

THE ETIOLOGY OF PAIN AND ABNORMAL ANATOMICAL CHANGES IN THE SPINE – A LITERATURE REVIEW

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Abstract

Straton Alexandru, Gidu Diana. The etiology of pain and abnormal anatomical changes in the spine – a literature review.

Background: Pain at the level of the spine is one of the most important reasons in generating low quality of life in sedentary subjects or former athletes and poor results in athletes. Also, pain at the level of the spine causes one of the largest indirect financial costs. Identification of physiological and anatomical problems that generate pain at the level of the spine, can lead to a better process for the reduction or eradication of pain, through the implementation of exercise training.

Aim: Identification of physiological and anatomical problems that generate pain at the level of the spine.

Key words: spine, muscle, pain.

Introduction

Back pain is second only to the common cold as a cause of lost days at work and it's also one of the most common reasons to visit a doctor's office or a hospital's emergency department. Back pain is one of humanity's most frequent complaints which generates low quality of life and one of the largest indirect financial costs.

The etiology of pain and abnormal anatomical changes at the level of the spine in sedentary peoples

Pain in the thoraco-lumbar spine is affecting a considerable proportion of the population (Sternbach R. A., 1986) and is one of the biggest health problems of our society, with 60% to 80% of population suffering from muscle injury or pain at the level of the spine (Andersson G. B. J., Fine L. J., Silverstein B. A., 1995). Approximately 50-60% of the population will have or had at least one period with pain at the level of the spine. Moreover, reported pain at the level of the spine, in adolescents, is considered a very serious public health problem (Olsen T. L., Anderson R. L., Dearwater S. R. et al., 1992), and women tend to suffer more frequently from pain at the level of the spine than men (Wells C., 1985).

Cassidy J. D., Carroll L. J., Cote P., (1998), showed that 28.4% of adults aged 20 and 69 years of Saskatchewan (USA) had pain at the level of the spine all the time and 84% have had pain at the level of the spine at least once in life. However, the favorable peak age for muscle accidents at the level of the spine, is 40 years (Andersson G. B. J., Fine L. J., Silverstein B. A., 1995).

Psychological factors play an important role in the emergence and development of chronic pain, but also in the etiology of acute pain with emphasis on transition to chronic pain (Linton S. J., 2000). Bigos S. J., Battie M. C., Spengler D. M. et al., (1992), found that psychological factors are more important than physical factors in reclaiming pain at the level of the lumbar spine.

Other risk factors in the occurrence of pain in the lumbar spine, which were found, will include sleep deprivation and fatigue, emotional instability, substance abuse (alcohol and drugs), smoking (Bigos S. J., Battie M. C., Spengler D. M., 1992; Al-Obaidi S. M., Anthony J., Al-Shuwai N., Dean E., 2004), family problems, excessive body weight, inappropriate body positions (generated mainly by the low consumption of drugs or changes in the kinematic pattern of walking in elderly subjects) (Bota A., 2007), physical inactivity, physical activity performed incorrectly (excessive or incorrect movements), poor muscle strength and prior pain at the level of the spine.

Physical factors set to work, which exposes the worker to an increased risk of pain at the level of the spine are persistent and very hard physical activity at work, prolonged sitting, chronic incorrect posture in orthostatic position, flexion, twisting, pushing, lifting (in many cases, the pain registered at the level of the lumbar spine caused by lifting weights have no explanation and is not confirmed by the presence of tissular accidents of structural components, which form the backbone), repeated falls, vibrations resulting from long periods of car driving and poor muscle strength. Psychological factors set at work are increased chronic stress (chronic stress is releasing cortisol hormone, which is involved in muscle and tendon injury), low job satisfaction, low motivation for work and mental fatigue (Bigos S. J., Battie M. C., Spengler D. M., 1992).

Muscle strength disbalances, between trunk extensor and flexor muscles, is a major risk factor in pain at the level of the lumbar spine (Lee J. H., Hoshino Y., Nakamura K., Kariya Y., Saita K., Ito K., 1999). Generalized muscle weakness (Lee J. H., Ooi Y., Nakamura K., 1995; Takemasa R., Yamamoto H., Tani T., 1995), obesity and decrease of trunk muscle strength are important factors in chronic pain at the level of the lumbar spine and exercise programs conducted to increase trunk muscle strength, are useful in reducing chronic pain (Bayramoğlu M., Akman M. N., Kiliç S., 2001). The decrease in trunk muscle

strength is one of the most important causes for problems emergence at the level of the lumbar spine, thus emphasizing, the importance of designing training programs based on developing muscle strength and resistance at the level of the trunk (Doymaz F., Cavlak U., Kucuk M., Telli O., Bas Aslan U., 2006).

