High-intensity specific intermittent training (SIT) in the preparation of the tennis player

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Summary

The ability to perform actions repeatedly at high speed has a very clear relationship with the manifestation of endurance in sports such as tennis. The training in which there are interspersed periods of work of high intensity with others of recovery turns out to be a type of training more specific than continuous type. Within the interval systems, the intermittent training of high intensity (Intermittent training-IT) suppose a specially suitable method to improve aerobic and anaerobic endurance. Through this training will we be able to act on the adaptations related to the recovery between points, which has a direct relationship with the performance in the matches. In addition, the high intensity and low volume of training allows an optimal synergy with qualities such as explosive force and speed, so important in sports in which periods of work and recovery are interspersed. However, tennis has some specific characteristics that differentiate it from other intermittent sports such as brief recoveries and techniques of displacement and hitting the ball, so the use of intermittent training using typical movements of tennis (Specific Intermittent Training-SIT) is an especially suitable system. The choice of the intensity of the effort of the relationship between work and recovery times, and the degree of skill of the player are determining factors when carrying out specific training at high intensity.

In this review we try to show the interest of SIT training as a basic tool to encourage the improvements of the different factors of performance in tennis players.

Key words: Tennis. Intermittent training. Specific training. SIT. Endurance. Recovery. Explosive strength. Elastic strength. Speed.

El entrenamiento intermitente específico de alta intensidad en la preparación del jugador de tenis

Resumen

La capacidad de realizar acciones a alta velocidad de forma repetida tiene una relación muy clara con la manifestación de la resistencia en deportes como el tenis. El entrenamiento en el que se intercalan periodos de trabajo de alta intensidad con otros de recuperación resulta un tipo de entrenamiento más específico que el de tipo continuo. Dentro de los sistemas interválicos, los entrenamientos intermitentes de alta intensidad (Intermittent Training-IT) suponen un método especialmente adecuado para mejorar la resistencia aeróbica y anaeróbica. Mediante este entrenamiento se podrá actuar sobre las adaptaciones relacionadas con la recuperación entre puntos, lo que tiene una relación directa con el rendimiento en los partidos. Además, la alta intensidad y el bajo volumen de entrenamiento permite una óptima sinergia con cualidades como la fuerza explosiva y la velocidad, tan importantes en deportes en los que se intercalan periodos de trabajo y recuperación. Sin embargo, el tenis tiene unas características específicas que lo diferencian de otros deportes intermitentes, como son las recuperaciones breves, y la técnica de desplazamiento y de golpeo de la pelota, por lo que la utilización del entrenamiento intermitente usando movimientos propios del tenis (Specific Intermittent Training-SIT), es un sistema especialmente adecuado. La elección de la intensidad del esfuerzo, de la relación entre tiempos de trabajo y recuperación y el grado de destreza del jugador, son factores determinantes a la hora de realizar entrenamientos específicos a alta intensidad.

En esta revisión se intenta mostrar el interés del entrenamiento SIT como herramienta básica para potenciar las mejoras de los diferentes factores del rendimiento en tenistas.


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Introduction

In the course of a tennis match, a series of actions are performed at different intensities and durations, with changes of pace, turns and direction. Therefore, a variety of unique kinetic and kinematic actions occur in this sport, though there are similarities with other intermittent sports. However, the type of movement is also specific, with constant frontal, sideways and cross-step movements taking place, with variations in the length of strides to align distances with the ball, and the stable execution of hits, whilst simultaneously combining different tactical decisions related to fatigue, confidence and competitive stress.

These characteristics determine the aspects to train, and how the trainer should focus the tennis player’s preparation. Tennis performance does not just depend on resistance, rather also on other factors such as explosive strength, speed, agility of movement, technique, tactics and mental factors. Yet all of these factors occur together and with great complexity, and are therefore interrelated. To assess the level of our players, as well as to prepare them, it would be useful to create multifactorial systems specific to tennis1.

One of the most important characteristics in the manifestation of resistance, and in general, sporting performance in intermittent game sports, is the ability to repeat sprints2. In tennis, it is a question of repeating specific actions of the game at high intensity, and not just performing linear movements at maximum speed. To achieve the best results in this aspect, systems should be found that adapt most optimally to achieving this objective1.

This review aims to analyse the importance of specific intermittent training (SIT) as a basic tool to boost improvements in performance of tennis players.

