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Etiopathogenetic significance of hidden compression syndromes in chronic low back pain syndrome development

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Abstract: Pain syndrome is the leading clinical manifestation of dense connective tissue involutive degenerative changes. At the same time, the use of drugs that have a depressing effect on dense connective tissue regeneration contributes to an even greater metabolic disorder in the affected segment. Some NSAIDs can disrupt the chondrocytes metabolism and inhibit proteoglycans synthesis.

This paper investigates the reflectory interaction and tone-strength characteristics of the antagonist muscles of the lumbar and pelvic regions and their influence on the pain formation in LBP patients.

The additional aim of the study is to develop a rehabilitation technique.

Indexing Terms: chiropractic; low back pain; syndrome development; rehabilitation; dynamic EMG

Introduction

Back pain is one of the most common pathological symptoms. Approximately 20% of population suffers from recurrent back pain lasting 3 days or longer. The peak of complaints of the lower back pain (LBP) falls on a mature, working age from 30 to 45 years. Back pain is one of the most common causes of disability in patients aged under the 45. However, back pain is a symptom that has no age limitations and affects both children and the elderly. At the same time, the causes of pain are not the same, and individual nosological forms are presented differently in each age group.

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Despite the age, from 15 years till elderly, back pain is more often manifested in women. 24% of men and 32% of women suffer from back pain in the age from 20 to 64 years. (5)

Acute musculoskeletal back pain occurs at certain time in the life of more than 90% of people and is the second most common acute pain syndrome (after headache). Chronic back pain prevalence among the adult population varies significantly, from 2 to 40%, with an average of about 15%. (13) Chronic back pain lasts approximately 7 years but in some patients persist for more than 20 years. (17) Chronic pain syndromes incidence was shown to be increased significantly over the past 20 years, and these changes cannot be explained only by an increase in life duration. (4)

Not all LBP patients are lucky to receive a correct diagnosis and be prescribed an adequate treatment. This is due not only to medical problem complexity but also due to this suffering causes ignorance. One could stress that we have now an undoubted spine osteochondrosis over-diagnosis and its complications, radiculopathy, as the main cause of pain in general medical clinical practice. The prevailed number of patients with back pain are provided with this diagnosis. (5) We suppose that a much more common phenomenon is the back pain of a non-specific musculoskeletal nature without signs of root involvement. On the basis of more than 4,000 patients with back pain examination it was found that vertebrogenic radiculopathy and tunnel neuropathy were observed only in 5% of patients while 95% of the examined patients have musculoskeletal, reflex syndromes. (1)

In popular and sometimes even in medical literature there is a common mistake according to which the degenerative-dystrophic processes in the spine is considered to be the main cause of back pain. This has led to the fact that '*osteochondrosis*' has become one of the most common diagnoses in patients with back pain, and the impact on the degeneration of the spine and intervertebral discs has become the main tactic for treating back pain.

Osteochondrosis over-diagnosis is primarily associated with clinical symptoms underestimation and, conversely with the X-rays diagnostic value overestimation. It is impossible to establish a specific disease or a specific disorder of the spinal structures in more than 85% of patients with persistent back pain. (4) Along with spine osteochondrosis over-diagnosis the musculoskeletal system functional disorders ignorance is present with the appearance of various reflex pain musculoskeletal syndromes. (5)

The pain syndrome occurs on the basis of functional and degenerative changes in the musculoskeletal system structures (fascia, muscles, joints, fibrous ring,) with the involvement of adjacent structures of the peripheral nervous system. (13, 16)

One of the largest prospective studies of patients with chronic low back pain without radiculopathy found that 40% had facet pain, 26% had discogenic pain, 2% had sacroiliac pain, and 13% had irritation. segmental nerves. The cause of the pain was not identified in 19% cases. (23)

The majority of back pain cases can be caused by joints (4) and ligamentous apparatus of the spine changes together with muscle damage and disease (myofascial pain, polymyositis, etc.), pathology of internal organs (angina pectoris, gastric ulcer, cholecystitis, endometriosis, proctitis etc.); rarely psychogenic back pain was registered induced only by mental disorders.

Another common clinical myth concerns a herniated intervertebral disc. In a relatively small category of patients (up to 10% of patients with pain in the lumbosacral region) the discogenic component associated with compression, stretching, ischemia and immune damage of the intervertebral nerves roots by disc herniation plays a significant role. However, '*silent*' (that is, those that do not manifest themselves) herniated discs are many times more common than those that cause pain in the back, more precisely, in the back and limbs (radiculopathy). The size of the hernia also does not matter.

