POSTURE CONTROL AND VESTIBULAR OCULOMOTOR SYSTEM IN PISTOL SPORT SHOOTERS

ABSTRACT

Introduction: Shooting sports develop dexterity, concentration and balance in the athletes. The stability of the shooter is dependent on his/her resistance against internal and external disturbance that affects his/her balance. Objective: To evaluate the posture control and vestibular-oculomotor system of athletic pistol shooters. Methods: A cross-sectional descriptive analysis. Eight subjects (mean age of 37 years; SD ± 8.11), affiliated to the Brazilian Confederation of Target Shooting were evaluated. A sociodemographic questionnaire, besides stabilometry associated with the shooting simulator and computerized videonistagmoscopic system were used. Results: All volunteers presented right motor dominance; half shot with both eyes open; average practice time is 14 years (SD ± 9) and weekly training average is of 14 hours (SD ± 13). Half athletes reported injuries associated with shooting. Stabilometric correlation presented correlation in the anteroposterior and mediolateral velocities. None of the athletes presented pathological alteration in the videonistagmoscopic evaluation. Conclusion: Posture control of the assessed athletes presents significant changes to the displacement of the center of pressure velocities in the anterior-posterior and mediolateral directions. The vestibulo-ocular system was not correlated with posture control and functional changes were not observed in any of the volunteers.

Keywords: athletes, data collection, postural balance, vestibular apparatus.

INTRODUCTION

It is relevant to assess posture control not only for athletes, but also for the entire technical staff which follows them. Research with athletes has been carried out with the goal to correlate posture control with posture standards of each sport to performance of the athlete as well as to the dysfunctions or injuries occurred with it. Posture control is the erect and stable position developed by the athlete as well as to the dysfunctions or injuries occurred with it. Posture control is the erect and stable position developed by three systems: the visual, with information about cephalic movements and position concerning the environment; the vestibular, with static and dynamic information about cephalic movements and position concerning gravity; and the somatosensory, which sets the body in space concerning the body segments and the base of support. The integration of the posture control systems may have its function changed by pathological or even habitual conditions, such as, sports practice. Sport shooting is a sport which has been practiced since the first edition of the Olympic Games of the Modern Ages, in 1896, and its technique derives from the learning of its basic mechanics: stable position; breathing control; constancy at aiming; and squeezing the trigger, at which the individual must present motor skill and sufficient balance to reach the center of the target. In order to be efficient, the shooter must present, besides posture control, muscles ready for isometry, since he/she holds the total weight of the gun during practice of the sports basic movements.

Thus, to assess and describe posture control of pistol sport shooting athletes and to verify correlations between the roll-like posture and the vestibular-oculomotor system in these athletes became the aim of this research, since this modality is of high-performance in which the athlete is demanded in his/her limit, in training many times exhaustive in the attempt for better performance.