Methodology

To create this descriptive review article, a literary search was performed using various documentary sources to locate the documents. Searches were carried out on the databases of PubMed (NLM), Cochrane Library, Scopus, Scielo, Embase and Sport Discus, as well as on the Google Academic search engine.

The search was based on articles published between January 2000 and March 2018. The key words used to perform the review (isolated or combined), were: tennis, intermittent training, specific training, resistance and recovery.

When selecting the articles included in the review, factors considered were: the methodology, the quality of the research, and if the studies were performed on humans. Any article that was not directly related to the study object, any based on personal opinion and any that did not include valid measurement instruments, were excluded.

Specificity in tennis

Knowing the work and recovery time involved in tennis is an important factor when preparing players. Recovery time between points is set at 20 seconds for Grand Slam tournaments, and at 25 seconds for other tournaments in the professional circuit. However, often the time available is not used, generally being shorter and sometimes even closer to just 10 seconds3. Regarding point duration time, by analysing Grand Slam tournaments O’Donoghue & Ingram4 discovered average times of between 6.3 and 7.7 seconds. The work: recovery ratio (WR) oscillates between 1:2 and 1:4 on average5,6, establishing a real play time of 20-26%7. However, often efforts are made with an above-average duration, and work-recovery ratios of 1:1 and 1:2 when long points lasting over 20 seconds are played. This is particularly interesting because the dynamics of the game, the duration of the work and recovery times, and the ratio between work and recovery, will substantially alter the magnitude of the load borne by the tennis players5.

The intensity of play and the duration of the efforts determine the type of metabolism used. When points are very short and explosive, it is at the expense of ATP and phosphocreatine, with an aerobic recovery process during breaks, and with moderate lactate concentration clarification below 4 mmol. On other occasions, various long and intense points can occur, which cause a greater demand for oxygen consumption and for the glycolytic pathway, with higher levels of lactate production8.

Break and work times, as well as the movement types, enable higher levels of strength to be produced in a short space of time, and the manifestation of explosive strength in the game’s actions is a decisive factor in performance, and the capacity to repeat this explosive strength during the match is fundamental during play. The production of intermittent strength can generate fatigue on a central level, as well as in processes of excitation and contraction on a muscle fibre level, which can be reflected in losses of performance during the development of tennis matches9.

This fatigue can be related to the rapid call for strength, as deterioration has been observed after stretching-shortening cycle exercises10, or as a consequence of the frequent call for eccentric-type actions11,12. The displacements are not linear, and they present changes of direction, turns and speed, with special coordinative and neuromuscular patterns13. Continuous slowing-down and direction changing actions can lead to fatigue. In recent years, there have been hypotheses regarding a type of fatigue related to the demand for these kinds of eccentric actions, and the existence of a capacity to improve tolerance to this kind of tension in a specific way14.

We must add that tennis has a high technical, tactical and psychological component, entailing the need to give preparation a complex focus that covers - on many occasions simultaneously - all performance factors. Within this focus, it is worth remembering that a large part of the movements are made laterally or with a crossed step, and there are continuous acceleration and deceleration actions occurring in a complex way, more often than not at the same time as the hits and tactical decisions15,16.

Intermittent training characteristics

Despite the importance of having suitable maximum oxygen consumption values and a high lactate threshold17, for optimum recovery between points, training sessions and matches18, some studies have not found a direct relationship between the capacity to perform repeated...
sprints or specific explosive actions within intermittent sports and the maximum oxygen consumption, whilst they have found a relationship between explosive strength and jumping capacity\(^\text{20,21}\). A clear relationship has been observed between explosive strength levels with running efficiency and the ability to repeat high intensity actions\(^\text{22,23}\). In turn, the characteristics of the game require a manifestation of explosive and specific strength\(^\text{20,22}\). Therefore, improvements should be made to neuromuscular characteristics to increase the performance of a specific action, and also so that these actions can be repeated over a lengthy period\(^\text{23}\). The systems that provide aerobic and anaerobic improvements simultaneously achieve positive synergies with the manifestation of strength and speed, making them particularly important in preparing tennis players (Table 1).

Continuous training has occasionally revealed a negative effect on the appearance of explosive strength and speed, even when used concurrently with strength training\(^\text{24}\). Losses have also been observed in the capacity to apply strength and power after high-intensity interval training (HIIT), for example with work and recovery times of 4 minutes:4 minutes\(^\text{25}\). However, the correct handling of the intensity and duration of the effort can significantly modify this effect\(^\text{31}\).

