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ORIGINAL ARTICLE

Validity and reliability evidences of the Hit & Turn Tennis Test



Preuves de validité et reproductibilité des Hit & Turn Tennis Test

R.P. Urso^{a,*}, N.M. Okuno^{a,d}, R.V. Gomes^b, A.E. Lima-Silva^c,
 R. Bertuzzi^a

^a *Endurance Performance Research Group, School of Physical Education and Sport, University of São Paulo (USP), São Paulo, Brazil*

^b *School of Physical Education and Sport, University of São Paulo (USP), São Paulo, Brazil*

^c *Sports Science Research Group, Federal University of Alagoas (UFAL), Maceió, Brazil*

^d *Department of Physical Education, State University of Ponta Grossa, Ponta Grossa, Brazil*

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KEYWORDS

Aerobic fitness;
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 Heart rate

Summary

Objective. – To investigate the validity and reliability of the Hit & Turn Tennis Test (HTTT).

Equipment and methods. – Ten recreational (RG) and ten trained (TG) tennis players performed the HTTT and the 20-m Multistage Shuttle Run Test (MSRT) on separate days and in a counter-balanced order. Additionally, ten recreational tennis players performed the retest of the HTTT. For both tests, the maximal distance covered (Dmax), time to exhaustion (TE), peak velocity achieved (Vpeak), estimated maximal oxygen uptake (VO₂max-est), peak heart rate (HRpeak), blood lactate concentration before warm-up ([La]rest), and peak blood lactate concentration ([La]peak) were measured. Blood lactate concentration at the end of the fourth ([La]^{4°}) and eighth ([La]^{8°}) stages were measured in the HTTT.

Results. – Dmax, TE, Vpeak and VO₂max-est were significantly higher for the TG compared to the RG ($P < 0.01$). [La]^{4°} and [La]^{8°} were significantly lower in the TG when compared to the RG ($P < 0.01$). There was no significant difference in Dmax, VO₂max-est, HRpeak, [La]rest or [La]peak between the HTTT and MSRT for both groups ($P > 0.05$). Dmax, TE, VO₂max-est, HRpeak, Vpeak, [La]^{4°} and [La]^{8°} were significantly reliable for the HTTT (the ICC ranged from 0.86 to 0.98, $P < 0.01$). A Bland-Altman analysis was also used and indicated high reliability in the HTTT for VO₂max-est ($1 \pm 3.3 \text{ mL kg}^{-1} \text{ min}^{-1}$), Vpeak ($0.12 \pm 0.33 \text{ km h}^{-1}$), [La]^{4°} ($0.39 \pm 1.34 \text{ mmol L}^{-1}$) and [La]^{8°} ($0.2 \pm 2.7 \text{ mmol L}^{-1}$).

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* Corresponding author. EEF, Departamento de Esporte, Universidade de São Paulo, Avenue Porf. Melo de Moraes, 65, Cidade Universitária, CEP: 05508-030, São Paulo, SP, Brazil.

E-mail address: rodrigo.urso@usp.br (R.P. Urso).

MOTS CLÉS

Capacité aérobie ;
Endurance
spécifique ;
Consommation
d'oxygène ;
Lactate ;
Fréquence cardiaque

Résumé

Objectif. – Examiner la validité et la fiabilité du Hit & Turn Tennis Test (HTTT).

Sujets et méthodes. – Dix joueurs de tennis amateurs (RG) et dix joueurs entraînés (TG) ont effectué un HTTT et un Multistage Shuttle Run Test (MSRT) de 20 m en des jours différents, et dans un ordre aléatoire. De plus, les dix joueurs amateurs ont réalisé un nouveau test de l'HTTT. Pour les deux tests, la distance maximale (Dmax), le temps d'épuisement (TE), la vitesse maximale de course (Vpeak), la consommation maximale d'oxygène estimée (VO₂max-est), la fréquence cardiaque maximale (HRpeak), la concentration de lactate sanguin avant l'échauffement ([La]rest) et le pic de concentration de lactate ([La]peak) sont mesurés. Les concentrations de lactate sanguin à la fin du quatrième ([La]4°) et huitième ([La]8°) passages ont été mesurées dans le HTTT.

