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Importance of Visualization to Postural Stability in Amateur Boxers

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Abstract:
The article is connected with problem of postural stability and balance in fighting sports as boxing. The present empirical studies demonstrate that the lack of information about the body position is one of the factors which affect functioning and human physical activity. The study was carried out on the 11-person group of boxers who trained boxing. The particular focus during the examination was on three aspects: duration of the attempt, measures of stability used and instructions given to the subjects. Researches demonstrated that impairment of the sense of vision or sudden change in the field of view largely delays proper development of the postural response of the human body.

1. Introduction

The problem of postural stability and balance has been widely discussed in a number of scientific studies. Among publications that deserve particular consideration are studies by Golema [1987], Juras [2003], Kuczyński [2003], Błaszczyk [2004], and Bober [1993]. These authors focused mainly on the examinations of balance in free standing position. Some of the researchers accept the presence of disturbances that come from the inside or from the outside in their investigations [Riley *et al*. 1997; Balabana *et al*. 2001; Blouin *et al*. 2007]. Body stability during sudden change in the conditions of the environment is also of significant importance. Analysis of the results of the studies reveals relationships between certain components of motor coordination and vertical posture [Hatzitaki *et al*. 2002]. The results of these studies stimulate medical and rehabilitation advances, with balance system performance being a priority. Balance is the process of maintaining the position of the body's centre of gravity vertically over the base of support and relies on rapid, continuous feedback from visual, vestibular and somatosensory structures and then executing smooth and coordinated neuromuscular actions [Juras *et al*. 2013]. Postural control is a complex process and consists in static or dynamic balancing of destabilizing forces of gravity and inertia (including moments of these forces) through stimulation of the respective muscle groups. The system of balance control can be approached as a control system [Błaszczyk *et al*. 2005].

Postural control is a complex process requiring integration of the sensory information and execution of appropriate postural responses. To maintain upright stance, the central nervous system (CNS) must coordinate motion across many joints and muscles using sensory information provided by visual, somatosensory and vestibular systems. Since postural coordination and the role of different sensory systems change as a function of task constraints, the CNS must use different strategies for appropriately stable balance control under different task conditions [Akram *et al*. 2008]. Difficult balance task paired with a cognitive task reduced sway by decreasing attention toward balance related cues [Swan *et al*. 2007].The present empirical studies demonstrate that the lack of information about the body position is one of the factors which affect functioning and human physical activity. Adults with poor balance and high postural sway fall more often and have a higher bone fracture risk than adults with better postural control [Goulding *et al*. 2003]. Motor abilities largely determine human existence, whereas losing eyesight causes that this system is disturbed, which considerably affects the quality of living. The goal of the present study is to evaluate the effect of momentary loss of control over the sense of vision on spatial position, stability and the process of control of balance in standing position. Despite the prevalence of fear of falling, coupled with low balance confidence in older adults and patient populations, there has been little focus on the impact of such psychological factors on postural control. The majority of research examining the effects of anxiety on balance behaviour has been restricted to posturographic measures [Hauck *et al*. 2008]. Due to the methodological requirements of the main problem of the study, the authors formulated the following research hypothesis Limitation of the input and disturbance in the information from visual receptor impacts on destabilization of the process of maintaining balance as a result of improper and incomplete information from the peripheral to central nervous system that coordinates body balance.

2. Material and Methods

The study covered 11 healthy and physically fit men at the age ranging from 18 to 24 years. Based on the interview with the study participants, no pathological states were found in the subjects (diseases connected with motor organ, eyesight disturbances, balance and neurological changes). The study group was comprised of the boxers from "Wisłoka" boxing club in Rzeszów, Poland. All of them participated in at least 3 professional boxing training sessions a week and competed in amateur boxing league. The test was carried out in May 2010. The examination was carried out in the afternoon, before the physical exercise connected with training session, in a special room (without access of the light from the outside). Only the subject tested and a person who turned off the light were present in the room. All the subjects expressed their consent to participate in the study and were informed about the aim and nature of the examinations. None of the persons knew how each test will look like so that not to the credibility of the results could be ensured. Essential role in the experiment was played by a surprise factor, which was turning on the light. The experiment consisted in standard evaluation of stability during free standing on the stabilographic platform in three consecutive attempts. The total duration of each attempt was 30 s.

— attempt 1: free standing on both legs; after 10 s the light went off (a person examined had not known about this before),
— attempt 2: free standing on both legs; a person was informed that after 10 s the light would go off,
— attempt 3: free standing on both legs, without any disturbances.

Tab. 1. Results obtained after the first attempt (light went off after 10 s without warning).

