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Application of Muscle and Bone Balance Theory in Lumbar Disc Herniation

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Abstract: *Pingle Guo's theory of "Balance of Muscles and Bones" has a long history. Muscles and bones are fundamental to each other to maintain the static and dynamic balance of the spine and ensure the normal movement of the spine joint. Muscle and bone balance is the normal physiological state of lumbar vertebrae, and the imbalance of muscle and bone is the basic pathogenesis of lumbar disc herniation, which is caused by "slot out of muscle" and "bone dislocation". It is an important principle to treat prolapse of lumbar intervertebral disc by massage. Aiming at the tenderness and percussion pain of soft tissue around the waist and the limitation of muscular activity around the waist, and the "osseosynostosis" of the lumbar vertebrae, which is mainly manifested by the reduction or disappearance of the physiological protruding of the lumbar vertebrae, or the decrease of the lumbar vertebrae's activity, or the different degree of scoliosis, etc. Therefore, the application of "muscle and bone balance" theory of clinical diagnosis and treatment of lumbar disc herniation is of great significance.*

Keywords: *Lumbar disc herniation, Muscle and bone balance, Massage manipulation*

1. Introduction

After hundreds of years of development and innovation, Pingle Guo's osteoplasty has rich clinical experience and is widely used in the treatment of orthopedic diseases. The main point of view of the theory of muscle and bone balance is that muscle and bone are the general term of the complex motion system of the human body and have the function of maintaining the balance of the system. Among them, tendons, bone tendons, tendons and bones are fundamental to each other, and jointly maintain human spine, joint coordination and stability, that is, "tendons and bones balance." Physiologically, tendons act on bone to produce joint movement, and bone provides support for the tendons. Pathologically, both tendon and bone damage affect each other, and the tendon and bone imbalance may occur (1). Lumbar disc herniation is refers to causes from each kind of reason's intervertebral disc's degeneration to cause the fiber annulus rupture, the nucleus pulposus to protrude, to stimulate or the compression nerve root, causes the low back pain and the lower limb radiation pain orthopedics department common disease, the frequently-occurring disease (2). Along with our country socialization advancement speeding up unceasingly, the working at desk population rises, the sedentary long standing and so on bad habits, and the lumbar disc herniation morbidity unceasingly rises. The disease occurs more frequently in men than women between the ages of 25 and 55. Lumbar disc herniation occurs mostly at the L4-L5 and L5-S1 levels and accounts for about 95% of the incidence (3-4). At present, the treatment of LDH is divided into two categories: surgical and non-surgical. Surgical treatment is traumatic, costly and prone to recurrence. Weinstein compared the long-term outcomes of patients with lumbar disc herniation within two years with those of the nonoperative group, and found that the operative group was no better than the nonoperative group (5). Therefore the overwhelming majority patient's first choice of treatment is the non-surgery treatment. Clinically, massage is one of the most common conservative therapies, with unique efficacy, little side effects and so on, which are well received by patients. There are many guiding theories for the treatment of LDH, such as the theory of "both muscle and bone" and the theory of meridian muscle. Years of clinical experience in orthopedics and biomechanical research in the formation of the theory of muscle and bone balance for the treatment of lumbar disc herniation has unique views. This theory has a deep understanding of the pathogenesis of LDH, feedback of massage manipulation and treatment principles, and plays an important role in guiding clinical treatment. It is explained as follows.

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2. Connotation of tendon and bone

Tendons have a wide range of connotations, both broad and narrow. Generalized tendon equivalent to modern medicine in the muscles, tendons, fascia, ligaments, peripheral nerves, blood vessels, cartilage and other collectively. A sinew, especially the muscular system of the body (6). So tendons are actually a general term for the muscular system of the human body. Note: "Sinew is the power of meat." The muscles of the human limbs are attached to the bones by tendons, and the peripheral nerves and blood vessels are distributed among the muscles. Therefore the tendon is all over the human body, the main department movement, is the human body movement essential muscle system. Bone is the framework of the whole body. It has the physiological functions of supporting tendons, storing marrow and protecting the viscera. The Ling Shu · Jing Meridian says, "Bone is the trunk … the sinew is the firmness." This shows that bone is where the sinew begins and ends. Tendons act on bones to produce joint movement and protect viscera. The generation of human movement depends on the cooperation of bone and muscle.

