LOW BACK PAIN AND THE POSSIBLE ROLE OF PILATES IN ARTISTIC GYMNASTICS

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Systematic scientific review

Abstract

Low back pain is one of the commonest sites of pain in gymnasts. This pain may accompany well defined anatomical abnormalities of the spine or be present without significant skeletal abnormality. Skeletal abnormalities correlate with age and hours of training per week implicating that spinal injuries in gymnasts are "training-dose" related. We give an overview of the studies reporting on the incidence and prevalence of spinal injuries and low back pain in artistic gymnastics. The origin of low back pain is described and analysed. Pilates is an increasingly popular system of body-stabilising exercise. Its main principles are devoted to activation of the muscles contributing to spinal stabilization. It was used as a rehabilitation method for a lower back problems and was shown to be effective and of good subjective acceptance in the general population, whereas specific studies in the artistic gymnastics are lacking. According to the studies with training programs implementing similar lower-trunk stabilizing principles as Pilates, gymnastics couches may be encouraged to implement this kind of exercise for prevention and treatment of chronic low back pain in gymnasts.

Key words: *sport, injury, training, spine, rehabilitation, prevention*

INTRODUCTION

It is becoming increasingly difficult to achieve top level results in artistic gymnastics. As the sport disciplines become increasingly professionally planned and thoughtfully guided, new methods and resources are being increasingly introduced which prevent random and coincident factors to influence the training process (Čoh and Čuk, 1995). Achievement of top-level results in artistic gymnastics is dependant on several factors ranging from implementation of scientific findings on one hand to efficient prevention of injuries on the other. Sport injuries can represent a serious obstacle in achieving goals in Artistic Gymnastics. To the gymnasts chronic pain syndromes of which low back pain is one of the commonest, are a classic example of sport related injuries (Micheli, 1985; Caine et al., 1989; Tertti, 1990; Konermann and Sell, 1992; Wadley and Albright, 1993; Lohrer and Arentz;2001; Bono, 2004; Caine and Nassar, 2005; Bennett at al., 2006; McCormack et al., 2006; Kraft et al., 2007; Harringe et al., 2007a; Harringe et al., 2007b; Marini et al., 2008; Vrable and Sherman, 2009).

The incidence of low back pain is increased with increment in hours of training per week (Goldstein et al.,1991), therefore it is of paramount importance, to implement in the training process new methods and exercise programs, which are able to reduce and prevent the development of chronic back pain.

PILATES - A METHOD OF SPINAL STABILIZATION

Pilates, a special method of training, is a system of exercises developed by Joseph Pilates (1880-1967) during World War I (Lately, 2001). Its popularity is growing worldwide in the last two decades. It is popular in all areas of fitness (Segal et al., 2004; Jago et al., 2006) and rehabilitation (Smith and Smith 2004; Johnson et al., 2007; Kaesler et al., 2007). Pilates is a method of bodystabilization, which combines

strength and stretching exercises in a special way, always following a set of basic principles. In the published literature several sets of basic principles are defined (Siler, 2000; Craig, 2001; Ungaro, A. 2002; Merrithew, 2003; King, 2004; Herman, 2004) all striving to adequately teach a correct execution of Pilates exercises. A correct execution of exercises includes activation of deep trunk stabilizers (transversus and obliquus abdominal wall muscles) at the same time with the muscles of pelvic floor and multifidus which enables a better stabilization of lumbar spine. This is an exercise system, which, correctly executed, prevents and diminishes lower back pain (Donzelli et al., 2006). In 2008, the study of deep trunk stabilizers' activation in Pilates exercise was published which was aimed to assess activity of transversus and obliquus internus abdominal muscles during classical Pilates exercises performed correctly and incorrectly (Endleman and Critchley, 2008). The activation of muscles was assessed using an ultrasound scanning. Strong and consistent activation of trunk stabilizers was found during the correct exercise execution, which was absent when exercises were incorrect. This finding confirms the efficiency of Pilates in trunk and spinal stabilization.

SPINAL INJURIES AND LOW BACK PAIN SYNDROMES IN ARTISTIC GYMNASTICS

Low back pain is an extremely common complaint in competitive gymnasts, and these athletes are at risk for multiple potential structural injuries to the spine. Low back pain can have an acute presentation, which most often represents muscle and ligament strains with transient pain diminishing in several days or weeks. Alternative presentation is a more chronic, persistent or recurrent pain syndrome, which is a greater drawback for the gymnast, since it can result in significant impediment iny the training process. Of particular concern among gymnasts is spondylolysis (Kennedy1994; McCormack and Athwal, 1999; Guillodo et al., 2000; Mannor and Lindenfeld, 2000). Of particular concern among gymnasts is spondylolysis (Kennedy1994; McCormack and Athwal, 1999; Guillodo et al., 2000; Mannor and Lindenfeld, 2000).

Caine et al., 1989 performed an epidemiological survey in female gymnasts, in which 43 out of 50 included gymnasts suffered from a cumulative number of 147 injuries in a one year period. Graduate onset of pain was a presenting sign of 56% of injuries and lower back was one of the most commonly affected regions.

