Neuroscience approach to sports injuries: Injury prevention out of the box.

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Abstract

Last few years has seen a revolution in rehabilitation research and strategies for sports injuries. This has created a huge theoretical foundation but practically there is an increase in the injury incidence and reoccurrence mostly involving ACL and soft tissue pathologies. Injuries by itself occur mostly in a multi-stimuli environment, with players needing to simultaneously process information from various sensory organs. Although evidence supports neuromuscular training for effective injury prevention and rehabilitation, many of these approaches primarily target biomechanical factors, such as muscle strength, balance, and plyometric function, and give less consideration to cognitive or neurological components.

Keywords: Soft tissue pathologies, Rehabilitation, Muscle strength, Plyometric function.

Introduction

All motor actions depend on an integrated unit which begins with sensory and perceptual activities including the visual, vestibular, and somatosensory systems. While muscles are important for the execution of skills, muscles don't think. Recent reports have found unresolved neuroplastic alterations after injury, reconstruction, and rehabilitation that may limit function and return to sports participation [1]. During severe injuries athletes experience some kind of sensory deprivation regarding the balance system. This proprioceptive impairment leads to further decrements including reduced drive for recruitment of alpha motor neurons, disturbed reflex joint stabilisation, increased postural sway in balance task and decrease in visual movement acuity tasks. Joint and muscle pain induce acute neural responses which protect the body by decreasing strength, agonist activation, muscle endurance and altering coordination patterns during all motor tasks [2]. This helps reduce the load on tissues after in the immediate aftermath of the injury, but this leads to chronic adaptations within the CNS. Rehabilitation has to be focus on maintaining the cognitive skills from the beginning, including within the early phases exercises with proprioception and visual and time and space decision making actions. Biggest non-physical stimulus during team sports is the task to track several players and the ball while simultaneously defining their position in the space related to the individual [3].

Discussion

Players require the cognitive skills related to attention switching, spatial and pattern recognition, memory recall, reflexes, vision, sensorimotor processing and impulse. Normally these skills can be maintained through normal technical and tactical training. Some soft tissue and skeletal injuries result in immobilisation of the specific area (and subsequently limits full movement). Immobilisation leads to a decrease in cortical activity and decrease the cognitive functioning of the player. There is also evidence indicating that neuromuscular injuries can have a negative impact on cognitive skills as well [4]. In addition, people with ACL injury history performed worse in a cutting task when a visual task was added in comparison to non-affected people. This can be seen as evidence of cognitive detraining and highlights the importance of stimulating the neural pathways and keeping the cognitive skills sharp when a player is unable to train. During rehabilitation the sensory, motor and autonomic function can be recovered, axonal/dendrite strengthen and these can lead to physical improvements and the normalisation of reflexes. Interventions to mitigate these detrimental neuroplastic effects, along with the established bio mechanical changes, need to be considered in the rehabilitation process and return to play progressions. Motor skills training can be a key tool during rehabilitation [5].

This helps reorganise the motor cortex of the CNS and increases protein synthesis, synaptogenesis and map reorganisation and can lead to improved task performance. The brain and spinal cord can develop new neuronal inter connections enabling new functions to be developed and old functions to be restored. When an injury occurs, new neural connections compensate for the relearning processes. Synaptic connections can be adjusted [6]. Sensory motor training leads to functional performance improvements. The ability to keep the constantly changing environment (player or

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ball positions) in short-term visual memory also plays a vital role in feed forward motor planning during activity. If visual motor processing is suboptimal, this will decrease the ability to compensate for external stimuli and or attenuate the rapid manoeuvres that depend on quick visual-motor interaction to avoid the re injury motor faults [7]. Athletes who return from rehab have an altered system of sensory input from the injured area and representation in the brain. The organism continues to rely more on the visual input for motor planning than gathering information from the previously injured part up to the brain. That, in turn, could hinder the right motor control to external stimuli from game situations and potentially lead to higher reinjury risk [8]. Rehabilitation strategies that can be used include the use of mental imagery which acts as a form of neurological and sport specific rehabilitation while players still have limited mobility. While visualising specific performances, muscles show small amounts of electrical energy associated with that specific action, despite the absence of any gross muscular movement. Eccentric training is another tool often used in rehabilitation programs.

Conclusion

Eccentric training does not only have a physical impact but also results in neural adaptation including the more efficient motor unit recruitment. The need to bridge the intense neurocognitive and motor control demands of sport during rehabilitation may therefore benefit from specific interventions that target these neuro cognitive factors in addition to the biomechanical techniques that are already widely addressed

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