3. Mutual use of muscles and bones is a prerequisite for exercise

The balance theory of Pingle's tendons and bones holds that the tendons and bones are fundamentally and mutually used. The Rhinoceros Candle, the Origin of Rhinoceros Tendon and Bone Skin and Fur pointed out that "tendons and collaterals are the key link of the whole body and benefit all the people who exercise", indicating that tendons provide power for the body movement and tendons and bones. Bone is the framework of the human body, the tendon has a supporting role for the tendon to provide a point of attachment, bone tendon. Bone is made up of the joints of tendons, which convey the force of muscle contraction to the bone (7). The two structures are close and interact each other in function, which is the basic condition to maintain the body movement. Muscle contraction drives the movement of bone to achieve the reasonable range of lumbar muscle flexion and extension, back extension and rotation movement, muscle support by the bone but not beyond the normal range of activities. Both of the destruction of a system will affect the normal balance of the waist, resulting in the occurrence of lumbar diseases.

4. Muscle and bone imbalance is the main pathogenesis of LDH

The pathogenesis of LDH is mainly due to the degenerative changes of lumbar intervertebral disc, resulting in the rupture of annulus fibrosus, the detachment of nucleus pulposus tissue from the posterior or vertebral canal, the compression of nerve root, and the symptoms of lumbar pain, numbness and pain of one or both lower limbs (8). This disease belongs to the spine muscle bone disease of orthopedics department, traditional Chinese medicine thinks this disease belongs to "lumbago disease" category. Tendons are rigid and bones are trunk, which is the understanding of the relationship between tendons and bones in early Chinese medicine. According to the theory of tendon and bone balance, tendons and bones are mutually used in physiology and influenced in pathology. Clinical doctors should pay more attention to the relationship between bone and tendon when treating lumbar disc herniation. The waist is made up of muscle such as polyfissure muscle, erector spine muscle, muscle between lumbar spine, and soft tissue such as lumbar intervertebral disc, lumbar nerve vessel, and tendon. Bone system is composed of vertebral body and articular process of lumbar vertebra (9). Tendons provide power for the movement of the body, connect the bones and have the function of knots and collaterals. And the skeleton of lumbar vertebra has support effect to muscle again. Both, like the two ends of Libra, are in a physiological dynamic equilibrium. Either side is destroyed, will cause the loss of balance state, the formation of "slot" and "osseous dislocation" of the unbalanced state. Thus appears the lumbar intervertebral disc herniation and so on degeneration change. According to the theory of tendon and bone balance, the disease of tendon and bone is usually caused by the abnormal tendon system. If one end of the lever is unbalanced, the other end of the lever will be involved, and the disease will lead to the abnormality of the bone. So the main pathogenesis of LDH is tendon and bone imbalance(10).Modern biomechanics suggests that when the spine is under load, the nucleus pulposus is compressed and a strong centrifugal force is applied to the annular fibers, stretching them so that the nucleus pulposus protrudes when the centrifugal force exceeds the range of the annular fibers(11).Make the dynamic balance of the lumbar vertebra be destroyed, the lumbar vertebra is unstable, the vertebral body appears displacement, thus affecting the static balance of the lumbar vertebra. So in the modern biomechanical point of view to further support the theory of muscle and bone balance rationality.

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4.1. Splitting of ribs

The term "slot" means an abnormal change in the shape, relative position, or function of a tendon (12). The Theory of Vegetarianism and Atrophy says that the liver governs the fascia of the body, clarifying the dominating effect of the liver on the sinew. The theory of tendon, pulse, flesh, skin and bone in Basic Theory of Traditional Chinese Medicine also proves the close relationship between liver and tendon. If the cold and dampness of the body, or overworked, blood deficiency is the lack of tendons, tendons by evil first. Causes the sinew the shape function to have the change, thus appears the waist back pain discomfort. According to the theory of muscle and bone balance, muscle, tendon, fascia, ligament, nucleus pulposus, intervertebral disc and cartilage are all contained in the scope of "muscle". In pathology, the rupture of lumbar fibrous ring leads to nucleus pulposus prolapse and other changes belong to the scope of "slot". Modern medicine thinks that the components of intervertebral disc are mainly extracellular matrix, it consists of proteoglycan, collagen and water. Proteoglycan has the function of keeping the intervertebral disc water content.Pathological degeneration of intervertebral discs is mainly due to the degradation of proteoglycan by matrix metalloproteins, which dehydrates the nucleus pulposus and reduces its elasticity, thus increasing the degree of intervertebral disc degeneration (13). Lead to rupture of annulus fibrosus, nucleus pulposus and other pathological phenomena. When the nucleus pulposus protrudes, it causes an inflammatory reaction in the tissue around the vertebral canal, which in turn affects the relative position of the surrounding muscles (intertransverse processes, rotators and other small muscles), forming a "slot of muscles". Transverse foramen tenacity of lumbar vertebrae was found to be related to nerve root compression by MRI examination (14). Therefore, it is proved that the formation of LDH is closely related to "slot out of muscle". The difference between the theory of steel-bone balance and the theory of steel-bone balance is that "steel-bone slotting" is the first abnormal phenomenon in the development of LDH. The pathology and biochemical mechanism of LDH indicate the importance of "slot out of muscle" in the development of LDH.