Thus, pain syndrome is the leading clinical manifestation of dense connective tissue involutive degenerative changes. At the same time, the use of drugs that have a depressing effect on dense connective tissue regeneration contributes to an even greater metabolic disorder in the affected segment. Some NSAIDs (*salicylates*, *diclofenac*, *indomethacin*, *naproxen*, etc.) can disrupt the chondrocyte's metabolism and inhibit proteoglycan's synthesis. (20)

There are many chronic back pain treatments. They include physiotherapy, various programs of physical therapy, muscle relaxation with spine 'stretching', NSAIDs and analgesics, epidural and paravertebral blocks with corticosteroids and local anaesthetics. Unfortunately an evaluation of the full long-term effectiveness of these measures showed extremely low results. (15)

A very important clinical problem are the postoperative scarring, recurrent disc herniation and complications after discectomy, the persistence or appearance of additional clinical and neurological

symptoms. Pain syndrome and the corresponding neurological symptoms may reappeared in 5-40% of cases after discectomy. Such an effect has been called '*failed back surgery syndrome*'. Early and late postoperative complications are considered to be the causes of this syndrome. (14)

The clinical problem

The treatment of patients is associated with certain difficulties, especially, with side effects development characteristically to the main drugs used as pathogenetic therapy for the disease. For example, NSAIDs which are the gold standard in the pain relief (6, 11) can cause gastrointestinal tract mucous layer ulceration, (7, 21) hematopoiesis suppression, the development of severe allergic reactions, toxic liver damage, and nephropathy. (22) At the same time NSAID-induced hepatic pathology increases with age. (24) Thus, it has been shown that drugs of the latest generation (coxibs) which are well known to induce COX-2 selective inhibition can cause a negative influence on the cardiovascular system and increase the risk of both myocardial infarction and sudden cardiac death developing. (18, 19)

Despite the LBP large number proposed physiotherapeutic methods nobody has showed their efficacy. Basically, these approaches are indicated in the stage of disease remission and have a significant limitation due to the increased risk of proliferative processes and cardiovascular complications.

Regarding the LBP patients recovery the prognosis remains unfavourable due to the limited effectiveness of existing treatment methods, and this, in turn, depends on the pain syndrome formation mechanisms poor understanding.

The aim of this study is to investigate the reflectory interaction and tone-strength characteristics of the antagonist muscles of the lumbar and pelvic regions and their influence on the pain formation in LBP patients. The additional aim of the study is to develop a rehabilitation technique.

Materials and methods

The clinical and para-clinical manifestations of the muscular-tonic reflex syndrome in patients with dorsalgia is the object of the study.

The methods of investigation: clinical (visual diagnostics, kinesiology diagnostics, manual muscle testing (MMT), (2, 3, 8, 9) neurological status determination), instrumental (X-ray, CT, MRI, surface electromyography), statistical.

Study protocol

36 patients of *Kinesitherapy and Rehabilitation 'Vysshaya Liga' Odessa Centre* were under the examination. They suffered with LBP reflectory muscular-tonic manifestations, the pain was provoked in the sitting position, when bending the body, and aggravated when walking. The course of the suffering is chronic relapsing, lasting from 1 to 3 years.

Visual diagnostics was used to evaluate sitting and standing posture, symmetry of external bone landmarks, volume and contours of contralateral muscle groups. Then MMT was performed for the main agonist and antagonist muscles involved in the verticalisation of the body, inclinations and step pattern. Study of the biomechanics of body flexion, hip extension. (3)

To confirm the data obtained the patients underwent surface dynamic four-channel EMG using the Insight™ hardware complex. Sensors-sensors were installed symmetrically in the projection of the erector spinae muscle (ESM) at the level of L3, gluteus maximus muscle (GMM), hamstring. The analysis of the results was carried out according to three parameters: the search for asymmetry in the work of the muscles; coordination of muscle groups during movement; EMG uniformity during muscle contraction.

Results

The following patterns of patients' postural disturbances were established visually: both semi-pelvis and gluteal fold descent in the standing position on the side of pain; lumbar triangle strengthening; gluteus maximus muscle volume decrease and blurring of the contours; lumbar

region muscles (LRM) volume increase; flexion position of the thigh; and body tilt in the '*sick*' side. Some patients demonstrated both shoulder blades and shoulder girdle asymmetry. These disorders persisted in the sitting position. MMT revealed gluteus maximus muscle hypotonia, the quadriceps femoris (rectus femoris) hyporeflexia, both lumboiliac muscle (LIM) and LRM hypertone on the pain side.

