Vision and Sport: The Past Present and Future Role of Orthoptics

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ABSTRACT

In 1970 Air Vice Marshal Daley addressed the graduating Orthoptists in Melbourne. Extracts from his speech were published in the 1970 Australian Orthoptic Journal. In his speech he outlined the significant role of Orthoptics in training pilots during World War 2. He also stated the important role of Orthoptics in sport and gave an example of the "Hawthorn footballer who, following some ailment lost his ability to mark the ball overhead. After orthoptics he recovered his skill, and retained his place in the league".

During this decade and in the 1980's Optometristís mainly in the United States started to develop ~ and propose theories for vision and sports performance. Limited Orthoptic literature in this area led to the development of optometric sports vision training programs. These years produced much anecdotal evidence and to date the sports medicine community largely continues to ignore the claims of vision training and sports performance.

The development of the Orthoptic profession in Australia over the last 50 years has highlighted the flexibility in applying our theoretical and practical knowledge to benefit special communities. This has occurred in low vision rehabilitation, CVA and head injury rehabilitation and driver rehabilitation. The role of orthoptics in sport is purely an extension of these specialty areas.

Sport brings together the celebration of human kind and the endeavors to perform and participate at the highest levels. Orthoptics is a celebration of a profession that continues to expand, thrive and offer opportunities to all those who are willing to participate.

The challenge of re-establishing the role of orthoptics in sport has only just begun. This presentation will highlight the past, present and future role the Orthoptist in sport.

INTRODUCTION

I would like to thank the Australian Orthoptic Association for this nomination. I would like to extend a warm welcome to overseas orthoptists who have joined us for another stimulating national conference. I hope this presentation will be educational, thought provoking and entertaining as I attempt to take you on a journey into the research ideas relating to vision and sport.

By 1939 Sir Philip Livingston an ophthalmologist had concluded the importance of binocular single vision in flying and with the outbreak of World War 2 developed standards for visual requirements for pilots. Orthoptic treatment was extensively used in treating pilots with visual problems related to heterophoria and convergence problems.

In 1970 Air vice Marshal Daley in an address to graduating orthoptists in Melbourne highlighted the significant role of orthoptics in training pilots during World War 2. In his speech he also suggested the importance of orthoptics in sport. Unfortunately the challenge to develop this area was not taken up by orthoptists at that time. Thirty years later I am able to present a scientific basis for othoptics in sport.

The search for excellence through physical performance is unceasing. Researchers, coaches, and athletes continue to explore the limits of human action potential. In this regard, the visual system and its contributions to sport performance success has been investigated for a number of years. These investigations have included the neurophysiology of the eye and brain as well as visual, perceptual and motor parameters.

The plethora of anecdotal evidence and lack of scientific research are frequently cited as the reasons for scepticism amongst critics of practitioners of sports vision. Whilst no-one would deny the importance of good visual acuity to almost all forms of sport, the relevance of binocular single vision is rarely appreciated by those outside ophthalmology. It may be possible to quantify improvement in visual performance in the clinic however the task of equating this with increased skills on the sports field is difficult. Practitioners of sports vision are generally involved in 4 different areas:

1. Vision screening
2. Vision training to improve performance
3. Prescription of protective eyewear and sunglasses
4. Treatment of sports related eye injuries

This presentation will mainly focus on the controversial area of vision training to improve athletic performance.

The relationship of vision and skilled movement

Skilled movement is not a spontaneous muscular response but represents a sequence of complicated processes within the central nervous system. An athlete absorbs information from the surrounding sporting environment and processes this information. The final output produces a movement response. This model of humans as information processing systems is commonly used to explain the role of vision in producing and controlling skilled movement. The human performance model was originally presented by Welford[1]. The model assumes that perceptual-motor

performance occurs when sensory input information is converted into a purposeful output action. In between the input and output actions information passes through three hypothetical central processing mechanisms.

Perceptual mechanism

This mechanism receives information from receptors such as the retina for visual information and the inner ear for balance information. The perceptual mechanism reorganises and interprets the information. The selection of information can be influenced by the athlete's previous experiences.

Decision mechanism

Information from the perceptual mechanism is passed through to the decision mechanism which decides the appropriate action. This mechanism is concerned with response selection and strategy formation. This can also be influenced by the athlete's previous experience.

Effector mechanism

If the decision mechanism selects a motor response, the relevant information is passed onto the effector mechanism which controls and organises the sequence of the desired movement. Neural commands pass from the central nervous system to muscle groups required for the movement. Through feedback this mechanism can control a movement during its execution and evaluate the final result in a way which allows changes to be made in the future.

The perceptual mechanism is made up of 2 different levels of visual information.

1. **Hardware**

The first type of processing involves the reception of visual information, this is affected by the ocular characteristics of the athlete's visual system. The hardware components of the visual system can be measured using orthoptic or optometric tests and forms the basis for a sports vision eye examination.

2. **Software**

The second type of processing involves the perception of visual information this is influenced by the strategies an athlete develops through experience that result in processing the incoming information more efficiently. Software aspects of sports vision include information processing strategies, encoding and retrieving perceptual information from memory, extracting relevant information from both advance cues and ball flight cues and the use of anticipatory skills.

