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AN HOLISTIC APPROACH TO RECOVERY FROM AN OVERUSE INJURY IN A GAMES PLAYER

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ABSTRACT

The management of a chronic injury to an international squash player is described. By good physiotherapeutic management and the involvement of an interdisciplinary team it was possible to make gains in the non-playing period. The rehabilitation period included physiological assessment on the basis of which a training programme was devised with target goals set throughout the period. Mental rehearsal of skills was included at all stages. As a result, the player's confidence was maintained and fitness levels improved. The long term prognosis has been good. The model could be applied to any sports injury.

INTRODUCTION

Injury, however small, can be critical to a top level games player. Almost every week there are tournaments or league matches which count towards championship success or national selection and it is never easy to rest injuries. Players will often continue to play with a nagging tendon inflammation or muscle injury, rather than take recommended rest. In the management of any sports injury consideration must be given to the total profile of the player through this traumatic period.

This case study describes the management of an injury in a female squash player suffering from medial epicondylitis. The condition can in many cases be difficult to treat successfully, as witnessed by the variety of treatments suggested for its cure. The claim that time alone is the only remedy, although to some extent true, is rather negative.

In most cases the onset of the complaint is insidious and the degree of discomfort prevents normal function. The aetiology includes a combination of mal-use and over-use. If recovery is achieved, recurrence is likely. Because normal function is prevented and a certain cure cannot be promised this is potentially a very frustrating time for a games' player. The most positive way forward in these circumstances is to ensure that as many gains as possible can be achieved during compulsory absence from competition.

The overall management consisted of three components, namely physiotherapy, exercise physiology and sport psychology.

MANAGEMENT OF THE INJURY: A CHRONOLOGICAL ACCOUNT

DAYS 1-14

Physiotherapy

As part of the initial examination the season was reviewed to identify the matches which could be missed (without jeopardising current ranking) and those which could remain as a goal for recovery. Careful questioning about the behaviour of pain during play identified that most discomfort was experienced on the forehand drive especially when the contact of ball and racquet occurred behind the leading foot.

It was agreed that this should be corrected in future skills practice ensuring that contact of ball and racket would occur at or in front of the leading foot thus reducing the stress on the forearm flexor muscle group. Initially this would be restricted to mental rehearsal of skills (vida infra), since all racquet handling was prohibited during this period.

Mechanical therapy was applied and the positive findings from the initial examination were monitored (Table I).

TABLE I

Physiotherapy examination findings

Distribution of Pain		Medial epicondyle of the humerus (1)	
Physical Examination			
		Passive	**Static Resisted**
Elbow	Flexion	—	Pain (1)
	Abduction in extension	Pain (1)	—
	Abduction in 15° flexion	Pain (1)	—
	Extension with wrist and Finger extension	Pain (1)	—
Wrist	Flexion	—	Pain (1)
	Radial deviation	—	Pain (1)
	Ulnar deviation	—	Pain (1)
Strength	Wrist flexion, ulnar and radial deviation were reduced by 50% of the other limb as measured using a Penny & Giles Myometer.		
Shoulder and Cervical Spine	Both were found to be normal.		
Current History	The condition worsened over a four week period and any activity involving gripping was painful.		
Previous History	The same condition was present two years ago. This resolved when a change in circumstances reduced the intensity of play. Full competitive squash started 4 months previous to the onset of symptoms.		

Three major aims were set for this phase of rehabilitation, namely: to assess psychological parameter, to design an appropriate training programme and to create a programme of mental rehearsal skills and set fitness goals.

(a) Assessment of Physiological Parameters

During a game of squash, male players have been shown to elevate their heart rates to 80-85% of their predicted

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maximum for a considerable proportion of the game (Docherty and Howe, 1978). Initial observations would agree with this observation in international female squash players (Nimmo et al, unpublished). Exercise of this intensity therefore necessitates contributions from both aerobic and anaerobic metabolism. In order to maintain the level of performance dictated by the game, a considerable level of strength and more specifically, strength endurance must be attained. The effectiveness of all these parameters can be improved by maximising the ratio of lean body mass to fat and by maintaining adequate flexibility. Physiological tests were carried out in these relevant areas 2 days after the last competitive squash match.