When evaluating the hip extension biomechanics on the side of pain, an advanced activation of the lower back muscles (LBR) with semipelvis cranial displacement and flexion was revealed. The data obtained indicate the GMM (the main extensor muscle) hypoexcitability which was also confirmed by dynamic EMG.

Discussion

The LBP occurrence being provoked by the sitting position and aggravated by standing and, especially, in the step pattern, is the result of lumbar region muscles (ESM, *quadratus lumborum*, LIM) hypertonicity due to GMM both hypotension and hyporeflexia. GMM hgypotension results in both pelvic region and hip joint instability, the *piriformis muscle* (PM) compensatory shortening which compresses the superior gluteal nerve that causes and enhances the GMM hyporeflexia. One could suppose about the '*pathobiomechanical ring*' formation: the greater is GMM hypotonia the more pronounced is the hip joint instability and PM shortening that in turn lead to superior gluteal nerve (innervating the GMM) compression. GMM hyporeflexion additionally results in LIM shortening and hypertonicity that induces femoral nerve compression and muscle rectus femoris hyporeflexia: the biomechanics of hip flexion is completely disturbed which increases the symptoms manifestation during walking.

Conclusion

As a result of the study performed a pattern was revealed in the pain syndrome occurrences at the level of the lower back on the background of GMM both hypotension and hyporeflexia and pelvic region instability on the side of pain. The '*pathobiomechanical ring*' that arises in this case leads to a steady increase in pain expression, biomechanical disorders, pathological process chronicity and treatment efficacy failure. Etiopathogenetic treatment should be aimed to '*pathobiomechanical ring*' elimination.

To receive these effects we have proposed stages in tonic-power balance restoring of the muscles which were observed in this study:

1. Pelvic region external stabilisation with a rigid-elastic belt which should reduce the load on PM, the superior gluteal nerve decompression and restore the GMM innervation.
2. To restore GMM both strength and volume using kinesitherapy.
3. To induce the GMM its antagonists (LIM) re-reduction.

Summary

1. A shortened muscle has increased excitability and is included in all movements
2. The reflectory syndromes are hidden compressive syndromes and are the result of the region instability
3. Muscular instability is the result of compression that occurs during movement
4. The hypotonic muscle stimulates the shortened muscle hyperexcitability. The lower the gluteal muscle excitability, the higher is the piriformis muscle excitability
5. The original rehabilitation technique aimed to '*pathobiomechanical ring*' elimination in patients with chronic LBP allows to eliminate the pain syndrome and to restore the spine biomechanics.

Clinical example

Patient K., 33 y, complained of pain in the right lumbar region that occurs in the sitting position, aggravated by standing, bending the body, and walking. About 2 years ago, the patient noted a change

in work activity, every day he sits at the computer for 6-8 hrs. Pain appeared about 14 months ago, gradually intensified. Patient almost stopped sitting at work. He terminated his daily jogging for 5-7 km and kung-fu classes due to increased pain.

The patient was examined clinically, the MRI did not reveal a gross disc pathology with root compression (Figure 1).

Fig 1

The patient was diagnosed with lumbar osteochondrosis musculo-tonic syndrome. The patient received conservative anti-inflammatory and vascular therapy, analgesics, anti-inflammatory therapy directly on the lumbar region, massage; lumbar spine manual therapy and traction therapy were performed. These measures had a temporary analgesic effect and did not affect the ability to work at all. Over time, the process has become persistent chronic.

A clinical examination in a standing position revealed flexion and deviation of the body to the right, right lumbar triangle strengthening, the pronounced tension of right lumbar muscles (Figure 2), gluteal muscles (strongly contrasting with other muscles) pronounced hypotension and hypotrophy.

MMT revealed right GMM and quadriceps femoris muscle hyporeflexia (Figure 3). At the same time, tendon reflexes of the right lower limb were without pathology.