4.2. Misalignment of bone

Malocclusion "is a slight abnormal change in the normal space or relative position of a joint of the bone that results in a limited range of motion[12].Humans evolved four physical curvatures of the spine on the sagittal plane: the cervical, thoracic, lumbar, and sacral flexures. Lumbar flexure is completely from the seat to the upright after the emergence of the (15), which shows that the human body is to adapt to the physiological curvature of the spine upright function generated. It proves the close relationship between human spine and biomechanics. At the same time, the human bone system has a strong metabolic capacity. When the lumbar intervertebral disc caused by "slot" degeneration, the spine experienced a process from stable to unstable to stable.In order to adapt to the new structural stress, it is constantly adjusted. After degeneration of intervertebral disc, the stress distribution of intervertebral disc and articular process will change obviously, which makes the joint and vertebral body of the related motion segment adapt to the new structural stress and change the tilt and lateral tilt (16-17), causes "the bone slit". Therefore, it is indicated that the "splitting of ribs" may cause "osseous dislocation". The normal position of bone and joint was changed. The theory of tendon and bone balance holds that tendon and bone affect each other in pathology. When the tendon produces abnormality, the function of tendon and vertical bone weakens, which leads to the abnormality of bone. At this time the bone can not provide support for the tendon, tendon function is also affected. Both form a vicious circle. Therefore, in the clinical treatment of LDH massage process, not only should pay attention to the "osseous seam", but also pay attention to the "slot out of the ribs. The results of clinical efficacy test should not be based on "osseous suture" is reduced, it is important to use tendon treatment in patients with pain relief of the waist and legs.

In a word, the tower mechanical structure of lumbar vertebrae is the embodiment of vertebral body structure development and functional adaptability. Each segment of the vertebral body through the spinous process, articular process and other bone structures constitute a static bone system. By the nerve, the blood vessel, the muscle, the ligament, the transparent cartilage plate and so on constitutes the dynamic tendon system. According to the theory of LDH, LDH is closely related to the destruction of the stable relationship between the LDH and the LDH, which weakens the LDH and changes the bone structure. Namely muscle disease causes bone disease, happen "osseous dislocation". Changes of lumbar scoliosis, deviated spinous process and so on can be seen in "misalignment of bone"(18),Appear nerve root is affected, aggravate muscle is injured. Therefore, the main pathogenesis of LDH is muscle and bone imbalance.

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5. Restoring "muscle and bone balance" in the waist is the key to the treatment of LDH

Lumbocrural pain is the most common clinical manifestation of LDH. The mechanisms of pain are inflammatory chemical stimulation, autoimmune response and neuromechanical compression (19). Massage can be based on the application of different manipulation, to reduce the waist aseptic inflammation, promote the role of soft tissue repair. At the same time, the relative position of spine can be adjusted to reduce the mechanical compression on nerve roots, so as to treat LDH (20). TCM Orthopedics and Traumatology believes that we should pay attention to the principle of balance and balance in the process of disease diagnosis and treatment. In the face of the dialectical relationship between bones and tendons, one-sided emphasis on the importance of bone, while ignoring the role of tendons is not desirable. Therefore, in the course of treatment of LDH, we should not only pay attention to the reduction of "osseous suture", but also pay attention to the treatment of waist "slot".Min Fang(21) has been found to reduce the level of IL-6 and increase the ratio of T lymphocyte subsets in peripheral blood of patients with LDH, and relieve the pathological pain by regulating the pain hypersensitivity.JingHu Li (22) found that lever positioning manipulation can change the position of intervertebral joint and nerve root and relieve pain of lower limbs after treating lumbar disc herniation. And the manipulation of the force can directly act on the spinal segment lesions, so as to reshape the stability of the lumbar spine, so that the biomechanical balance of the lumbar spine can be restored. Jian Ma (23) and others treated LDH by lower limb rotational reduction. Psoas major muscle was treated by gravity and circumflex force of lower limbs. Rattling was the most effective way to relieve symptoms. Thus corrected the tendon to slot, the bone wrong suture pathological condition. Massage manipulation can not only be used to restore the local biomechanical structure of lumbar vertebrae, but also increase the stability of the lumbar "bone system". Can also use the tendon manipulation to promote local blood and lymph circulation, accelerate the dissipation of inflammation and pain absorption of substances, and restore the "tendon system" balance. Therefore, in the treatment of LDH, it is necessary to apply the whole view of muscle and bone, combine finite element analysis (24) with modern biomechanics, focus on adjusting muscle tissue tension to improve local microenvironment, correct the diseased lumbar vertebrae to return to normal physiological position, so as to restore the "muscle and bone balance" of lumbar.

