110 - PARAPLEGIA AND TRACK CYCLING – CASE STUDY ABOUT THE EFFECTS OF A 10 WEEK TRAINING ON A PARA-ATHLETE PERFORMANCE AT THE 1KM TIME TRIAL

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INTRODUCTION

The high level of the Paralympics competitions is acquiring, increasingly, prestige in the world sporting range. This is due to the judicious organization system, associated to the increasingly number of athletes and sport modalities (adaptable or not).

Considered as one of the most complex modalities, the track cycling (TC), or indoor, has a great number of followers although the intrinsic peculiarities of its practice. (Cycling track, bike and other equipment).

The trials are between athletes who are previously evaluated and classified according to the injury type and consequent limitations.

A great challenge put on by the TC practice would be the predominant use of the lower limbs, even among the athletes who have been affected by spinal cord injuries.

The paraplegia is known as a type of spinal cord injury, traumatic or ischemic, which drastically reduces the motor command from the lower limbs and pelvic region, occurring in a complete or incomplete way (HARRISON, 2002; BERNE & LEVI, 2000). The paraplegia induced by ischemic spinal cord injury is a type of lower limbs paraplegia, caused by a significant reduction of the spinal cords blood flow. (SILVA et al, 2002).

According to the features related to the muscle tone, atrophy level and spasticity, paraplegia could be classified as flaccid or spastic (CONDE et al, 2006), however, it would not show subdivisions that could quantitatively evaluate it.

Each individual diagnosed as paraplegic, therefore, shows peculiar features regarding the topography, extension and commitment level due to the injury, making it difficult to extrapolate data to a homogeneous population concerning the diagnosis, however heterogeneous concerning the arising limitations.

The reduction of physical performance in individuals who have been affected by spinal cord injury is overdue, at most of the cases, to the direct loss of the motor control and sympathetic activity. As a consequence, the oxygen consumption, the maximum heart rate, the stroke volume, the venous return and the thermoregulatory mechanisms are substantially damaged. (SCHMIDTBLEICHER & TURBANSKI, 2010)

Despite these limitations, the present work shows a case study of a TC athlete, carrier of paraplegia induced by incomplete spinal cord injury and competitor of the 1km time trial for approximately three years. To sum up, wins the trial the cyclist who goes trough the 1km distance in the shortest time. The start is made from a starting block that blocks the bike by its rear wheel edges. The bike is released simultaneously with the stopwatch and only one competitor for time tape is allowed to go trough the cycling track.

This kind of trial is at the Sprint category (up to 1000 meters) mostly anaerobic (CRAIG & NORTON, 2001). It is a rhythmic and cyclic activity, the power and the speed being the main physical ability that will determinate the trial success.

The McVeigh and staff's study (2009) has checked the sporting practice influence on the social integration and the quality of life upgrading of the individuals affected by spinal cord injury. For this analysis two validated questionnaires were used (CIQ and RNL) as well as topics related to daily activities, perceived exertion, indoor activities and productivity on 90 individuals (45 physically active and 45 sedentary). The pointing from the group of physically active individuals was significantly bigger than the other group and the authors correlate the membership of sports after the occurrence of spinal cord injury, with the bigger capacity of social integration and better quality of life.

The main goal of this study consists at doing a descriptive analysis about the ten week training alterations regarding the Power Peak, the maximum speed and the fatigue index of a TC para-athlete, while the CR trial simulation.

METHODOLOGY

The sample was a physically active individual, male gender, aged 33 years old, body mass 75,5kg and stature 1,79 meters. The individual has got previous experience in track cycling training, and he has been a competitor of the 1km time trial, rate C1, for about three years.

The diagnosis for this individual confirmed the paraplegia induced by incomplete ischemic spinal cord injury. Because of the injury sequels, the individual shows a significant reduction on the lower limbs motor control, verified by a mobility deficit and orthostatic support, as well as a remarkable reduction of the lower limbs muscle mass.

The volunteer has been informed about the experimental procedures and its implications, and has signed a consent term to take part on the study. The ethics committee in institution research has approved the protocol.