Fig 2

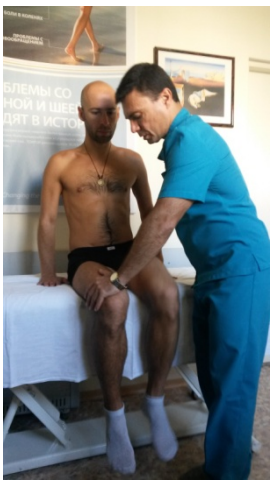
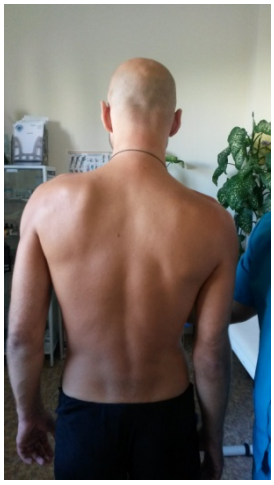


Fig 3



The patient underwent dynamic EMG of the muscles of the lumbar region and GMM to study the tone of these muscles under load. As can be seen from the myograms, the GMM is initially hypotonic and is not included in the movement during hip extension (Figures 4 and 5).

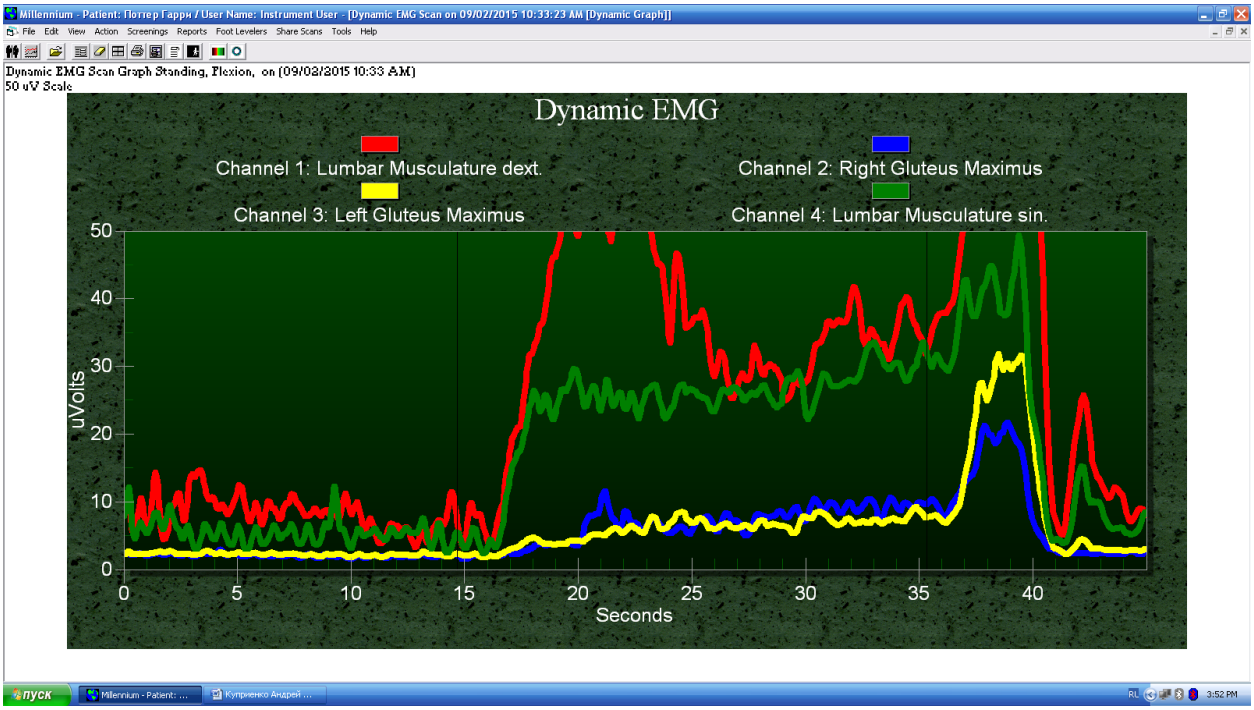
Figures 4a and 4b show dynamic EMG registration in a neutral position (standing) and during the right hip extension.

Fig 4a

Fig 4b

Figure 5 shows the trace from dynamic EMG of the paravertebral muscles of the lower part of the body at the level of the lumbar spine and GMM. In the first phase of trial (standing position) one could register a GMM electrical activity acute reduction. In the second phase for 15s (right thigh extension) one could register the lumbar region muscles electrical activity acute increase (more than the right one) and GMM electrical activity slight increase.