The great prevalence of spine injuries in competitive artistic gymnastics was reported already in early studies of this problem (Goldstein et al., 1991). In this study the magnetic resonance imaging (MRI) was used to demonstrate spinal abnormalities. They were found in 9% pre-elite, 43% elite and 63% olympic level gymnasts and in only 16% of swimmers. The spine abnormalities were predicted by age and hours of training per week which suggests that spine injuries in gymnastics are »dose« related, with 15 hours of training or more per week suggested as a threshold of significantly increased risk.

THE ORIGIN OF BACK PAIN

The most common injuries of spine resulting in back pain can be in simplistic terms classified into four general types. The first type of pain is the result of acute overload and microtrauma of spinal elements resulting in typical strain-type of pain. This pain and soreness comes from the spinal muscles and ligaments which are overstretched and injured and usually goes away within a few days with appropriate resting and lowering of activity.

Second class of back pain injuries comes from the rupture of intervertebral disc with or without herniation of the jelly nucleus pulposus through the crack. This type of hernia injury causes lumbar pain and sciatica (pain radiating down the buttock and the posterior part of the leg) and is associated with the irritation of and the pressure on the spinal nerve roots. This type of injury may arise with sudden twisting or bending movements of the spine.

Third type of spine injury is the consequence of hronic wear-and-tear type of degenerative injury. In this process intervertebral discs shrink, this causes the parts of facet joints to increasingly rub againts each other (figure 1). With time the degenerative process results in osteoarthritic bony formations (spurs) which encroach on the spinal canal and narrow it causing spinal stenosis. Finally, the fourth

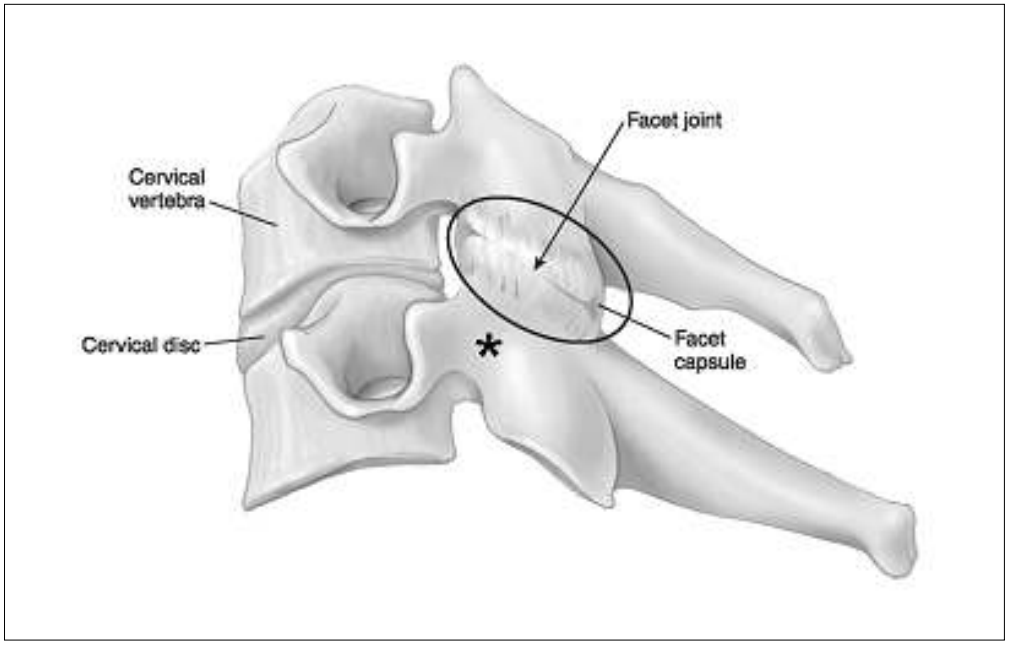

Figure 1. *The anatomy of intervertebral discs and facet joints.*

typical type of spine injury is spondylolysis and consequent spondylolisthesis. Spondylolysis is a condition where there is a disconnection in the bony part of the vertebra between both facet articular surfaces (see the asterisk in figure 1). This may be the consequence of a stress fracture and is typically found in the lower back (fifth lumbar vertebrae). When this causes a slipping of one vertebrae over the other the resultant misalignment of the spine is called spondylolisthesis (figure 2).

In the study on olympic-level female gymnasts spondylolysis and spondylolisthesis were found in 3 out of 19 gymnasts, and were present only in the subgroup with the current ongoing low back pain (Bennet et al., 2006). Similarly to the above mentioned results of Goldstein et al. (1991), the abnormalities of the spine in the study of Bennet et al. (2006) were detected in approximately two thirds of olympic-level gymnasts. In the contrast to this two reports, in the study on elite horse vaulters only slight degenerative changes of the lumbar spine were found with MRI scanning, although 85% of included vaulters reported back pain and 75% reported daily back pain (Kraft et al., 2007). Therefore it may be concluded from this opposite findings that the presence of back pain

Figure 2. Spondylolisthesis. (Note the misalignment of the fifth lumbar vertebrae above the sacrum, which is the result of slipping forward of the fifth lumbar vertebrae).

in gymnast is not a necessary consequence of a significant pato-anatomical derangements of the spine. In this case the value of appropriate preventive training such as Pilates may be especially high. However persistent or major back pain in a gymnast must be recognized by their trainers as a possible sign of significant spinal injury (such as spondylolysis) and appropriate medical help must be sought.