In order to respect the tennis-specific characteristics, training systems must be used that intersperse work phases with high intensity and, sometimes, variable intensity, with other passive rest phases, which is what occurs during play, acting on the ATP and phosphocreatine regeneration processes. From a metabolic perspective, intermittent resistance training (IT) fulfils the requisites of interspersing work with

Table 1. Most relevant studies about intermittent training.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Sample (n)</th>
<th>Protocol</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Castagna et al. 2004(^\text{28})</td>
<td>16 basketball players</td>
<td>10x30 m sprint. 30 s of recovery.</td>
<td>No relationship was observed between VO(_{2\text{max}}) and sprint repetitions.</td>
</tr>
<tr>
<td>Stojanovic et al. 2012(^\text{22})</td>
<td>24 basketball players</td>
<td>10x30 m. Measurement of performance loss</td>
<td>No relationship was observed between VO(_{2\max,x}) and sprint repetitions. Relationship found with CMJ.</td>
</tr>
<tr>
<td>Denadai et al. 2017(^\text{24})</td>
<td>Review</td>
<td>16 studies on concurrent and resistance training</td>
<td>Positive relationship between explosive strength training and the ability to repeat sprints.</td>
</tr>
<tr>
<td>Mikkola et al. 2012(^\text{2})</td>
<td>36 untrained males (16 strength, 11 resistance, 11 concurrent)</td>
<td>21 weeks Strength, resistance and concurrent training</td>
<td>Negative effect of the continuous and concurrent training on explosive strength.</td>
</tr>
<tr>
<td>Wilson et al. 2012(^\text{20})</td>
<td>Review</td>
<td>21 studies on concurrent and resistance training</td>
<td>The mode, volume, intensity and work-recovery relationship modify explosive strength.</td>
</tr>
<tr>
<td>Dupont et al. 2004(^\text{21})</td>
<td>22 football players</td>
<td>10 weeks 12-15x15 s 15 s recovery 12-15x40 m 30 s recovery</td>
<td>Micro-intervals of recovery improve intensity, speed and resistance.</td>
</tr>
<tr>
<td>Juel et al. 2004(^\text{2})</td>
<td>6 subjects</td>
<td>7 weeks 15x1 min / 150% VO(_{2\text{max}}) They trained one leg with extensions compared to contralateral exercises</td>
<td>Avoids loss of speed, improving resistance and tolerance to acidity.</td>
</tr>
<tr>
<td>Belfry. 2010(^\text{22})</td>
<td>Different samples: 7 males 8 males 14 males</td>
<td>10 s high-intensity and 5 s low-intensity protocols</td>
<td>Increases the recruitment of type II fibres, improving their aerobic capacity.</td>
</tr>
<tr>
<td>Rozenek et al. 2007(^\text{24})</td>
<td>12 males</td>
<td>15:15-s / 100:50% VO(_{2\text{max}})</td>
<td>Ratio 2:1 mixed work. Ratio 4:1 anaerobic work and rapid presence of fatigue.</td>
</tr>
<tr>
<td>Bouthcer. 2011(^\text{25})</td>
<td>Review</td>
<td>Study on fat loss, physical fitness, resistance to insulin, and skeletal-muscle</td>
<td>Causes greater efficiency in the use of carbohydrates and an enhanced capacity to use fatty acids.</td>
</tr>
<tr>
<td>Gerber et al. 2014(^\text{26})</td>
<td>8 males</td>
<td>20 s / 150% VO(_{2\text{max}})</td>
<td>Greater use of fatty acids. Higher post-effort expenditure.</td>
</tr>
<tr>
<td>Helgerud et al. 2007(^\text{27})</td>
<td>24 males</td>
<td>Long distance 70% VO(_{2\max}) Continuous high intensity 15:15 s / al 90-95:70% 4.3 min / al 90-95:70%</td>
<td>Greater improvements in oxygen consumption than with continuous training with lower load volume.</td>
</tr>
<tr>
<td>Tabata et al. 1996(^\text{28})</td>
<td>7 males (continuous) 7 males (intermittent)</td>
<td>60 min / 70% VO(<em>{2\text{max}}) 7-8x20 s 170% VO(</em>{2\max}) 10 s recovery</td>
<td>Intense stimulus of aerobic and anaerobic systems by training at high intensity and low volume. Intense stimulus of aerobic and anaerobic systems by training at high intensity and low volume.</td>
</tr>
</tbody>
</table>
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recovery periods, with the option of adjusting these times to those frequently found in tennis and varying them in accordance with the training objectives.