METHODS

Maximum oxygen consumption ($\dot{V}O_2$ max) was assessed on a motor driven treadmill using an incremental exercise test beginning at 10 km.hr^{-1} and increasing by 2 km every 2 mins. Minute by minute gas analysis was carried out using a Morgan Exercise Test System. The subject was considered to have reached a true $\dot{V}O_2$ max when she satisfied two of the criteria detailed by Fairshter et al (1983).

The ventilatory inflection point (Brooks and Fahey, 1984) was estimated from the gas exchange as the $\dot{V}O_2$ whereas $\dot{V}E.\dot{V}O_2^{-1}$ began systematically to increase, without a concomitant increase in $\dot{V}E.\dot{V}CO_2^{-1}$. This was carried out by five independent individuals and the mean value taken. The range of values on Test 1 was 38.9-40.3 and on Test 2, 36.4-37.3 ml.kg^{-1}min^{-1}.

As $\dot{V}O_2$ max may stagnate in a training process lasting several months, whilst endurance capacity continues to improve (Åstrand and Rodahl, 1970), the onset of blood lactate (OBLA) was also determined during treadmill running. Fingertip blood was sampled (20 μl) immediately at the end of a 4 min exercise period at 12, 14 and 16 km.hr^{-1}. Lactate was assayed fluorimetrically, based on the method of Olsen (1972). The exercise intensity at which a concentration of 4 mmol.l^{-1} occurred was estimated by interpolation from the exercise intensity lactate curve (Jacobs, 1981). At this concentration it has been reported that an athlete should be able to exercise for approximately 30 mins. It may therefore serve as a practical exercise training index (Kinderman et al, 1979).

Strength was measured isometrically as the maximum voluntary contraction (MVC) of the knee extensor group with both knee and hip joints flexed at a right angle. The apparatus used to measure force has previously been described (McLean et al, 1985) and is based upon the principles of Tornvall (1963). Measurements were carried out on the dominant leg and precautions were followed in an attempt to ensure that a true value for the voluntary maximum isometric force was obtained (Edwards et al, 1977). The subject was allowed 4 attempts; the best performance was recorded.

After determination of the MVC the subject sustained to fatigue contractions at forces of 80%, 50% and 20% of MVC with a 5 min rest between. At forces greater than 15-20% of MVC muscle blood flow is restricted by the raised intramuscular pressure and is inadequate to allow energy to be derived from oxidative metabolism (Edwards and Wiles, 1981). Endurance capacity above 20% MVC is short but the factors which limit it are not clear. The ability to maintain force at a given percentage of MVC does not appear to be related to the contractile components of muscle (Maughan et al, 1985) but may be related to the buffering capacity. Sahlin and Henriksson (1984) have reported that the buffer capacity of the muscle quadriceps femoris is higher in trained individuals engaged in activities involving anaerobic work. McKenzie et al (1983) also found a good correlation between buffer capacity and the ability to perform anaerobic work. 50% and 20% MVC have been shown to correlate well with $\dot{V}O_2$ max (Harmon et al, 1984), a finding which is consistent with the suggestion that the metabolic characteristics of the muscle may influence the ability to perform sustained isometric contractions at forces of 20-50% of MVC. It was hoped that by measuring isometric endurance it would be possible to gain some insight into muscle metabolism by a non-invasive technique.

Body weight, height and body fat were measured on both occasions. Body fat was estimated from skinfold measurements (Durnin and Rahaman, 1967). The coefficient of variation for the method calculated from the mm measurement was 1.7%. This made an insignificant error when the values were expressed as % body fat. Flexibility was measured by "sit and reach" (Wells and Dillon, 1952). The best result of 3 attempts, after full warm-up, was recorded.

RESULTS

Results of the first tests (2 days after competition) are presented in Table II.