Many studies have shown that chronic pain from the lumbar spine level is correlated with disc degeneration, which in turn may be accelerated by mechanical failure of the narrow hyaline cartilage which is covering joint surface of the body vertebral bone from the bone support area cartilage of joint surfaces or from annulus fibrosus area (Sandover J., 1983). It is well known that intervertebral disc is used in spine stability (Krismer M., Haid C., Ogon M., Behensky H., Wimmer C., 1997) and to support compressive loads at the level of the spine, being the subject of tensions in the movement of flexion and lateral rotation, leading sometimes, to pain, because it's innervated. Compressive injuries of the intervertebral disc may be initially asymptomatic, but may lead to a degenerative process, which in turn, over time, can lead to internal disc disruption, which becomes symptomatic as a result of chemical or mechanical irritation of nociceptors in the annulus fibrosus. (Bogduk N., 1991). There is also, the possibility of genetic factors in the development of disc herniation as an expression of disc degeneration (Matsui H., Kanamori M., Ishihara H. Et al., 1998).

It is well known that spine stability is determined by bones, ligaments and muscles supporting structures. The bone-ligament structures of the human lumbar spine become mechanical unstable (in vitro) to a compressive load of approximately 90N, being a load less than the weight of the upper trunk. Lumbar spine is always subjected to compressive loads far greater than the tolerance of 90N. For example, a human upper body weight of 80kg. will exert a compressive load of approximately 400N in the joints of lumbar vertebral bodies L4 and L5 (Howarth S. J., 2006). This clearly illustrates the importance of muscles support at the level of the spine in improving the spine's ability in resisting to compressive loads without problems. Since movements at the level of the spine is achieved in all three planes simultaneously, it is essential that these movements to be precisely controlled by the trunk muscles to produce the strength necessary to optimize the load on the bone-ligament structures of the spine (Kaigle A. M., Holm S. H., Hansson T. H., 1995; Gardner-Morse M. G., Stokes I. A., 1998) and prevent accidents.

The etiology of pain and abnormal anatomical changes at the level of the spine in performance athletes and former athletes

Usually, the muscle-ligament support of the lumbar spine can withstand extreme loads without the occurrence of any problems. The level of the lumbar spine - the most mobile part of the spine - with muscle-tendon-ligament structures are an important source of a great dynamic power generation, when twisting motions are achieved in golf, tennis or baseball, when the landings are completed in

gymnastics or athletics (jumping tests), when the squat is completed in weightlifting or when the kicking is carried out in box.

In performance sports the tensions from the level of musculoskeletal ligament structures and, also, from the intervertebral discs are different from subjects who did not practice performance sports, but also, is depending on the sport practiced. Sacro-iliac dysfunction may be the hidden occurrence of pain at the level of the lumbar spine in sports that have asymmetric movements or landings (Ovricenco M. V., 2005). Thus, functional aspects of spine biomechanics are not only essential in achieving proper training technique, but also, is essential in achieving an appropriate correct medical attitudes to prevent, diagnose and treat diseases of possible stress pathology at the level of the sacro-lumbar spine, in performance athletes (Ionescu M. A., 2005).

In a study conducted by Granhed H. and Morelli B., (1988), on 32 former performance wrestlers, aged between 39 and 62 years and 13 former performance weightlifters, aged between 40 and 61 years, it was found that the incidence of pain at the level of the lumbar spine, throughout life, was the highest in former performance wrestlers (59%), compared to former performance weightlifters (23%) or control group (composed of subjects who have not practiced any sport) (31%). However, former performance wrestlers and weightlifters, have a higher tolerance for pain occurring at the level of the lumbar spine, compared with control group. Also, former performance wrestlers have a higher frequency for the presence of old trauma to the spinal structures and former performance weightlifters have a significant decrease of intervertebral disc. Former performance wrestlers and weightlifters, with old trauma to the spinal structures, presents a more frequent presence of pain in the lumbar spine (Granhed H., Morelli B., 1988). In a study of 71 athletes (weight lifting, wrestling, ice hockey and sports tourism guidance) and 21 subjects who have not practiced any sports, found that more than 90% of performance athletes had intervertebral disc degeneration (disc thickness reduction) and 88% of performance athletes had intervertebral disc damage, the highest frequency being recorded in weightlifters and ice hockey players. Also, 78% of performance athletes and 38% of subjects who have not practiced any sports, reported pain at the level of the toraco-lumbar spine, and 71% of the same athletes and 75% from the same subjects who have not practiced any sports, reported pain at the level of the toraco-lumbar spine after 15 years. Many of the anomalies present at the toraco-lumbar spine appear to occur during the teenage growth and trend to deteriorate, in a variable extent, in 15 years, probably due to continued or increased sport practice with loads or due to old growth of the subjects (Baranto A., Hellström M., Cederlund C. G., Nyman R., Swärd L., 2009).