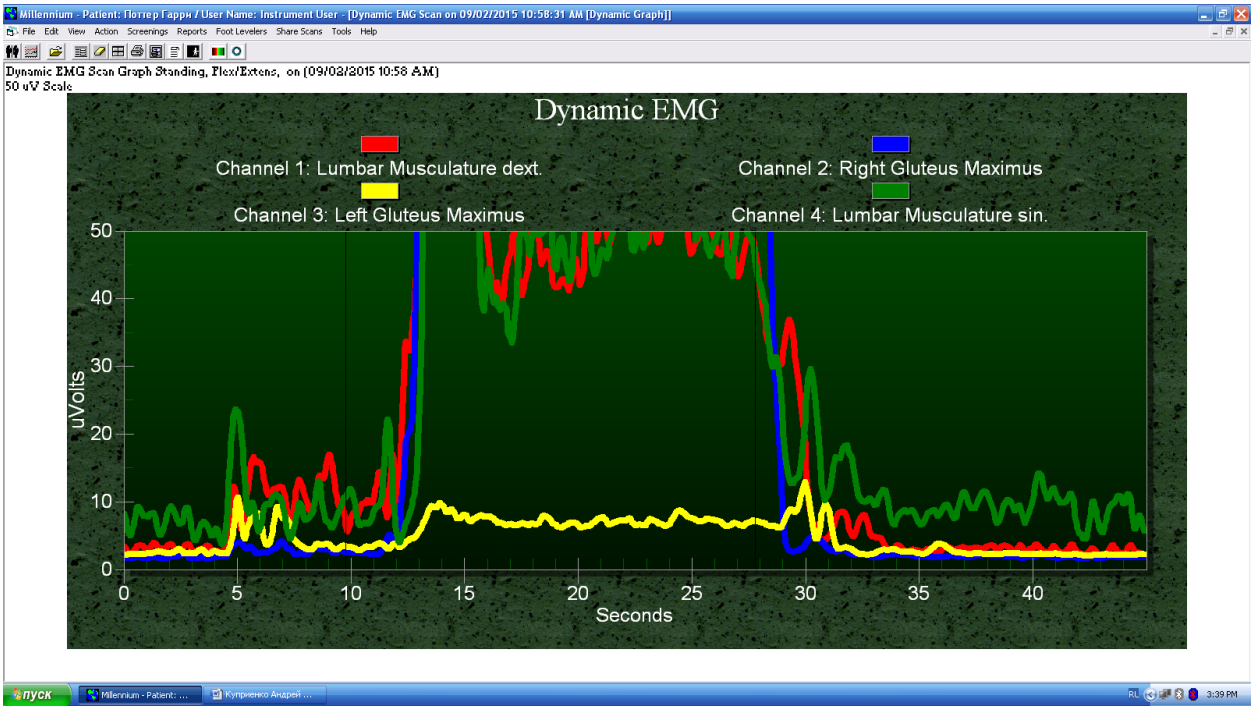
Fig 5



Following external stabilisation of the pelvis with a belt, the patient underwent repeated dynamic EMG. The obtained data testified to the improvement of innervation and GMM inclusion in the movement (Figure 6).

Figure 6 shows the trace from dynamic EMG of the paravertebral muscles of the lower part of the body at the level of the lumbar spine and GMM. In the second phase at 12s (right thigh extension) one could register lumbar region muscles electrical activity acute increase (more than the right one) and right GMM electrical activity significant increase.

Fig 6



The patient started a course of rehabilitation treatment according to the above mentioned scheme. It was possible after 3 weeks to achieve double pain expression decrease from 8 points to 4 points according to Pain Visual Analogous Scale, the walking distance without pain increased from 100 m to 2 km. He completely stopped to take painkillers, the sitting time without pain was equal to 25 min.

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Qualifications
Location

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About

A new generation and synthesis of manual muscle testing (MMT) protocols have appeared in the Ukraine, Russia and Central Europe thanks to the work of Gleb Kirdoglo, MD, PhD. At the invitation of medical centers and specialized associations, the UAAK organises training cycles in Germany, Estonia, Latvia, Kazakhstan, Moldova, and Israel. In 2012, the *Ukrainian Association of Applied Kinesiology and Medical Rehabilitation* -- UAAK -- was created and registered. The number of students who have attended the training now exceeds 5,000. The President of the Ukrainian Association, Dr. Gleb Kirdoglo, initiated the creation of professional AK communities in Kazakhstan and Moldova. These MMT research results have been presented at major scientific conferences in Kyiv and Moscow. Courses to learn such techniques directly from Dr. Kirdoglo and his colleagues are available via www.UkraineAK.com. Over 700 specialists from 9 countries have become members of the UAAK.

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