THE ROLE OF PILATES IN PREVENTION AND TREATMENT OF LOWER BACK PAIN

Pilates as a form of body stabilizing exercise may be used in the rehabilitation of chronic low back pain. Through the activation of lower trunk stabilizers it may improve the spinal protection and enable one to neutralize the influence of improper posture and repetitive strains on the development and persistence of lower back pain. The proof of this presumption came in 2006, when three randomized controlled trials were published on the efficacy of Pilates-based therapeutic exercise in the rehabilitation of low back pain. However, it is important to mention that randomized clinical studies on this subject began to be published as of 2006 (La Touche et al., 2008).

In the first study by Rydeard et al., (2006), 39 subjects with chronic low back pain were randomized to the 4-week Pilates program group or the control group without specific training program. After the 4-week training the subjects in the intervention group had a significantly lower functional disability score (2.0 vs 3.2) and a significantly lower pain intensity score (18.3 vs. 33.9). The benefit in disability score was maintained even after 12 months. In the second study by Donzelli et al. (2006), 43 subjects with lower back pain were randomized to the classic "Back school" rehabilitation program or the Pilates based rehabilitation program. The length of each program was 10 daily sessions. Pain and disability scores similarly improved in both group with the Pilates group showing somewhat better subjective response to treatment. In the third study by Gladwell et al. (2006), 49 subject with chronic non-specific low back pain were randomized to contol or Pilates group. The Pilates group undertook a six week program of Pilates and after that both groups continued with normal activity. Improvements were seen in the Pilates group post-intervention withincreases in general health, sports functioning, flexibility, proprioception and the most important a decrease in pain. All other articles searched using SienceDirect and ISI Web of Knowledge confirmes the role of Pilates in prevention and treatment of low back pain (Sekendiz et al., 2007; Da Fonseca et al., 2009; Levine et al., 2009; Curnow et al., 2009). The terms used for the search were "Pilates" and "Low back pain".

The rehabilitation of gymnasts with lumbar injuries is poorly studied. The related literature would support incorporating the concepts of dynamic lumbar stabilization and sport-specific training into rehabilitation programs of low back pain (Standaert, 2002). In 2007a, Harringe et al. published the results of controlled intervention study, in which 42 young female teamgym gymnasts were randomized to specific segmental muscle training program of the lumbar spine. Gymnasts in this training program reported significantly less number of days with low back pain as compared to baseline, whereas no difference was observed in the control group. 8 gymnasts in the intervention group (53%) became pain free. Another study examined advanced level female artistic gymnasts and the most common pain sites were the ankle and low back (Marini et al., 2008). In this study, the specific preventive-compensative training program in the warm-up and cool-down sessions was tested for reduction in pain syndromes. Besides other things this training program was reported to implement treatment of shortened muscle chains and mobilization of back using fit-ball (which can be found also in individualized Pilates programs). After intervention, low back pain was reduced in all pain severity subgroups with the greatest benefit in the severe pain subgroup.

In artistic gymnastics there are no controlled randomized studies to examine the benefit of Pilates exercise on the prevention or treatment of low back pain. However in recent years, some data has accumulated which may allow extrapolation of the usefulness of Pilates also to the field of artistic gymnastics. According to presented results and the widespread popularity of Pilates it is possible to expect that in future also the studies examining the specific effect of Pilates exercises in the prevention of low back pain will emerge in the field of artistic gymnastics.

CONCLUSION

Chronic pain syndromes represent a significant problem for the advanced and elite level gymnasts. Low back pain is one of the commonest sites of pain. This pain may accompany serious anatomical abnormalities of the spine or be present without significant skeletal abnormality. Therefore, the gymnast with repetitive and disability-causing pain should be medically examined to exclude serious spinal abnormalities which were shown to be possibly present even in elite-level gymnasts (such as spondylolysis and spondylolisthesis). We presented data from studies, which show that skeletal abnormalities correlate with age and hours of training per week implicating that spinal injuries in gymnasts are "training-dose" related. It is left for future studies to examine to what extent the damage gained in the active training period would predispose gymnasts to the spinal medical problems in later life. As regards the preventive and rehabilitation methods, Pilates was shown to be effective and of good subjective acceptance in the general population, whereas specific studies in the artistic gymnastics are lacking. According to the studies with training programs implementing similar lower-trunk stabilizing principles as Pilates, gymnastics couches may be encouraged to implement this kind of exercise for prevention and treatment of chronic low back pain in gymnasts.

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