WHAT VIRTUAL REALITY CAN DO FOR SPORT ? A NARRATIVE REVIEW OF THE LITERATURE

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Key words: virtual reality, sport, competitive sports, physical activity.

Background: The physical fitness of athletes is well above the average of normal people. In addition, the response time has to be much better to reach the championship level, therefore the training demands have changed greatly over the decades. Traditional exercise will always be a fundamental factor in training, however, new technologies have to be considered in order to maximize their effectiveness. An example of a technology is Virtual Reality (VR), where the athlete's "awareness" to a purpose-built world, where they can gain experience and skills similar to the conditions during the competition. The aim of this narrative review was to determine the utilization of VR in training of competitive athletes. Methods: A literature review using PubMed has been conducted to examine the current state of the art in the available literature using VR in the aspect of competitive sports. For the complete review 157 articles on the use of VR in sports were identified, but no article indicated competitive sports. After the individual sports search, 6 articles were adopted for this review of the literature. Results: The presented research results show positive results with the use of VR for athletes on academic level. Not only do they improve the response time in decision-making during competitions, but they also have the opportunity to learn new schemes for use in competitions more quickly. The presented articles describe the performance of competitive athletes at the academic championship level, so there is still a lack of confirmed research on top athletes in the available literature. Conclusions: Based on the limited number

of scientific articles available, it can be assumed that the use of Virtual Reality has a positive impact even on the development of competitive athletes in order to achieve the best possible performance and new skills. It is now possible to make preliminary conclusions and recommend further research on the leading athletes in the respective sports.

INTRODUCTION

High-performance sport is related with the above-average physical fitness of the athletes. A championship level requires many years of hard workouts. Individual training should include physical development part in order to achieve the best possible results during competitions. Athletes usually perform a several kinds of movement which requires fast reactions of the nervous system. The reaction time is much faster than that of an average person [1]. In recent decades, the nature of sports competitions changed. Thus, the training procedure had to change. Nowadays the training procedures are largely supported by various technologies [2]. There are many machines and programs which provide information on physiology and behavioral neurobiology of athletes [3], likewise the biomechanics analysis of kinematic and dynamic data. An example of new technologies is virtual reality (VR). The utilization of VR technologies can be seen in entertainment, military, education, medicine, rehabilitation, likewise in sports. VR is an artificially generated simulation of the real environment generated by computer software, where a human-machine interaction occurs [4]. Virtual reality has many advantages and is increasingly popular among athletes [5]. The VR allows to practice the same sport elements for many times in unchanged conditions with real-time biofeedback. A great advantage is also the possibility to design own scenarios in order to improve performance and to adapt to more and more demanding schemes while practicing sport.

Sports training and virtual reality

Nowadays, an increasing number of scientists, together with experts in various fields of expertise, use technologies related to virtual reality. The aim of this narrative review was to examine the current state of knowledge in the available scientific literature on VR technology in the sports aspect. In the course of writing the current literature review, the PubMed database

was searched using various combinations of the following terms: (((((virtual reality[MeSH Terms]) OR virtual environment[MeSH Terms]) OR virtual system[MeSH Terms]) OR immersion[MeSH Terms]) OR video simulation training[MeSH Terms])) AND (((((athletes[MeSH Terms]) OR sport*[MeSH Terms]) OR professional sport*[MeSH Terms]) OR physical training[MeSH Terms]) OR sport performance*[MeSH Terms] OR Athletic Performance*[MeSH Terms]). 157 articles were found. The initial abstract screening showed none of research on high-performance athletes. Therefore, we decided to search VR-related research in the specified sports. Finally, 6 articles were accepted for our review.