6. Imbalance of tendons and bones with tendons first "is an important principle guiding the treatment of LDH

It is not only an important pathogenesis of LDH, but also an important role of tendons in the treatment of LDH. In the process of treating LDH with massage manipulation, doctors should use the whole view of muscle and bone, not only emphasize the reduction of "osseous suture", but also pay attention to the treatment of "slot out of muscle".

6.1. Loss of dynamic balance in the lumbar region is the first step

Muscles and Bones Theory suggests that soft tissues such as muscle ligaments and intervertebral discs around the lumbar region provide dynamic balance of lumbar movement. When the lumbar intervertebral disc is overloaded, the dynamic balance of the waist is broken. Qixin Zheng (25) and other researchers believe that the degenerative changes of intervertebral disc after compression begin at the microscopic level, that is, the loss of collagen fibers in the annulus fibrillaris. Therefore, soft tissue lesions around the waist throughout the whole process of lumbar disc herniation. So whether it is cold damp heat evil invasion or their own liver and kidney deficiency, the first damage is the dynamic balance of the waist. In particular, chronic lumbar muscle strain in the elderly easily lead to dynamic balance of the waist is destroyed, leading to the stability of the lumbar vertebra decline, the occurrence of disc degeneration. So there is not always a misalignment of the ribs, and the misalignment of the ribs is always accompanied by the ribs (26).

6.2. Reinforcing Tendons for Bone Treatment

Clinical application of massage treatment of LDH first to protect the main tendons, tendons and soft bones to bone, tendons and bone coordination and balance, rational use of good tendons manipulation, the function of natural recovery. Ribbing manipulation can relax the tense muscles of the waist by kneading, rolling, plucking and pressing, and release the inflammatory adhesion of the soft tissue of the waist so as to relax the channels and activate the collaterals (27). So as to restore the dynamic balance of

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"tendon bundle bone and beneficial joint" and maintain the stability of lumbar "tendon system". The stability of the spine itself mainly depends on the muscles and soft tissues of the waist, so the incidence of LDH is closely related to the degeneration of soft tissues such as muscles. Min Fang (28) observed the EMG of the lumbar extensor muscle before and after LDH by isokinetic test system and surface electromyogram, and found that the contractile strength of the lumbar extensor muscle group was improved by manual treatment. At the same time, the work efficiency of the muscle group is improved, the coordination ability of the flexor and extensor muscles of the waist is restored, the fatigue degree of the waist and back muscles is relieved, and the dynamic balance of the lumbar vertebra is reconstructed.

6.3. Treating tendons and protecting bone

Under the guidance of the theory of muscle and bone balance, the adjusted manipulation can effectively improve the contractile force of the muscle group around the lumbar region of LDH patients, relieve the edema of muscle fibers and relieve the pain of the patients.

At present, the main methods of adjustment in clinic are oblique pulling of lumbar spine (29) and rotational reduction of spine (30). An Xie (31) found that adjusting manipulation can effectively increase the lumbar flexion, extension, lateral flexion and lateral rotation of the lumbar spine. Adjustment is closely related to the subject's posture, degree of cooperation, loading force, direction and so on, but the descriptions of "skillful effort" and "pulling" are more general. At the same time, the therapeutic effect is positively correlated with the clinical experience of the doctors. So young doctors need a lot of practice to get a handle on it.

7. Conclusion

According to the theory of "gluten and bone balance", the pathogenesis of LDH is "gluten slot", that is, the dynamic balance of waist is broken, the static balance is broken, and LDH is a kind of disease. Massage can be used to treat LDH. Massage can relieve the tension of lumbar muscles, strengthen the contractility of lumbar muscles, and restore the dynamic balance of lumbar muscles, which is the basis of LDH treatment. In the treatment of LDH, attention should be paid to both muscle and bone, and the function of muscle should not be overlooked. The therapeutic effect of massage on LDH is closely related to the quality of manipulation, which depends on the coordination and integration of various elements, and the cooperation of both doctors and patients.

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