Résultats. – Dmax, TE, Vpeak et VO₂max-est étaient significativement plus élevés pour les TG par rapport aux RG ($p < 0,01$). [La]4° et [La]8° TG ont été significativement inférieures par rapport aux RG ($p < 0,01$). Il n'y a pas eu de différences statistiques en Dmax, VO₂max-est, HRpeak et [La]peak entre le HTTT et le MSRT pour tous les deux groupes ($p > 0,05$). Dmax, TE, VO₂max-est, HRpeak, Vpeak, [La]4° et [La]8° étaient significativement fiables dans l'HTTT (l'ICC a varié de 0,86 à 0,98, $p < 0,01$). L'analyse de Bland-Altman a été utilisée et elle a indiqué une grande fiabilité du HTTT pour la détermination de VO₂max-est ($1 \pm 3,3 \text{ mL kg}^{-1} \text{ min}^{-1}$), Vpeak ($0,12 \pm 0,33 \text{ km h}^{-1}$), [La]4° ($0,39 \pm 1,34 \text{ mmol L}^{-1}$) et [La]8° ($0,2 \pm 2,7 \text{ mmol L}^{-1}$).

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1. Introduction

It is well known that tennis is an intermittent sport, demanding short high-intensity efforts (4–10 seconds) and short recoveries between rallies (10–20 seconds) as well as longer pauses when exchanging sides of the court and at the end of a set (90 and 120 seconds, respectively) [1]. Consequently, tennis players must have great ability to repeatedly perform dynamic movements that involve acceleration, deceleration, changes of direction and jumps during a match that could last less than one hour or longer than five hours [2–4]. As a result, good aerobic fitness has been considered determinant for high performance in this sport because it ensures a rapid recovery between points [5,6].

Traditionally, athletes' aerobic fitness is directly assessed while running or cycling to exhaustion during an incremental test performed in the laboratory [6]. However, in addition to the expensiveness of the equipment, these tests do not involve sport-specific movements and require specialized assessment. Alternatively, field tests such as the 20-m Multistage Shuttle Run Test (MSRT) have been proposed due to their simplicity and possibility to evaluate many players simultaneously [7]. Although the MSRT requires the athletes to accelerate, decelerate and change directions, it is probable that this test is not the most appropriate to assess tennis-specific demands because this test does not involve tennis-specific muscle groups or movement patterns [8,9].

More recently, a tennis-specific field test called the Hit & Turn Tennis Test (HTTT) was developed to assess the aerobic fitness of tennis athletes [5,10]. In this test, the subjects must perform repeated displacements along an 11-m line (the length of the tennis doubles baseline) and simulate forehands and backhands at each corner consecutively with sound signals coming from a DVD. The last stage completed is used as an indicator to estimate maximal oxygen uptake (VO₂max-est). Differentiating it from the commonly used laboratory and field tests, this test requires the players to perform short displacements with tennis-specific footwork

in addition to simulating tennis-specific strokes. Although the idea of the test seems attractive, only one study has analyzed the validity and reliability of the HTTT [5]. Ferrauti et al. [5] tested the external validity of the HTTT, comparing the results to a tennis ball machine test. Nevertheless, the construct validity has also been suggested to be an interesting type of validity that can be applied [11].

Therefore, the aim of this study was to examine the construct validity and reliability of the HTTT. Second, considering that the MSRT is a valid and reliable test [12,13], the relationships of performance and physiological measurements between the HTTT and MSRT were also analyzed. We hypothesized that the HTTT would be capable of discriminating the performance of tennis players with different training statuses. In addition, considering that different incremental test protocols may result in similar physiological peak values [14–16], we believed that the HTTT and MSRT would induce similar maximal performance and physiological stress.

2. Methods**2.1. Study design**

Subjects were submitted to three experimental sessions with minimum and maximum intervals of 48 hours and 1 week, respectively. At the first experimental session, height and body mass were determined, and skinfold measurements were taken. In this session, participants were familiarized with the MSRT and the HTTT using submaximal efforts. At the second and third experimental sessions, the players were submitted to the MSRT and the HTTT in a counterbalanced order. Maximal distance covered (Dmax), time to exhaustion (TE), peak velocity achieved (Vpeak), peak heart rate (HRpeak), blood lactate concentration before the warm-up ([La]rest), peak blood lactate concentration ([La]peak) and VO₂max-est were compared between tests

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