For the data collection, a mechanical weighing-machine from the Filizola label was used, previously measured according to the fabricator.

The bike used for the evaluations and training is from the Cervélo label, model P2 (Figure 1), weighting 7,7 kg (crank of 48 and 18 teeth gear).

The power meter from the SRM label (Figure 2) was linked to the bike, acting like its crank arm, allowing the continue and direct reading of the power curves, cadence and speed, without modifying the bike's aerodynamic structure. This equipment has been reported as a reference model on these variables readings, because of its validity and reproducibility (DUC et al, 2007).

Part of the training and the data collection were done at the cycling track of Contagem, Minas Gerais, Brazil. This track has its structure made of concrete and it does not have a coverage.

Any adaptation was made to the bike or the track, in order to favor the athlete performance because of the paraplegia, except for the use of a stiff orthesis pair, AFO type (Ankle and Foot Orthesis), allowing the use of special sneakers for the sport.

The training was performed four times a week, for ten weeks, two sessions held on the track (Tuesday and Saturday) and two using the stationary training (Monday and Thursday) with the same bike, which was adapted to a mechanical roller with rear mounting from the label Tranz-X (Figure 1), allowing the intensity adjustment through the wheel braking.

The sessions were scheduled according to the speed training principles (BOMPA, 2001) and subdivided according to the reaction phases (2-3 maximum series to 5-8 seconds, with 2-3 minutes pauses), acceleration and maximum speed (2-3 series until the maximum speed with 1-2 minutes pauses) and resistance speed (trainings and maximum series according to the distance: 8x125m, 4x250m, 3x375m and 3x500m with 15-30 seconds pauses).

The ratio volume/intensity progress of the training was grounded on the wavelike variations dynamic suggested by Matveev (1997).

Three evaluations were done in order to verify the PP, the Vmax and the IF related to theses variables: initial, intermediate (after 5 weeks) and final (after 10 weeks).

The authors' decision of adapting a field test based on the simulation of the competition itself, is grounded on the Bertucci et al (2005) reports that verify significant differences between laboratorial tests with cycle ergometer and real cycling situations.

In each evaluation, the equipment was previously measured and calibrated.

The evaluations were standardized according to the real CR trial situations. After the warm-up and track recognition period, the athlete was placed on the start line, already on the bike and with the sneakers properly fixed on the pedals. For that, an appraiser held the bike's rear portion, acting like a mechanical lock specifically used at the official competitions. After five seconds on the static start position, an oral countdown to the start was initiated.

Two attempts were done in each evaluation day , with 10 minutes pause between those and the shortest time registered to complete the way was used for the study. The data concerning time, distance, power and speed was drawn from the SRMwin software, specific for the power meter in case.

RESULTS

There were 36 training sessions in total, 18 of them were stationary trainings and 18 track trainings.

The initial evaluation PP (250W) was bigger than the one found on the intermediate evaluation (202W). However, the intermediate evaluation showed a shorter IF (49,5%) when compared to the initial (53,2%).

The final evaluation registered a bigger PP between all the evaluations (216W) and the IF (53,2%) was similar to the initial evaluation, but the total track time on the final evaluation was the shortest one (Chart 1)

Evaluation	Time (mm:ss)	PP (watts)	PF (watts)	PMéd (watts)	IF (%)
Initial	02:19,6	205	96	110,6	53,2
Intermediate	02:14.9	202	102	112,4	49,5
Final	02:14,1	216	101	115	53.2

Chart 1 – data regarding time (mm:ss), power peak (PP), final power (PF), Average Power (PMed) and Fatigue Index (IF) on the three evaluations (initial, intermediate and final) that simulated the 1km time trial.

The maximum speed was increased in each evaluation (initial 28,8 km/h, intermediate 29,4 km/h and final 30,4 km/h). The final evaluation presented the biggest IF (13,2%), but the biggest maximum speed (30,4 km/h) and also the biggest final speed (26,4 km/h) were registered at this evaluation (Chart 2).