METHODOLOGY

The present analytical-descriptive transversal study was based on texts published between 2004 and 2011, in English and Portuguese languages searched in the scientific databases: PubMed, MedLine, Scielo, Science Direct, NCBI, Bireme/Lilacs, Scholar Google, besides the classical bibliography on sport shooting from 1985. Data were analyzed and collected in laboratories of human movement, neurofunctional performance and biomechanics analysis. The ethical assumptions for reasearch with human beings were respected according to the resolution 196/96 from the National Health Board. All volunteers spontaneously signed the Free and Clarified Consent Form. The sample consisted of eight athletes from the Brazilian Confederation of Target Shooting; seven men and one woman. The exclusion criteria were: clinical history of vestibular dysfunction; use of vestibular suppressor medication for vertigo control; post-traumatic rehabilitation process or musculoskeletal episode which could make the evaluations impossible and alterations related to attention and concentration due to psychological dysfunctions. The analysis proposed for this research was based on three instruments: individual medical record designed by the researcher for sociodemographic characterization; stabilometry platform model Biomec 400, dimensions of 1x1 m, analogic-digital system of 16 bits, brandname EMG System® with acquisition collected in the sampling frequency of 100 Hz and associated with the NOPTEL® shooting simulator, system NOS Sport version 4.208 with analysis program NOS 4.2, 38 mm caliber pistol, semi-automatic functioning, German manufacturing, brand name Walther® weight with empty magazine of 970 g. Target measuring 7 x 17 cm and 150 cm from the ground, divided in concentric areas with decreasing punctuation.
for the edges, distance between the center of the platform and the target of 6 m, measure proportional to the shooting event at 25 m; and the computerized videonistagmoscope system, by Contronic® Sistemas Automáticos Ltda., with a mask attached to the infrared micro camera and interconnected to a Dell® notebook. Each volunteer was examined in a 45-minute interval following the same procedures sequence for all of them. The athlete started from resting in sitting position for five minutes, when the sociodemographic form was filled out and the evaluation was explained. Subsequently, the stabilometric examination, which consisted of four acquisitions, with 30-second duration for each acquisition, took place. This time was based on the concept that prolonged aiming time harms the shooting accuracy16 and on the protocol by Bastos et al.24. On the first acquisition (control-PC position), the athlete should adopt orthostatic position on the platform, barefoot, upper limbs along the body, support base according standard guidelines of the platform, eyes open and aim at the target. On the second acquisition (shooting-PT position), the athlete should adopt shooting position on the platform, barefoot, aim the pistol to the target and press the trigger once, remaining at the position after this task. On the third acquisition (PT + TV visual task), the athlete should adopt shooting position on the platform, barefoot, aim the pistol to the target, simultaneously identify letters “X” distributed among many letters in a projection also made on the target direction (Epson data show multimedia projector), press the trigger once and remain at the position after the task. On the fourth acquisition (PT + TM mental task), the athlete should adopt shooting position on the platform, barefoot, aim the pistol to the target, simultaneously mentally count from 30 to zero in multiple of three, press the trigger once and remain at the position after the task. Finally, after three minutes of rest from stabilometry, the athlete sat on a chair and was examined by computerized videonistagmoscopy by the protocol of the quotient of movement sensitivity (QMS) which simulates 16 positions and movements experienced by humans in their routines who, when compromised, may present vestibular signs and symptoms such as vertigo, nausea, vomiting, posture instability and nystagms25. The eye movements occurred on each position were recorded in a film for subsequent analysis. The results of this test are obtained through classification from intensity 0 to 5 and symptoms duration after the performed movements measured in seconds (from five to 10 = 1 point; 11 to 30 = 2 points; > 30 = 3 points). At the final result, it is considered: minimal involvement (1 to 10); moderate compromising (11 to 30); and higher than 31, severe state. Statistical analysis was performed with the Statistical Package for Social Sciences program, version 17.0 for Windows. All data obtained were compared in the QMS test and in the stabilometry acquisition protocols. Mean and standard deviation were used for the continuous variables. Parametric ANOVA tests were used to relate the means of the stabilometric endings for elliptical area (EA), total dislocation (TD), dislocation velocities for the pressure center in the anteroposterior and mediolateral directions (APV and MLV). The considered p value was ≤ 0.05. Multiple comparisons used post-hoc test between stabilometry protocols (PT, TV and TM) and the PC, considering confidence interval of 95%. The Spearman test correlated the sociodemographic viabiles and stabilometry protocols and p value ≤ 0.05 was considered.

RESULTS

The data analyzed present eight right-handed athletes; two present left eye as the director eye; five athletes shoot with both eyes open; six wear safety glasses to train and compete. The mean of time of practice was of 14 years (SD ± 9), mean age among athletes was 37 years (SD ± 8) and mean training time was of 14 weekly hours (± 13). One athlete reported a vertigo episode, two present vestibulopathy family history and five athletes reported injuries associated with the sport, which were accordingly compensated at the collection moment (tables 1 and 2). The stabilometric results in the ANOVA comparison found MLV significance with p = 0.23. In the post-hoc comparison between the PC and the remaining tasks significance was found in the mean difference between PC and TM whose p = 0.29 in a confidence interval of 95% = [0.06 – 0.5]. In the Spearman test, with p < 0.01, significance for AE and DT p = 0.90; AE and MLV p = 0.88; DT and APV p = 0.97; APV and MLV p = 0.95. For p < 0.05 significance for AE and APV with p = 0.83. Correlation between stabilometric and sociodemographic data did not produce significant value. In all parameters median increase in TV was observed. In MLV, greater posture oscillation was found compared with the APV and an outlier in PT (Figures 1 to 4). In the examination of the vestibular-oculomotor system, the eight athletes were within the classification of minimal involvement (0 to 10). Physiological findings between corrective saccades, delay of the vestibular-ocular reflex and horizontal nystagmus have been observed in three athletes, respectively (table 3).

Table 1. Sociodemographic characterization of the sample.