Introducing rest periods enables greater work intensity and an effect on aerobic and anaerobic adaptations\(^ {1,2,3,4}\). IT training sessions comprise work and recovery periods of \( \leq 30 \) seconds, with a work-recovery ratio (W:R) that can be of 1:1, 1:1.5, 1:2, 1:5:1 or 2:1. Short, high-intensity intermittent work can limit or override losses in speed, particularly efficient in improving the buffer capacity of muscle acidity\(^ {15}\), whilst achieving similar or greater increases in the maximum oxygen consumption than with continuous work\(^ {21,46}\). Intermittent effort protocols with very short periods of work and recovery increase the recruitment of type II fibres, acting on their aerobic capacity\(^ {19}\) whilst allowing for improved speed at the same time\(^ {31}\).

IT training has revealed important local and peripheral improvements; meaning major increases in the oxidative capacity and muscle performance\(^ {44}\). Yet the ratio between work and recovery phases is also a decisive factor when it comes to causing different adaptations. In exercises with an intensity nearing maximum oxygen consumption, a mixed aerobic-anaerobic activation has been observed when the ratio is 2:1, compared to more anaerobic adaptations when this ratio is 4:1, with a quick onset of fatigue\(^ {34}\).

This kind of work allows for increased efficiency in the use of carbohydrates as an energy source, but also, in the past decade, it has been proven that IT and HIIT training can also increase the capacity to use fatty acids\(^ {32,35,36}\). In addition there is a greater use of fats in these high-intensity exercises during the post-effort period\(^ {46}\).

Despite observations revealing kinetics in the faster oxygen consumption when explosive actions and sprints are carried out\(^ {16}\), a delay can take place in the first repetitions or intermittent exercises within a set, with an ascending trend reflected in the heart rate\(^ {44,65}\), which is why a precise design of the sets with adequate intermittent work-recovery periods should be established for the initial phase\(^ {46,67}\).

One of the advantages of interval training is the capacity to improve oxygen consumption with much lower work volumes. Helgerud et al.\(^ {37}\) indicate that high-intensity interval training such as intermittent training (15 seconds: 15 seconds) is more effective in increasing oxygen consumption than continuous training sessions, with a lower work volume.

A lower work volume would allow for less interference with determining qualities in performance, such as explosive strength and speed\(^ {48}\). It is also particularly interesting to reduce the load volume, as tennis is a sport involving a high volume of technical and tactical work and a long and busy schedule of matches.

Therefore, applying the IT training sessions can have an intense effect on the metabolic systems in a mixed way, triggering important improvements to anaerobic and aerobic capacity\(^ {16}\) whilst preserving manifestations of strength and speed.

**Intensity-specificity relationship**

The possibility of performing more comprehensive work, with mixed resistance training encompassing speed and agility, with direct changes and turns, whilst also introducing technical, tactical and mental elements, is enormously beneficial in the quest to achieve high performance, though it is necessary to monitor the degree of intensity achieved with these kinds of session (Table 2).

Regarding the type of movement, turns and direction changes, these entail different neural and biomechanical behaviour, meaning that performance markers are specific\(^ {38,39}\). Training sessions using linear sprints do not appear to have a clear relationship with improvements in movement in terms of agility and direction changes\(^ {40}\). A positive relationship has been observed between explosive strength and performance in changing direction or turning, as well as in the ability to repeat these actions. At the same time, improvements have been made in explosive strength using intermittent training sessions with direction changes\(^ {50}\).

Various studies have observed greater intensity with higher lactate concentrations in short efforts when direction changes are included, as opposed to when they are not\(^ {41}\). At the same time, the skill required to perform turns and direction changes at high speeds is decisive in tennis performance\(^ {46}\).

Specific team-sport and fighting-sport training sessions have revealed similar or superior intensities to running\(^ {21,56-59}\). In a high-intensity HIIT-type training session (2 minute intervals of work with 90 second recovery times) revealed high intensities, similar to those seen in running, using tennis exercises\(^ {51}\). Suárez Rodríguez and Del Valle\(^ {34}\) discovered higher heart and lactate rate values in tennis-specific exercises in both IT and HIIT sessions, compared to HIIT in running.

As with running actions, the increased volume of work – increasing the number and duration of explosive actions found in intermittent sports – reduces the anaerobic glycolytic participation, though on occasions, it is accompanied by an increase in the intervention of phosphagen metabolisms\(^ {50}\).