Evaluation	Time (mm:ss)	VMáx (Km/h)	VF (Km/h)	VMéd (Km/h)	IF (%)
Initial	02:19,6	28,8	25.4	26.3	11,8
Intermediate	02:14.9	29,4	25.9	27.8	11.9
Final	02:14,1	30,4	26.4	27.9	13.2

Chart 2 – Data regarding the time (mm:ss), maximum speed (Vmax), Final Speed (VF). Average Speed (VMed) and Fatigue Index (IF) in three evaluations (initial, intermediate and final) that simulated the 1km time trial.

DISCUSSION

For logical reasons, half of the training was done using the stationary form. Highlighting the principle of the specificity (BOMPA, 2001), it is assumed that if all the training were done at the cycling track, probably the athlete performance would be increased in a bigger measure.

As exposed on the chart 1, despite the fact that the initial evaluation PP (205W) had been slightly bigger than the one found on the intermediate evaluation (202W), the intermediate evaluation presented the shortest IF (49,5%) if compared to the initial (53,2%).

Therefore, other variables that could be considered for this analysis are the average power (PM) and the average speed (Vmed).

The final evaluation registered the biggest PP among all the evaluations (216W), with the fatigue index (IF) similar to the initial evaluation (53,2%) and bigger than the intermediate (49,5%), however, the PM and the Vmed were the biggest registered and the total track time was the biggest found.

On the three evaluations, the PP is achieved in the beginning of the Sprint, probably due to the breakage of inertia at the beginning of the movement and the huge application of force necessary for it. These findings were compatible with Craig & Norton (2001), who measured the power developed by an elite athlete during 1km counter-clock trial (Figure 3) and verified the PP at 1799W(reached before the 10 seconds) and the final potential with the value of 399W.According to the authors , the most

remarkable point of this study refers to the fatigue index of 78%.

In the present work, the athlete presented the IF(fatigue index) of 53,2% in his best measured time, however, the potential peak presented the value almost 10 times less(216W) than the one found in the Craig & Norton(2001) study.

After the PP, The potential curves and the speed suffered oscillations during all the way(graphs 1 and 2). This Phenomenon is justified by the increase of the centripetal acceleration in the curves due to the changing of the cyclist center of gravity who, for being inclined, travel a shorter distance than the wheels, presenting a smaller radial curvature than the curve(UNDERWOOD & JERMY,2010).

Schimidtbleicher and Turbanski (2010) verified the effects of training on the development of the superior member of 8 wheelchair (basketball or rugby professionals) and 8 physical education students (control group). The study consisted in the evaluation of potential, strength, maximal repetition and a 10 meters sprint performed with a wheelchair. The evaluations were performed before, after 8 weeks of training and 1 week after the last evaluation. The main findings of this study shows similar gains between the two groups in all qualities tested, however, when analyzing the strength and the power separately, the experimental group (wheelchair) presented greater gains when compared to the control.

The improvement of physical performance of individuals with spinal cord injury verified in the Schmitdtbleicher nad Turbanski(2010) study can be assigned to the use of the superior members, however, the experimental group had 2 individuals diagnosed as quadriplegics, with a light commitment of these members.

No further studies were found that presented similarity to the experiment of the present work.

CONCLUSION.

Based on the found results, we can conclude that a systematic training program and specific to its modality was able to improve the performance of the athlete/sample of this study.

The paraplegia presents unique features about topography, extension and to the level of commitment imposed by it, making it difficult to extrapolate data to a homogeneous population concerning the diagnosis, however heterogeneous concerning the arising limitations. Besides, athletes and coaches should be encouraged to direct the training in an specific way to the sport.

Further researches directed to the subject are necessary to have a more consistent theoretical reference.