Parameters	Max	Min	Avg	SD
COP-X Avg (cm.)	1.659	-2.555	0.147	4.179
COP-Y Avg (cm.)	2.256	-4.855	-1.799	7.666
COP-X Max (cm.)	2.555	0.436	1.335	1.986
COP-X Min (cm.)	-0.378	-3.192	-1.182	2.502
COP-Y Max (cm.)	5.009	0.95	2.8	5.002
COP-Y Min (cm.)	-1.195	-6.284	-2.585	5.222
Standard Deviation - X COP	0.863	0.154	0.459	0.736
Standard Deviation - Y COP	1.674	0.323	1.017	1.509
Avg. Displacement along X (cm.)	0.512	0.124	0.318	0.461
Avg. Displacement along Y (cm.)	1.054	0.235	0.703	0.884
Avg. Radial Displacement (cm.)	1.227	0.34	0.819	1
Standard Deviation - Radial Disp.	1.503	0.247	0.76	1.333
Corelation Coefficient	0.96	-0.795	0.12	2.012
95% Ellipse Slope	87.817	-82.081	17.472	234.174
SD - Major Axis of 95%Ellipse	1.259	0.322	0.706	1.147
SD - Minor Axis of 95%Ellipse	1.54	0.228	0.822	1.509
95% Ellipse Area (cm..cm.)	13.33	1.23	6.613	14.481
Avg Velocity (cm/sec)	2.012	1.273	1.595	0.756
Length (cm.)	60.351	38.192	47.84	22.692

Tab. 2. Results obtained from the second attempt (the subject was informed that the light would go off after 10 s).

Parameters	Max	Min	Avg	SD
COP-X Avg (cm.)	1.195	-2.503	0.103	4.276
COP-Y Avg (cm.)	1.454	-5.113	-1.84	7.507
COP-X Max (cm.)	2.503	0.447	1.213	2.267
COP-X Min (cm.)	-0.357	-3.241	-1.207	2.441
COP-Y Max (cm.)	5.113	0.708	2.696	5.452
COP-Y Min (cm.)	-0.971	-6.092	-2.556	5.64
Standard Deviation - X COP	0.896	0.13	0.457	0.722
Standard Deviation - Y COP	1.769	0.254	0.943	1.784
Avg. Displacement along X (cm.)	0.585	0.099	0.319	0.447
Avg. Displacement along Y (cm.)	1.04	0.191	0.62	1.037
Avg. Radial Displacement (cm.)	1.177	0.354	0.755	1.096
Standard Deviation - Radial Disp.	1.412	0.239	0.748	1.473
Corelation Coefficient	0.973	-0.705	0.153	1.891
95% Ellipse Slope	86.503	-86.574	5.964	231.942
SD - Major Axis of 95%Ellipse	1.256	0.362	0.781	1.059
SD - Minor Axis of 95%Ellipse	1.432	0.226	0.711	1.552
95% Ellipse Area (cm..cm.)	13.981	0.916	5.965	14.541
Avg Velocity (cm/sec)	2.147	1.321	1.605	0.882
Length (cm.)	64.401	39.641	48.154	26.467

Tab. 3. Results of the third attempts (free standing).

Parameters	Max	Min	Avg	SD
COP-X Avg (cm.)	1.563	-2.229	0.264	4.109
COP-Y Avg (cm.)	1.453	-5.14	-1.975	7.666
COP-X Max (cm.)	3.883	0.505	1.502	2.987
COP-X Min (cm.)	-0.247	-3.385	-1.243	2.645
COP-Y Max (cm.)	5.277	0.466	2.711	6.204
COP-Y Min (cm.)	-0.515	-5.944	-2.143	6.043
Standard Deviation - X COP	0.773	0.088	0.473	0.618
Standard Deviation - Y COP	1.737	0.189	0.908	1.811
Avg. Displacement along X (cm.)	0.484	0.065	0.311	0.371
Avg. Displacement along Y (cm.)	1.03	0.147	0.574	0.988
Avg. Radial Displacement (cm.)	1.133	0.317	0.709	0.903
Standard Deviation - Radial Disp.	1.417	0.276	0.79	1.404
Corelation Coefficient	0.985	-0.873	0.132	1.974
95% Ellipse Slope	67.34	-88.094	-16.259	204.482
SD - Major Axis of 95%Ellipse	1.474	0.368	0.725	1.057
SD - Minor Axis of 95%Ellipse	1.66	0.129	0.716	1.629
95% Ellipse Area (cm..cm.)	10.257	0.676	4.618	9.455
Avg Velocity (cm/sec)	2.48	1.125	1.506	1.302
Length (cm.)	74.4	33.744	45.195	39.048

The starting point for the studies was to investigate the process of maintaining balance based on the value of sway recorded with the stabilographic platform. An AMTI platform was used during the examinations.