Resistance training sessions with specific and short efforts with recovery periods and motor actions pertaining to the game, can be a suitable way of improving maximum oxygen consumption without having a negative effect on game-decisive qualities, such as strength or speed in intermittent-type sports with a high technical component\(^ {16}\). This will allow for an improvement in the ability to perform explosive actions whilst improving resistance\(^ {31,61,62}\). This type of training session offers a good response to the concurrence of strength work with improvements in resistance and speed\(^ {63}\).

One strategy that could be particularly interesting, consists in performing technical and tactical work in a situation of fatigue, as this can be decisive in final performance\(^ {15,54}\).

With exercises using actions pertaining to the game, with continuous changes of pace, turns and direction, there is a much greater demand upon the muscle-tendon system, with an intense accumulation of mechanical work, which is why work loads should be controlled carefully\(^ {35}\).

One relevant factor when choosing training sessions that respect the specific motor structure of tennis is the correct execution and the effect of fatigue upon this. As well as the athlete's physical level, other factors such as the player's level of play, moment of the season, age or perception of effort should also be considered\(^ {44}\). With regards to the Through the implementation of IT training sessions, the tennis player can achieve high performance, with a mixed approach of aerobic and anaerobic exercises, whilst preserving the key aspects of the game, such as explosive strength and speed.
subjective assessment of fatigue using the Borg Scale, a lower perception has been observed in tennis-specific exercises compared to running work using equal or lower heart rate intensity.  

Controlling the number of hits made, evolution during the exercise and maintenance of the motor efficiency registering the precision or number or errors made, could be a good strategy for keeping the training session suitable. Fatigue will cause a progressive loss of control over technical motion and hitting quality, which is why specific training sessions should keep particular control over the magnitude of the load. Controlling volume and intensity, as well as choosing a suitable relationship between the work and recovery micro-intervals, will ensure optimum technical execution throughout the different sets.

**Recovery training**

In sports in which the most important component of resistance is the capacity to repeat high-intensity actions, recovery time between play is a useful time for the body to recompose its metabolic and neuromuscular balance, or at least part of it. A good post-effort response, with a quick lowering of the heart rate, is the sign of a good adaption to specific effort, which is why suitable training targeting the specific dynamics of each sport is decisive. In SIT training, type II fibres are activated and players’ levels of explosive strength remain at more optimum levels, with a clear relationship shown between the capacity to generate high levels of strength and the capacity to recover between high-intensity sets (Table 3).

Intense 15-second exercises generate post-effort heart rate increments. Paradoxical behaviour has been observed among tennis players with post-effort elevations in heart rate when SIT training sessions are performed compared to immediate and rapid rates in running HIIT training sessions, and the immediate but slow rates in specific HIIT training, which would reiterate the importance of specificity in terms of the dynamics of work and recovery times, as well as the motor actions specific to the game.

The greater activation of type II fibres produces a superior effect over the activation of the sympathetic nervous system and deactivation of the parasympathetic system. This can explain the slower heart rate recovery in intermittent-type efforts and with technical actions that involve acceleration, deceleration and turns and changes of direction.

The improvement in the oxidative capacity of the muscle with the increase of oxidative enzymes, mitochondrial capacity and myoglobin concentration is, without doubt, a factor that facilitates recovery between sets. The oxygen present in the muscle fibre plays an important role in ATP resynthesis processes between points. Moreover, the capacity to clear lactate and tolerate muscle acidity, as well as the resynthesis of phosphocreatine, are decisive factors in the capacity to recover from a high-intensity action and to repeat it many times.

As we can see, the dynamics of recovery and the factors related to it will influence the capacity to recover between points, a decisive factor in performance. At the same time, the dynamic of interspersing appropriate work and recovery periods will have an efficient effect on the tennis-specific adaptive processes.