Sports vision testing

A sports vision assessment as conducted by an orthoptist should include:

1 Static and dynamic visual acuity for both near and distance with and without glasses, if worn.
2 Cover test in all positions of gaze to determine the nature and size of any heterophoria or heterotropia
3 Examination of the smooth pursuit and saccadic systems of ocular movements
4 Measurement by prism cover test of the heterophoria or heterotropia
5 Measurement of the near point of convergence
6 Assessment of the range and amplitude of accommodation
7 Assessment of motor fusion ranges of convergence and divergence for near and distance
8 Measurement of stereoacuity for both near and distance
9 Determination of the dominant eye
10 Assessment of the monocular and binocular visual field

In addition to testing the hardware aspects of the visual-perceptual system a sports vision examination may include tests for visual-motor performance. This includes:

Eye hand coordination.

Eye-hand coordination is defined as a perceptual-motor skill involving the integration of visual and tactile information so that a purposeful movement may occur. Eye-hand coordination is often divided into two components, proaction and reaction as tested on the Acuvision 1000. Proaction refers to action which is initiated or controlled by the athlete e.g. the motion of passing a ball. Reaction refers to movement that occurs in response to another action e.g. a player catching a ball

Peripheral awareness reaction time

Peripheral awareness reaction time measures how quickly an athlete is aware of an object in his peripheral vision. In team sports peripheral awareness is a crucial skill.

Total reaction time

This represents the measurement of reaction time plus movement time based on responses from the visual, auditory and motor systems. First step explosiveness and the ability to get off the mark quickly is an important component of visual-motor performance.

Eye / foot coordination

Eye/foot coordination is the ability of the feet to respond in a smooth and coordinated manner as a result of information provided by the visual system.

Coincidence anticipation

Coincidence anticipation is the ability to make a motor response coincident with the arrival of an object at a designated point e.g. predicting the arrival of a pitched ball in baseball.

Concerns about Optometric based sports vision training

In the 1970's and 1980's US optometrists gained increasing attention for their claims that all athletes could benefit from vision training programs. In the majority of the health sciences evidence-based practice forms the major nexus between science and clinical/professional intervention. To this day vision training is increasingly advocated and utilised in clinical and behavioural optometry as a basis for improvements in sports performance yet the evidence-base to support such an intervention is far from compelling. The evidence surrounds three key assumptions to the efficacy of sports vision training:
Assumption 1: The visual attributes being trained are limiting factors to sports performance.

Assumption 2: Functional aspects of limiting visual attributes can be improved through visual training
Assumption 3: Improvements in the functional aspects of key visual attributes translate to enduring improvements in sports performance.

Consideration of the evidence-base relevant to each of these assumptions highlights the need for considerable caution in making strong claims as to the likely benefits to sports performance of existing approaches to visual training.[2]

Abernathy and Wood report the outcome of a controlled study on the impact of visual training on sports performance. The study was conducted over a four week period with 30 subjects allocated to training, placebo and non treatment groups. Results of this study indicated that visual training did not improve either visual or motor performance, however, there was a learning effect. It is important to note that subjects undertaking the vision training had no visual problems. As has been shown, any exercise regimen should be based entirely on the individual athlete's requirements. It is a misconception that a standard set of eye exercises can be given to anyone, as claimed by many sports vision optometrist. Before prescribing a treatment regime, a complex study of the subject's binocular status is necessary.

The Orthoptic approach to sports vision

To the orthoptist the present sports vision training programs present several problems. Firstly they are based on adaptations of treatment modalities utilized by optometrists in the management of children with specific learning disabilities, an area in which there is a great deal of controversy. Secondly it is suggested that all athletes undergoing a similar vision training program regardless of their sporting discipline or binocular status can obtain a beneficial effect. Finally it is not just a lack of situation specificity that is missing but far more importantly a lack of subject specificity, as the exercise regime is not tailored to individual needs.[3]

The orthoptic therapies used are proven methods based on sound scientific principles. The fact that 'the patients' originate from the general population rather than from the sporting fraternity is irrelevant. The skill of the eye care practitioner testing athletes is in identifying those with defects or deficiencies that will benefit from treatment. Orthoptists interested in conducting sports vision testing and training may wish to implement the following guidelines in clinical practice:

1. Conduct an eye examination to establish an athlete's ocular status
2. Ocular motility and binocular vision deficiencies should be identified and linked to asthenopic symptoms.
3. Classical Orthoptic vision training can be introduced with the aim of restoring binocular function and relieving symptoms
4. Athletes who pass the eye examination do not require classical vision training intervention. However the use of warm up eye exercises is a possibility. The focus should switch to visual motor performance, visual awareness coaching and perhaps training the perception of visual information.

Vision training is therefore classified into 4 categories: (this classification is based on guidelines developed at the Sports Vision Clinic, School of Applied Vision Sciences)

1. Classical Orthoptic exercises
2. Visual-motor performance
3. Visual awareness training on the field and warm up eye exercise
4. Perceptual - visual search strategies, decision making

At the Sports Vision Clinic, School of Applied Vision Sciences I currently offer athletes Orthoptic exercises and visual-motor performance training. The ongoing challenge is to identify and develop programs for developing visual awareness programs and perceptual training which is currently limited.

CONCLUSION

An elite or talented junior athlete will dedicate themselves to achieving physical perfection in order to perform at the highest possible level. The fact that the sportsman involved in ball games may not even have a routine eye test, in activities which are wholly dependant on visual skills is surprising.

A sports vision assessment, which should be undertaken by an orthoptist will evaluate the binocular status and visual motor function of each individual in order to ensure that any areas of weakness are identified and treated. Vision therapy will help the athlete to use his entire monocular and binocular system at optimal levels and may well result in improved performance on the sports field if conducted in a proper scientific manner.

Over the years sports physiotherapist have become an integral part of the sports science team dedicated to maximising the athlete's performance. The Orthoptist is ideally suited to join the sports science team and manage the athlete's visual system.

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