TABLE II

Results of the physiological assessment at the onset of the injury period (Test 1) and just prior to entering back into competition (Test 2)

	Test 1	Test 2
$\dot{V}O_2$ (ml.kg^{-1}min^{-1}) [Time to max (min)]	51.3 [9]	51.5 [9]
$\dot{V}O_2$ at $\dot{V}_E$ inflection (ml.kg^{-1}min^{-1})	37.1	39.4
OBLA (km.hr^{-1})	6.8	6.4
OBLA (% of $\dot{V}O_2$ max)	92.0	100.0
MVC (N)	500.0	613.0
Holding time at 80% MVC (sec)	24.0	30.0
Holding time at 50% MVC (sec)	61.0	77.0
Holding time at 20% MVC (sec)	203.0	216.0
Body Fat (%)	21.8	21.8
Body weight (kg)	60.2	60.2
Flexibility (cm)	10.5	12.5

(b) Design of an Appropriate Training Programme

After Test 1, a training programme was devised in consultation with the player for the subsequent off-court period. It was evident from the results of the physiological tests that the ability to ork aerobically was of a very high level. In fact OBLA was not reached until 92% of $\dot{V}O_2$ max, above the reported norm of 60% (Brooks and Fahey, 1984). It has, however, also been reported that some athletes never reach 4 mmol.l^{-1} blood lactate concentration and it has been proposed that 2 mmol.l^{-1} might be a more appropriate criterion value for OBLA (Davis et al, 1983). However, this has not been related to practical training levels. The high level of aerobic capacity attained by the player was a reflection of the previous training, which had a large component devoted to steady runs.

MVC was above norms reported for untrained females (485N) (Harmon et al, 1984). However comparison with other international female squash players (Nimmo et al, unpublished data) indicated that this area was deficient by approximately 10%. This was also true of all the strength endurance tests. It therefore became an area to highlight in the training schedule. Practically, in an attempt to improve strength, the number of weights sessions was increased (avoiding movements involving wrist and elbow flexion) and included 45 sec runs (approx. 300 m) with 1 min recoveries. In order to accommodate the player this was sometimes substituted by exercise on a cycle ergometer. It was important to maintain the aerobic capacity and the training was maximised by running at OBLA for 30 min or by using fartleck sessions.

The change in training programme was quite dramatic and it was therefore important to try to alleviate latent stiffness and soreness. For this reason mobility was an integral part of the training schedule. Competition edge was maintained by entering two 10 km races which were aimed at running at OBLA or less. These were completed in times of 45 mins 6 secs and 43 mins 58 secs. As the group was aware of the problems of a change in lifestyle affecting diet and possible body composition, advice was given by a dietician.

(c) Short Term Sport Psychology Programme

The athlete in this case study had two major concerns. Firstly, was she sufficiently motivated to undertake extra training during the period of injury, and secondly, would she lose much of her skill through not being able to play?

These two needs invited the application of two skills which are common to most sport psychology programmes.

Goal Setting

Goal setting is a technique which helps maintain motivation and clarify what a person is trying to achieve (Syer and Connolly, 1984). This particular period (DAYS 1-14) was, by instruction from the physiotherapist, free from racquet handling and therefore allowed more time to be devoted to fitness training than the normal competitive season. Short term goals were set each week in consultation with the physiotherapist. These short term goals provided the detail of what was expected in any one week. In this way motivation was maintained and the athlete could see progress in fitness and in readiness for competition. Training goals were set as follows:– in each week; three sessions of weight training, three sessions of running (or equivalent) at OBLA, two sessions of mobility and two sessions of general conditioning.

Mental Rehearsal

Mental rehearsal is one of a set of skills which sports psychologists have devised to assist athletes in preparation and performance and is commonly used to help athletes learn new skills or augment physical practice. In this case it was used to assist the player in the phase of recovery in which no racquet skills could be practised. It is a common fear that a great deal of skill reduction will occur during a period of enforced rest. Mentally rehearsing the skills in question keeps the player involved in skill work. The player set herself the goal of rehearsing mentally for ten mins each day. To do this she first of all relaxed and then focused her mind on a particular squash drill with which she was familiar. The imaging involved all senses — mentally seeing the ball, feeling the correct court movement and hearing the racquet strike the ball. It should be noted that both relaxation and mental rehearsal are skills which require practice (Harris and Harris, 1984).

