.

Despite a decrease in the perception of pain and reduced levels of the markers associated with muscle damage, the research team was unable to establish any performance benefits resulting from the administration of Ibuprofen. Muscular performance of the hamstrings (maximal strength, knee flexion ROM and vertical jump performance) decreased following the eccentric-exercise session. Ibuprofen administration had no effect on the level of decline. The reduction in performance post-exercise was similar for both groups.

The results of the research reveal that intake of Ibuprofen can decrease the perception of muscle soreness induced after a bout of eccentric activity but cannot assist in restoring muscle function. Athletes will be able to continue with training although their performance, at least at maximal levels, might not be as good as expected.

(Journal of Strength and Conditioning Research Vol 17 (1) 53-59)

Nick Grantham

Previous injury predicts in-season problems for rugby players

Exercise and sport participation is often promoted as a means of improving health and reducing the risk of illness. But exercise and sport undoubtedly pose their own health problems and little has been done to assess and quantify the factors that increase the risk of injury. Now New Zealand researchers have taken a lead on such an exercise, prompted by the evidence that rugby is the largest contributor to sports injury costs borne by the country's mandatory injury compensation scheme.

The New Zealand Rugby Injury and Performance Project (RIPP) was undertaken to examine a wide range of extrinsic (to do with the sport) and intrinsic (to do with the player) factors thought to be linked with rugby injury. At the beginning of the 1993 rugby season, 258 male rugby players were recruited into the study through rugby clubs and secondary school. After comprehensive anthropometric and fitness assessment, they were followed closely through the season to track their participation, their injury incidence rates and the proportion of the season lost through injury – the latter being a key measure of severity.

In terms of injury incidence, the key risk factors to emerge from the final analysis were:

- grade – with players at the highest level sustaining the highest rate of injuries
- previous injury experience – with players who reported a pre-season injury having a higher injury incidence rate than those who had no injuries during the previous season.

For time lost through injury, the key risk factors were:

- playing position – with midfield backs missing 21% of the season on average, compared with just 7% for inside backs
- body mass index (BMI) – with very slight players at greatest risk
- strenuous physical activity for more than 39 hours per week
- previous injury
- cigarette smoking status – with both ex-smokers and current smokers at increased risk.

The key message from the researchers focuses on the role of previous injury. 'The results of the analysis of previous injury indicate that players who entered the season carrying an injury placed themselves at higher risk of both missing play and sustaining a higher injury incidence rate through the following season,' they point out.

'Thus returning to play before full recovery from injury may also place players who were otherwise fit at a higher risk of further injury. To reduce their risk of sustaining injuries and missing playing time, players should enter the rugby season injury free.'

Br J Sports Med 2001 Jun 35(3), pp157-166

Isabel Walker

Can creatine work for younger performers?

Creatine is extremely popular with adult athletes, many of whom believe it gives them a performance-enhancing boost. But does creatine offer any ergogenic benefits to young performers? A group of sports scientists based at the University of San Francisco have examined all the available research in a bid to establish a rationale for creatine supplementation in child and adolescent athletes.

The main argument for the use of creatine in this age group is that children struggle to use and reproduce creatine phosphate and ATP effectively, so limiting their ability to regenerate high-energy phosphates during exercise. Creatine supplementation, it is suggested, could help children improve their performances in high-intensity exercise. However, there is a lack of compelling evidence to support this theory and a number of arguments against it. Here are the main ones:

- children are not mini adults and have a greater reliance on aerobic rather than anaerobic metabolism. If the goal of creatine supplementation is to enhance anaerobic metabolism, it would therefore have a limited effect;
- adolescents appear able to regenerate high-energy phosphates during high-intensity exercise and improve performance in short-term high-intensity exercise through training, therefore reducing the need for supplementation;
- performance during growth tends to be limited by mechanical factors rather than by the relative contribution of the aerobic and anaerobic energy systems;
- the long-term safety and efficacy of creatine supplementation has not been established in children and adolescents.

However, the arguments for and against creatine supplementation in children and adolescents are derived from an extremely limited number of studies. A significant amount of research is needed to enable us to fully understand the metabolic changes that accompany growth before we can even start to consider the efficacy and safety of creatine supplementation. With this in mind the research team concluded that there was insufficient evidence to support the use of creatine by children and adolescents.

The Journal of Strength and Conditioning Research, vol 15, no 4, 524-528

Nick Grantham

Notes

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