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PARAPLEGIA AND TRACK CYCLING – CASE STUDY ABOUT THE EFFECTS OF A 10 WEEK TRAINING ON A PARA-ATHLETE PERFORMANCE AT THE 1KM TIME TRIAL

ABSTRACT

A major challenge posed by the CP would be the predominant use of the lower limbs, even among athletes who have been affected by spinal cord injuries. Paraplegia is a type of spinal cord injury, traumatic or ischemic, which drastically reduces the motor command from the pelvis and lower limbs, Objective: A case study on the effects of ten weeks of training in peak power (PP), maximum speed (Vmax) and fatigue index (FI) of these variables during the simulation of the 1000m Time Trial. Sample: A paraplegic individual ((33 years old,75,5kg,1,79m) with previous experience in training in CP. Methods: To perform three assessments (initial, intermediate and final) that simulates the1000m time trial, during ten weeks of specific training for speed development. We used a power meter SRM ® for the continuous reading of the time, distance, speed and power. Results: The intermediate evaluation of PP had lower than baseline (202 and 205W) but the intermediate evaluation of IF was lower (49.5 and 53.2%). The final evaluation showed the highest PP (216W), with the IF similar to the initial (53.2%). The Vmax was increased progressively during the three assessments (28.8, 29.4 and 30.4 km / h). The IF of velocity was similar in the first two assessments (11.8 and 11.9%) and higher in final assessment (13.2%), but the latter was recorded at the shortest time to complete 1000 m. Conclusion: The proposed training program was able to improve an athlete's performance in this study. Although paraplegia determine unique features, athletes and coaches should be encouraged to direct training specifically to sport.

KEYWORDS: Paraplegia, Track Cycling, Power.

LA PARAPLÉGIE EST DE CYCLISME SUR PISTE – ÉTUDE DE CAS SUR LES EFFETS DE 10 SEMAINES DE FORMATION POUR LA PERFORMANCE D'UM PREUVE DEL'ATHLETE – 1KM (CONTRE LA MONTRÉ)

RESUME

Un grand challenge imposé par le paracyclisme serait l'utilisation prédominante des membres inférieurs, même entre des athlètes qui ont souffert des lésions de la moelle épinière. La paraplégie est un type de lésion de la moelle épinière, d'origine traumatique ou ischémique, qui réduit considérablement le commande moteur de la région pelvienne et des membres inférieurs. Objectif: Réaliser un étude de cas sur les effets de dix semaines d'entraînement sur la puissance de crête (PC), la vitesse maximale (Vmax) et le taux de fatigue (TF) de ces variables, pendant la simulation de l'épreuve de 1 km contre la montre. Prélèvement: Un individu paraplégique (33 ans, 75.5 kg, 1.79 m) avec de l'expérience antérieure à l'entraînement au CP. Méthodologie: Réaliser trois évaluations (initiale, intermédiaire et finale) qui simulent l'épreuve de 1 km contre la montre, pendant dix semaines d'entraînement spécifique pour le développement de la vitesse. Un wattmètre de la marque SRM a été utilisé pour la lecture continue du temps, de la distance, de la puissance et de la vitesse. Résultats: L'évaluation intermédiaire a présenté un PP plus petit que l'évaluation initiale (202 e 250w) cependant le IF de l'évaluation intermédiaire a été plus petit (53,2 e 49,5%). L'évaluation finale a démontré le plus grand PP(216w), avec le TF similaire à la initiale (53,2%). La Vmax a été augmentée progressivement pendant les trois évaluations (28,8, 29,4 et 30,4 km/h). Le TF de la vitesse été similaire dans les deux premières évaluations (11,8 et 11,9%) et supérieur à l'évaluation finale (13,2%), cependant, à la dernière un temps plus court a été enregistré pour compléter le trajet. Conclusion: Le programme d'entraînement proposé fût capable d'améliorer la performance de l'athlète/prélèvement de cet étude. Malgré le fait de la paraplégie déterminer des caractéristiques uniques, les athlètes et les entraîneurs doivent être encouragés à orienter l'entraînement de façon spécifique pour la modalité.

MOTS-CLÉS : paraplégie, cyclisme de piste, puissance.