**Table 2. Most important studies about the intensity-specificity relationship.**

<table>
<thead>
<tr>
<th>Reference</th>
<th>Sample (n)</th>
<th>Protocol</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brughelli et al. 2008</td>
<td>Review</td>
<td>Relationship between ability to change direction and strength training</td>
<td>Different behaviour in the movements with changes compared to linear movements.</td>
</tr>
<tr>
<td>Young et al. 2001</td>
<td>36 males</td>
<td>6 weeks. Sprints over 20-40 m. 20-40 m with 3-5 direction changes</td>
<td>Linear training exercises did not reveal a relationship between improvements in agility movements and direction changes.</td>
</tr>
<tr>
<td>Lakomy, Haydon. 2004</td>
<td>18 elite hockey players</td>
<td>6x40 m test Deceleration 6 m Recovery 30 s</td>
<td>Positive explosive strength and speed relationship with the capacity to decelerate and change direction and repeat. Improvements in explosive strength via IT with direction changes.</td>
</tr>
<tr>
<td>Dellal et al. 2010</td>
<td>10 elite football players</td>
<td>30:30 s / 100% VO\textsubscript{2max}. 15:15-s / 105-110-115%VO\textsubscript{2max}. Straight line run Football exercises</td>
<td>Higher lactate concentrations when direction changes are introduced with football-specific actions.</td>
</tr>
<tr>
<td>Fernández-Fernández et al. 2011</td>
<td>4 male tennis players 4 female tennis players</td>
<td>4x120 s. 90 s recovery. 95% maximum heart rate Run vs. tennis exercises</td>
<td>Similar intensities. Specific exercises can be used as an alternative to running. Interesting to sometimes work on the technical aspect of fatigue.</td>
</tr>
<tr>
<td>Suárez Rodríguez, del Valle. 2017</td>
<td>13 competition-level tennis players</td>
<td>3x3x120 s. Recovery at 120-130 beats HIIT run HIIT forehand-backhand hits SIT forehand-backhand hits</td>
<td>Heart and lactate rates higher in tennis-specific exercises. Lower subjective perception of fatigue in specific efforts in terms of running exercises. Controlling intensity and loss of technical efficiency by recording hits and errors.</td>
</tr>
<tr>
<td>Hader et al. 2014</td>
<td>11 team-sport players</td>
<td>2x10x22 m 2x10x16.5 m with two 90\degree changes</td>
<td>Working with direction changes entails intense mechanical load.</td>
</tr>
</tbody>
</table>
Table 3. Most outstanding recovery training studies.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Sample (n)</th>
<th>Protocol</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suárez Rodríguez, 2015⁴⁶</td>
<td>15 competition-level tennis players</td>
<td>1-3 exercises lasting 14 min: continuous running, rallies and points. 2-3 split exercises 3x3x2 min: one running, one hitting, one intermittent hitting. Recovery at 120-130 beats/min.</td>
<td>Quicker heart rate recovery is observed in running efforts than in tennis-specific exercises. Post-effort elevated heart rate in intermittent exercises.</td>
</tr>
<tr>
<td>Buchheit et al. 2009⁴⁷</td>
<td>20 team-sport players</td>
<td>30:15 s test vs. continuous test</td>
<td>Superior effect over sympathetic activation and the parasympathetic deactivation in specific intermittent efforts.</td>
</tr>
<tr>
<td>Kang et al. 2007⁴⁸</td>
<td>24 males, 24 females</td>
<td>4 protocols lasting 30 min: 1- Continuous at 75 W 2- Alternating 50-100 W every 5-min 3- Alternating 100-50 W 4- Alternating 25-125 W</td>
<td>Slower heart rate recovery in efforts when there are changes in intensity.</td>
</tr>
<tr>
<td>Girard, Millet. 2009⁹⁵</td>
<td>Review</td>
<td>Neuromuscular fatigue in racket sports.</td>
<td>Oxygen in muscle fibre is important in the resynthesis of ATP between points in a tennis match.</td>
</tr>
</tbody>
</table>

Conclusions

- High-intensity intermittent training sessions reveal a clear relationship between the appearance of explosive strength and speed and the manifestation of resistance.
- In terms of high-intensity specific intermittent training sessions, intensities are reached that are the same or greater than those in running. Pace, turns and direction changes can lead to higher physical demand, with stronger stimuli.
- The intensity and relationship between work and recovery times are decisive factors in adjusting the load.
- The perception of fatigue is usually lower in specific-type efforts, with a lower ratio with the heart rate or lactic intensity.
- Different behaviour has been observed in recovery specific and intermittent efforts, which is why it would be advisable to act on the recovery mechanisms using training with movements and displacements specific to the game, as well as specific work and recovery times.

Conflict of interests

The authors declare to have no conflict of interest whatsoever.

Bibliography

La motricidad en el deporte: adaptaciones a altas intensidades y entrelazamiento de carga externa similar sobre la frecuencia cardiaca.