Physiotherapy

The trend throughout the 14 days was that all movements, although painful, increased in force. Pain became more latent in quality and the number of painful movements was reduced. By the 14th day only slight pain was elicited on maximally resisted wrist flexion.

DAYS 15-25

Physiotherapy

At this stage mechanical therapy stopped, and on-court skills practice commenced. Initially the duration of each session was 20 mins and its effect was monitored over a 24 hour period before the vigour of on-court skills was progressed. Overload occurred once on day 19 due to a combination of activities other than squash. Resolution occurred over 48 hours.

On-court practice was limited to 20 mins of solo drills. Practice was only allowed on alternative days and a fast ball was used to prevent overload. Playing technique was also observed. The player reported that the pain was most acute if the ball was hit late on the forehand side. A change of technique was discussed to assist the player in hitting the ball more consistently ahead of the forward foot and became the focus for mental rehearsal (every day) and court practice (alternate days).

Fitness Goals

From day 15 onwards weight training and OBLA running were reduced to twice each week. Mobility and general conditioning exercises were maintained at the previous level (2 sessions per week).

Mental Rehearsal

In the early phase of re-introduction of racquet work, the player reported lack of confidence in strokes played on the forehand side (which had in the past caused most pain to the injured elbow). Mental rehearsal was altered to include imaging the forehand shots without pain. At the same time work on the forehand side was strictly limited to a number of minutes set by the physiotherapist. Gradually the player was able to play the forehand shots with greater power as confidence increased.

DAYS 26-29

Physiotherapy

To avoid excessive loading the player began competitive squash against opponents of lesser ability. Occasional twinges were experienced when playing the forehand drive if the ball was contacted behind the leading foot. On-court work had progressed gradually from solo work to partner work and from 20 to 60 mins each session. The principle of restricting play to alternate days was maintained. Games against less skilful players were arranged to allow practice without competitive pressure. Eventually the player reported that she felt that the injury had sufficiently recovered to return to competitive matches.

Fitness Goals

The pattern for this phase was two sessions of weight training, one session of mobility and one session of general conditioning each week. The skills practised on court (60 mins) were demanding enough to constitute a training load.

Mental Rehearsal

Mental rehearsal focussed on game plans at this stage.

PSYCHOLOGICAL ASSESSMENT PRIOR TO RETURN TO FULL COMPETITION

In general the player reported that the fear of losing skill during the injury period was offset by the short term sport psychology programme. It is difficult to make objective measures of such feeling, but the Competitive Sport Anxiety Questionnaire does allow some quantification of anxieties. The scale measure pre-competition anxiety in three dimensions, namely, cognitive, somatic and self-confidence. The player was asked to complete this questionnaire prior to several matches before resting the injury and in the first few matches after rehabilitation. In general, despite a five week lay-off from competition, there was no decrease in confidence and no increase in anxiety.

Physiological Assessment

Two days prior to returning to full competition a physiological assessment was carried out. The protocol used was identical to that used at the onset of rehabilitation. Testing session 2 (Table II) showed that the training had been successful in its objectives in that aerobic capacity, flexibility and body composition had been maintained or slightly improved and the strength, strength endurance factors improved.

Conclusion

Return to full competition occurred on the 31st day. The physiological and psychological components of the management proved to be successful in making gains during a period of enforced absence from playing squash. Success for the overall management can also be claimed in that the injury did not recur during the remaining 8 months of the competitive sqush season. However, only the foundations for prevention of recurrence were formed during the period of rehabilitation described in this paper. Continued strict self-discipline to apply the basic rules of management of an overuse injury was required for the remainder of the season.

The rules were identified as:

1. Maintenance of good technique.
2. The avoidance of overload — (a) Never playing more than once in a day; (b) not playing on consecutive days. The demands of tournament play are excessive initially and are the only exception to this rule. There should be no racquet handling for two or three days after a tournament.
3. The avoidance of sudden increases in the duration of loading produced by training or playing.
4. The affected muscle group must be fully lengthened passively every day. The player identified this as the most beneficial prophylactic measure 8 months after returning to play.

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