CICLISMO PARAPLEJIA Y LA PISTA – ESTUDIO DE CASO D ELOS EFECTOS DEL 10 SEMANAS DE TREINAMENTO PARA EL DESEMPEÑO DE UN ATLETA EN PRUEBA - 1KM (TIME TRIAL)

RESUME

Un gran desafió impuesto por el paraciclismo sería el uso predominante de los miembros inferiores, incluso entre atletas que sufrieron lesiones medulares. La paraplejia es un tipo de lesión medular, de origen traumático o isquémico, que reduce drásticamente el control motor de la región pélvica y de los miembros inferiores. Objetivo: Realizar un estudio de caso sobre los efectos de diez semanas de entrenamiento sobre el pico de potencia (PP), la velocidad máxima (Vmáx) y el índice de fatiga (IF) de esas variables, durante el simulacro de la prueba de 1 km contrarreloj. Muestra: Un individuo parapléjico (33 años, 75,5 kg, 1,79m) con experiencia previa en el entrenamiento en CP. Metodología: Realizar tres evaluaciones (inicial, intermedia y final) que simulan la prueba de 1 km contrarreloj, durante diez semanas de entrenamiento específico para el desarrollo de la velocidad. Fue usado un potenciómetro para la lectura continua del tiempo, distancia, potencia y velocidad. Resultados: La evaluación intermediaria presentó un menor PP que la evaluación inicial (202 y 205w) aunque el IF de la evaluación intermedia fue menor (53,2 y 49,5%). La evaluación final mostró el mayor PP(216w), con el IF similar al inicial (53,2%). La Vmáx fue aumentada progresivamente en el transcurso de las tres evaluaciones (28,8, 29,4 y 30,4 km/h). El IF de la velocidad fue semejante en las dos primeras evaluaciones (11,8 y 11,9%) y más alto en la evaluación final (13,2%), aunque en esta última fue registrado el menor tiempo para completar el trayecto. Conclusión: El programa de entrenamiento propuesto fue capaz de mejorar el desempeño del atleta/muestra de este estudio. A pesar de que la paraplejia determina características especiales, atletas y entrenadores deben ser encorajados para dirigir el entrenamiento de una forma específica para esta modalidad.

PALABRAS CLAVE: Paraplejia, Ciclismo en Pista, Potencia.

PARAPLEGIA E CICLISMO DE PISTA – ESTUDO DE CASO SOBRE OS EFEITOS DE 10 SEMANAS DE TREINAMENTO NO DESEMPENHO DE UM PARA-ATLETA NA PROVA DE 1 KM (CONTRA-RELÓGIO)

RESUMO

Um grande desafio imposto pelo paraciclismo seria a utilização predominante dos membros inferiores, mesmo entre atletas que foram acometidos por lesões medulares. A paraplegia é um tipo de lesão medular, de origem traumática ou isquêmica, que reduz drasticamente o comando motor da região pélvica e dos membros inferiores, Objetivo: Realizar um estudo de caso sobre os efeitos de dez semanas de treinamento sobre o Pico de potência (PP), a velocidade máxima (Vmáx) e o índice de fadiga (IF) dessas variáveis, durante a simulação da prova de 1 km contra-relógio. Amostra: Um indivíduo paraplégico (33anos,75,5kg,1,79m) com experiência prévia no treinamento em CP. Metodologia: Realizar três avaliações (inicial, intermediária e final) que simulam a prova de 1 km contra-relógio, durante dez semanas de treinamento específico para desenvolvimento da velocidade. Foi utilizado um potencímetro da marca SRM® para a leitura contínua do tempo, distância, potência e velocidade. Resultados: A avaliação intermediária apresentou menor PP do que a avaliação inicial (202 e 205w) porém o IF da avaliação intermediária foi menor (53,2 e. 49,5%) . A avaliação final demonstrou o maior PP (216w), com o IF semelhante à inicial (53,2%). A Vmáx foi aumentada progressivamente no decorrer das três avaliações (28,8, 29,4 e 30,4 km/h). O IF da velocidade foi semelhante nas duas primeiras avaliações (11,8 e 11,9%) e maior na avaliação final (13,2%), porém nesta última foi registrado o menor tempo para completar o trajeto de 1km. Conclusão: O programa de treinamento proposto foi capaz de melhorar o desempenho do atleta/amostra deste estudo. Apesar de a paraplegia determinar características ímpares, atletas e treinadores devem ser encorajados a direcionar o treinamento de forma específica à modalidade.

PALAVRAS-CHAVE: Paraplegia, Ciclismo de Pista, Potência.