3. Results

Attempt 1: During the first attempt the subjects stood on the platform. Without prior warning, the light went off after 10 seconds. The results of the study are presented in the following tables:

The values of the radial displacement ranged from 1.503 to 0.247. The correlation coefficient ranged between the level of -0.795 and 0.96 with the mean value of the coefficient of 0.12 and standard deviation of 2.012. Average velocity for the first attempt was 1.595. Standard deviation for the whole length of COP pathway was 22 692.

Attempt 2: During the second attempt, a subject, standing already on the platform (after completion of the previous attempt) was informed that the light would go off after 10 seconds.

The values of the radial displacement ranged from 1.412 to 0.239. Average displacement was 0.748; whereas standard deviation amounted to 1.473. The correlation coefficient ranged between the level of -0.705 and 0.973 with the mean value of the coefficient of 0.153 and standard deviation of 1.891. Average velocity for the first attempt was 1.605. Standard deviation for the whole length of the COP pathway was 26 467.

Attempt 3: During the third attempt, a subject stood on the platform and was informed that the last attempt consists in the examination of the process of maintaining balance in free standing, without any external disturbances.

The values of the radial displacement ranged from 1.417 to 0.276. Average displacement was 0.79; whereas standard deviation amounted to 1.404. The correlation coefficient ranged between the values of -0.873 to 0.985 with the mean value of the coefficient of 0.132. Average velocity for the first attempt was 1.506. Standard deviation for the total length of the COP pathway was 39 048.

4. Conclusions

Performance of the receptors that are used to send information about the changes in spatial arrangement and position of the body, function of the central nervous system as a regulator and the effect of the external factors considerably impact on the proper coordination of postural sway. Despite apparent separatedness, the above systems operate synergically to some extent, which causes that under normal conditions, exclusion of one of them leads to disturbances in the posture. The properly coordinated vertical position should be characterized by the scope, precision and economics [Grochmal *et al.* 1986].

Exclusion of the sense of vision, or rather strong disturbance to this sense through switching off the light without warning the subjects about this fact, allowed for evaluation of the effect of this sense on maintaining stable posture. The study was carried out on the 11-person group of boxers who trained boxing. The particular focus during the examination was on three aspects: duration of the attempt, measures of stability used and instructions given to the subjects. According to Kuczyński [2000], the difference during the study might have been caused by the instruction of “stand possibly motionless” and, on the other hand, the instruction of “stand relaxed”. Among the adopted measures of stability of balance system, particular analysis was carried out using possibly best results in order for them to fully represent the properties of the analysed stabilographic signals.

Analysis of the results of the studies and the progress in the test reveal the effect of the sense of vision on the whole process of postural control. In the first attempt, with a sudden disturbance to visual contact with the environment (the light went off), the most of the subjects exhibited a temporary loss of balance but they quickly returned to a more vertical position. In this area, stability of each person works individually. The fact of not falling suggests a strong response from the nervous system, which in such cases is provided with higher frequency of signals that send proprioceptive information. Compensation of the posture occurs, as mentioned above, through other systems (which remain in the state of readiness). Through this action, the postural system attempts to correct the errors and to return to a central reference pattern. According to Sienkiewicz [2001], each motor decision is accompanied by ‘afferent copy’, based on storing the above pattern. Moving on to consecutive attempts, through informing a subject about what would happen after some time, the results of coordination and sway area were insignificantly deteriorated in the most of the cases. This means that their scatter is slightly greater and more distant from the centre of pressure on the platform. Through information about the external disturbance, the person can be prepared to sudden situation through a postural habit and the feedback discussed in previous chapters, which is of fundamental importance to combat sports. Furthermore, the person, through awareness of the possibility of the danger, remains in the state of readiness and feels more confident. With this confidence, the person lets the postural to be greater. In the third attempt, when a person is instructed that they have to stand relaxed and nothing will disturb their vertical attempt, one can observe, in the most of cases, the biggest body balancing, which suggest the highest comfort of the person with respect to the conditions in the environment.

Conclusions

1. The study demonstrated that impairment of the sense of vision or sudden change in the field of view largely delays proper development of the postural response of the human body.
2. Eyesight has an important role in maintaining postural stability when contradictions or limitations occur in the flow of other information used by the balance system.

3. Disturbance in the systems of postural control that is caused by closing the eyes is manifested by the increased measures of scatter in stabilograms in the group of boxers studied.
4. The basic criteria for coordination abilities, including balance, are: accuracy, precision and movement economy.

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Znaczenie wizualizacji w stabilności postawy osób trenujących boks amatorski

Słowa kluczowe: równowaga, sport, koordynacja, zdolności, motoryka

Streszczenie

Problem stabilności postawy i równowagi jest szeroko przedstawiony w wielu badaniach naukowych. Celem niniejszej pracy jest określenie wpływu chwilowej utraty kontroli nad zmysłem widzenia przestrzennego, stabilności i procesu kontroli równowagi w pozycji stojącej. Wprowadzanie ograniczenia i zaburzeń w informacjach z receptorów wzrokowych, wpływa na destabilizację procesu utrzymania równowagi w wyniku niewłaściwych lubi niekompletnych danych obwodowych przekazywanych do centralnego układu nerwowego, który koordynuje równowagę ciała.