Disc degeneration occurs with increased frequency in wrestlers (Videman T., Sarna S., Battié M. C. Et al., 1995) and gymnasts, compared with subjects who have not practiced sports. The presence of spondylosis was

found at about 50% of the performance athletes, which at the same time, have had pain at the level of the thoraco-lumbar spine. Also, the presence of scoliosis was found in approximately 80% of performance athletes, which exercised movements with asymmetric loads of trunk and upper limbs, as tennis players or spear throwers; however, the emergence of pain was not yet shown at the level of the thoraco-lumbar spine (Swärd L., 1992; Hutchinson M. R., 1999).

Incidence of pain in the lumbar spine is lower in former athletes (937 former athletes - athletes - sprinters and distance runners, soccer players, weightlifters, wrestlers, boxers, etc.) versus subjects who has not practiced any sports (620 control subjects). Also, former weightlifters have intervertebral disc degeneration throughout the spine, while former soccer players have only intervertebral disc degeneration in the lumbar spine; however, the same symptoms were not found in distance runners or sprinters (Videman T., Sarna S., Battié M. C. et al., 1995).

Swärd L., Hellstrom M., Jacobsson B. și Pëterson L., (1990), in a study of 142 athletes (wrestlers, gymnasts, soccer players and tennis players aged between 14 and 25 years) showed that decreasing the thickness of the intervertebral disc and vertebral body changes radiological investigated are directly correlated with perceived pain at the level of the thoraco-lumbar spine. However, a study of 134 former athletes (wrestlers, gymnasts, soccer players and tennis players aged between 27 and 39 years) and 28 subjects who did not practice any sports with comparable age, were found, despite radiological anomalies recorded at the level of the thoraco-lumbar spine, that pain perceived frequency of former athletes is not different then the group of subjects who did not practice any sports (Lundin O., Hellström M., Nilsson I., Swärd L., 2001).

Elite divers have an increased frequency of pain incidence recorded at the level of the thoraco-lumbar spine in young children (approximately 85% of the 20 elite divers, aged between 10 and 21 years, had pain at the level of the thoraco-lumbar spine or had pain for the first time in their life at a median age of 15 years) (Baranto A., Hellström M., Nyman R., Lundin O., Swärd L., 2006).

Rhythmic gymnastics athletes have shown an increased relative risk for pain occurrence at the level of the thoraco-lumbar spine (Hutchinson M. R., 1999). Apparently, the pain presence at the level of the thoraco-lumbar spine in female subjects (67 gymnasts aged between 13 and 19 years and 27 female subjects who did not practice any sport), has as associated factors increased body weight, increased body mass index, increased fat mass, age, smoking and a stronger agitated or depressed behavior. Also, a study of 19 Olympic-level gymnasts, aged between 12 and 20 years, has shown that mechanical injury present to the spine (microtrauma located in the spine, intervertebral disc degeneration, spondylosis (degeneration of intervertebral discs and joints, often accompanied by emergence of bone spurs in the vertebral bodies), spondilolistezis (anterior slipping of a vertebra in

relation to the underlying vertebrae)) are directly connected with the presence of thoraco-lumbar pain at the level of the spine (Bennett D. L., Nassar L., DeLano M. C., 2006). However, other authors have found that rhythmic gymnastics isn't a sport with an increased risk of pain at the level of the thoraco-lumbar spine (Cupisti A., D'Alessandro C., Evangelisti I. et al., 2004).

Perceived pain in the lumbar spine is a common problem for rowers at all levels. For rowers, a major problem in generating problems (pain) at the level of the lumbar spine is the fatigue caused by long sessions of rowing (Holt P. J., Bull A. M., Cashman P. M., McGregor A. H., 2003). Some experts have found that the most common problems encountered in rowers, recorded at the level of the lumbar spine (McNally E., Wilson D., Seiler S., 2005), is due to hiperflexion and excessive rotation of the trunk, generating a sacro-iliac joint dysfunction and/or herniated disc (Rumball J. S., Lebrun C. M., Di Ciacca S. R., Orlando K., 2005).

Also, strike and service strike biomechanics in tennis, is leading to pain at the level of the lumbar spine (Marks M. R., Haas S. S., Wiesel S. W., 1988), which in large part, is due to disbalances recorded at the spine muscles (Knudson D., Blackwell J., 2000). However, a study conducted by Saraux A. Guillodo Y., Devauchelle V. et al., (1999), showed that the practice of tennis does not involve an increased risk of pain in the lumbar spine.

Therefore, the perceived pain at the level of the lumbar spine is typically generated by 5% - 8% of athletic injuries and perceived levels of pain intensity, encountered in performance athletes during growth, are influenced by sex, age, type of sport, very high intensity or frequency of training, inadequate technique, inadequate sports equipment, low force for flexion and extension muscles of the spine, poor mobility of the spine, etc. (Harvey J., Tanner S., 1991).

Conclusion

Many problems recorded at the level of the spine are caused by multiple physiological, physical and psychological factors, that expose sedentary subjects, former athletes or sports-performance athletes to a high risk of developing or maintaining the pain at the level of the spine. Also, the factors of pain generation and the present stage of the condition (acute or chronic pain) are also determining factors in the choice of treatment.

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