Adaptation of the games with virtual reality

One of the possibilities of VR implementation in practice is presented by research conducted at Bishop University in Canada. Researchers assessed the impact of alternative forms of basketball training. The study recruited 27 players, age 16-26, each participant with experience at least 7 years. The study was scheduled to be conducted in between seasons time so that players would not undertake traditional training. The participants were divided into 3 groups, a control group with verbal description of the task, a immersive VR group and group which only watch the play patterns on screen. The training session included 1 training for 7 days. After a series of trainings, the participants were re-tested and invited to perform task on field. The play patterns were recorded for analysis. The analysis of movement before the training sessions relived no statistical significant differences between the groups. After the training sessions, the statistical significant differences were noted within all groups. The biggest improvement were noted in VR group, then using the image displayed on the monitor and the smallest in the traditional way [6]. Learning new motor task may be one of the possibilities of VR application, another may be to improve them. Sometimes players train hundreds of hours to master new skills or movements to gain advantage during the game. Excessive training of a new pattern, can often cause frustration in players, which can be transferred into the level of preparation. Faster time of mastering the game is the basis for a faster sports career. McLeod et al. tested the heading task with the use of head mounted display VR

system. They recruited experienced footballers at an early age for their research. During the VR simulation reactions of players, preparing the position to receive the ball, the flight path as well as the influence of speed on the whole scheme were recorded. The analysis of the results showed that the movements and reaction time correlated with the movements in real game. The data suggest that the players have an expectation of, and memory for, the pattern that the rate of change of a will follow during the flight. Players present more confidently and, according to the theory of LOT (Linear Optic Trajectory), the reaction time and the rightness of taking appropriate steps during the game by the players [7]. An interesting correlation was also observed by Michalski et al. who checked the influence of improving table tennis skills using VR. They recruited 57 players, 29 underwent training with VR. Before and after the training, the technique and skills were evaluated by a professional table tennis coach. The VR-group participants during the training were immersed in a virtual world in which they could see the picture, hear sounds and feel the vibrations on the pallet imitating the moment of the ball bouncing. The analysis of the results presented a significant statistical differences in the results with significant benefit for the group using VR [8].

Improving physical adaptation

Another aspect appearing in the sport is the physical preparation for the tournaments. Regular training may effect on fatigue or deterioration of capacity caused by exhaustion. Prolonged intensive effort in competitive sports may cause pain due to fatigue and excessive anaerobic work. Thus, may result in worsening or slowing down of training cycle, during the competition may even result in exclusion from it. Wender et al. evaluated the impact of virtual reality training on pain reduction during excessive effort. The study included 94 participants. The testes performed exercise test on ergometer with 20 seconds interval of work rate to maximize muscle activity and the occurrence of thigh quadriceps pain. The results showed that cycling with the use of virtual reality reduces the feeling of pain without losing muscle efficiency [9]. The researchers noted that the level of distraction using virtual reality is so intensive that the participant does not pay attention to pain, i.e. creates the mechanism of hypoalgesia,

whereas traditional movement is not sufficiently scattering [10].

Often in contact sports such as basketball, football or handball, it is very desirable to "anticipate the future", to be able to react correctly e.g. defensively to the attacker before his movement. Such skills are acquired over the years by gaining experience in the game and confronting many opponents, with time leading players read the opponent's intended movements from the small body movements. Such players become a "wall" for attackers who cannot get around them. Magnaguagno et al. tested the improvement of defense in handball players through VR training. The study involved 24 players. The results suggest the players achieved better defense skills and noticed more possibilities to offensive play with weaker opponents defenses [11].

CONCLUSION

The presented articles show the performance of athletes at university competition levels. The available literature still lacks many reports concerning leading athletes from different sports disciplines. With the development of technology, new opportunities are being created for the staff preparing athletes for competitions, but this is currently not so widespread. Virtual reality, despite its benefits in sports such as table tennis, basketball or even football, is little used. Although it is believed that the sport remains the same, the tactics, style of play or pace during it are constantly changing [12]. The technological support may offer better chance of success, as there are more and more athletes who have dreams of becoming the best in the world.

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Received: Jun 08, 2020

Accepted: August 29, 2020