<table>
<thead>
<tr>
<th>Sociodemographic data</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male sex</td>
<td>7 (87.5%)</td>
</tr>
<tr>
<td>Female sex</td>
<td>1 (12.5%)</td>
</tr>
<tr>
<td>Right directing eye</td>
<td>6 (75%)</td>
</tr>
<tr>
<td>Left directing eye</td>
<td>2 (25%)</td>
</tr>
<tr>
<td>Right motor dominance</td>
<td>8 (100%)</td>
</tr>
<tr>
<td>Left motor dominance</td>
<td>0</td>
</tr>
<tr>
<td>Safety glasses (wears them)</td>
<td>6 (75%)</td>
</tr>
<tr>
<td>Safety glasses (does not wear them)</td>
<td>2 (25%)</td>
</tr>
<tr>
<td>Shoots with two eyes open</td>
<td>5 (62.5%)</td>
</tr>
<tr>
<td>Shoots with one eye open</td>
<td>3 (37.5%)</td>
</tr>
<tr>
<td>Vertigo ou dizziness episode</td>
<td>1 (12.5%)</td>
</tr>
<tr>
<td>Labyrinthitis family history</td>
<td>2 (25%)</td>
</tr>
<tr>
<td>Injury associated with shooting (compensated)</td>
<td>4 (50%)</td>
</tr>
</tbody>
</table>

Table 2. Description of the anthropometric data of the volunteers.

<table>
<thead>
<tr>
<th>Anthropometric data</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (a)</td>
<td>37</td>
<td>8</td>
<td>18</td>
<td>44</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>83</td>
<td>14</td>
<td>60</td>
<td>112</td>
</tr>
<tr>
<td>Height (m)</td>
<td>1.81</td>
<td>0.6</td>
<td>1.71</td>
<td>1.94</td>
</tr>
</tbody>
</table>
The analysis of the posture control considering sensory, cognitive and environmental stimuli, may help to understand the mechanisms of posture adjustments and their dysfunctions. In sports, suitable posture assessment produces data about the functional capacity of the athlete, besides identifying specific alterations which compromise their posture control and consequent performance. Balance, sensory characteristics and vestibular system examinations get together as useful instruments in this investigation. In sport shooting and similar modalities, as arch shooting, the posture examination has been approached for performance improvement, injury investigation and alterations associated with this class of sport. It must be highlighted that in these studies there is no standardization in the evaluations, and the vestibular system is not directly included in the exams when it should be. Considering the concepts mentioned before and the technical demands of shooting basic mechanics, Yur’Yev, in his technical literature on shooting, mentions many times the importance of the sensory and vestibular-oculomotor connections for the practice of this sport.

The stabilometric examination lets us compare our sample with the one with recurve arch athletes evaluated by Wolff et al., who used the same parameters of this research and found, as in the present study, remarkable oscillation in APV and AMV. When shooters, judo fighters and ballet dancers were compared in a protocol with visual suppression, only the judo fighters presented a good performance. Thus, it is considered that visual suppression or conflict as the aim of the TV of this study, may alter the posture control since ballet and shooting depend more on the visual system in comparison with judo. Judo fighters train the somatosensory system and do not depend as much on vision. The fact the TV had increased oscillation of APV and MlV may be explained by the difficulty in set vision in the presence of multiple targets. The presence of an outlier in the APV correlation and the stabilometric acquisitions may be attributed to reduced training volume of the mentioned athlete, which had total time of only three weekly hours at the time of the study. This athlete may have taken too long to perform the

DISCUSSION

The analysis of the posture control considering sensory, cognitive and environmental stimuli, may help to understand the mechanisms of posture adjustments and their dysfunctions. In sports, suitable posture assessment produces data about the functional capacity
stable position mechanics which is essential to posture control acquisition in this sport. Another relevant fact about this athlete which may be equally related to the training volume is that, when submitted to the examination of the vestibular-oculomotor system, he presented delay in the vestibulo-ocular reflex gain. The athlete who presented corrective saccades trains two weekly hours and has three years of practice. The one who presented horizontal nystagmus reported having 18 years of practice, but was away from training for personal reasons. That who reported a vertigo episode has three years of practice. The one who presented horizontal oculomotor system test may be related to the training volume is that, when submitted to the examination of the vestibular-oculomotor system, which may be equally related to the training volume, there was calculation of n = 20; however, adherence was of eight athletes, which can be attributed to the competitions volume in the period of the collection.

CONCLUSION
At the end of the study it could be concluded that the pistol sport shooting athletes presented posture control with significant alterations for the APV and MLV correlation, especially for the APV variation. The correlation between the vestibular-oculomotor system and posture control did not present significance.

Vestibular-oculomotor physiological findings may indicate proportional relations between time of sports practice and training volume of the assessed athletes. There was no conflict of interests involving the parts of this study.

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