Materiał i metody. Badaniami objęto 11 zdrowych i sprawnych fizycznie mężczyzn w wieku od 18 do 24 lat. Na podstawie wywiadu z uczestnikami badania, stwierdzono brak stanów patologicznych u badanych (choroby związane z narządu ruchu, zaburzenia wzroku, równowagi i zmiany neurologiczne). Badana grupa składała się z bokserów z Wisłoki Boxing Club w Rzeszowie (Polska). Wszyscy z nich uczestniczyli w co najmniej 3 profesjonalnych sesjach boksu zawodowego tygodniowo lub startowali w amatorskiej lidze bokserskiej. Badanie przeprowadzono w maju 2010. Zostało ono przeprowadzone w godzinach popołudniowych, przed wysiłkiem fizycznym związanym z treningiem, w specjalnym pomieszczeniu (bez dostępu światła z zewnątrz). Tylko obiekt testowany i badacz, który gasił światło były obecne w pomieszczeniu. Wszyscy badani wyrazili zgodę na udział w badaniu i zostali poinformowani o celu i charakteru badań. Żadna z osób nie wiedziała, jak będzie wyglądać badanie, w związku z czym wiarygodność wyników zastała zapewniona. Istotną rolę w tym eksperymencie odegrał czynnik zaskoczenia, którym było zgaszenie światła. Eksperyment polegał na standardowej ocenie stateczności podczas

postawy swobodnej na platformie stabilograficznej w trzech kolejnych próbach. Całkowity czas trwania każdej próby wynosił 30 s. Próba 1: swobodnie stojąc na obu nogach, po 10 s światło zostaje wyłączone (Osoba badana nie wiedział o tym wcześniej). Próba 2: swobodnie stojąc na obu nogach; osoba została poinformowana, że po 10 s światło zostanie wyłączone. Próba 3: swobodnie stojąc na obu nogach, bez żadnych zakłóceń. Głównym punktem było zbadanie procesu utrzymywania równowagi opartej na wartości „kołysać" otrzymanej z platformy stabilograficznych. Podczas badań użyto platformy AMTI.

Wyniki. Analiza wyników badań i postęp w badaniach wykazują wpływ zmysłu widzenia na cały proces kontroli postawy. W pierwszej próbie, z nagłym zaburzeniem kontaktu wzrokowego z otoczeniem (zgaszenie światła), większość badanych wykazywała chwilową utratę równowagi, ale szybko wracała do pozycji bardziej pionowej. W tym obszarze, stabilność każdej osoby pracuje indywidualnie. Kompensacja pozycji następuje, jak wspomniano powyżej, z innych układów (które pozostają w stanie gotowości). W ramach tego działania, „system postawy" próbuje poprawić błędy i powrócić do centralnego wzorca odniesienia. Przechodząc do kolejnych prób, poprzez poinformowanie obiektu o tym, co się wydarzy, wyniki w obszarze koordynacji i kołysania w większości przypadków zmieniają się. Wykazują nieco większe rozproszenie i bardziej oddalone od środka ciężkości na platformie. Dzięki informacji o zewnętrznych zakłóceń, osoba może być przygotowany na nagłą zmianę sytuacji , co ma fundamentalne znaczenie dla sportów walki. Ponadto, osoba, poprzez świadomość możliwości zagrożenia, pozostaje w stanie gotowości i czuje się bardziej pewna siebie. W trzeciej próbie, gdy osoba jest poinformowana, że nic nie będzie zakłócać ich pionową próbę, można zaobserwować, w większości przypadków, największe zbilansowanie ciała, które sugeruje, najwyższy komfort osoby, w stosunku do warunków w środowiska.

Podsumowanie. Badania wykazały, że zakłócenie zmysłu wzroku lub nagłe zmiany w polu widzenia głównie opóźniają proces prawidłowej odpowiedzi posturalnej ludzkiego ciała. Wzrok odgrywa ważną rolę w utrzymaniu stabilności postawy, gdy występują sprzeczności i ograniczenia w przepływie innych informacji wykorzystywanych przez system równowagi. Zakłócenia w systemach kontroli postawy, które jest spowodowane przez zamknięcie oczu objawia się zwiększonym środkiem rozrzutu stabilogramów w grupie badanych bokserów. Podstawowymi kryteriami zdolności koordynacyjnych, w tym bilansu, są: gospodarka ruchu, dokładność, precyzja.