

# PATHOGENETIC OPTIONS OF TREATMENT OF THE KNEE OSTEOARTHRITIS

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**ABSTRACT** — This article is devoted to the pathogenesis of osteoarthritis with primary impairment of blood circulation in the subchondral bone and secondary infringement of diffuse nutrition of the cartilage and its subsequent disorder. The pathogenetic treatment stopping degeneration of cartilage tissue has been offered.

**KEYWORDS** — intratissual electric stimulation, gonarthrosis, pathogenetic treatment, knee joint, synvisc.

The problem of the treatment of the knee joint osteoarthritis of the recent years has not decreased but increased. The involutive gonar gonarthrosis is recorded in the majority of the population over 60 years old. The medication therapy based on symptomatic action is commonly used.

In recent years, hyaluronic acid started increasingly to be used for administration in joints. Hyaluronic acid in the existing formulations according to the literature data has two functions: lubricating and increasing of activity of chondrocytes.

Another important issue of the treatment is the activation of metabolic and reparative processes in hyaline cartilage, the ability to influence the nutrition of matrix and the functional activity of chondrocytes. Possibility to influence the amplification of these processes occurs through the diffuse nutrition of hyaline cartilage, which is performed only from the bone tissue. The name "osteoarthritis" refers to a dominant role of the bone in the disease occurrence. You should not consider the processes occurring in the cartilage without the root causes – the impairment of circulation in the bone tissue adjacent to the joint. The pathological process "bone-cartilage" is single and it should be treated by the methods affecting both tissues.

Pathophysiological and functional changes may be detected long before the occurrence of pain and radiological changes.

In recent decades owing to physiologists and anatomists enough data have been accumulated to



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confirm that the source of the pain is the bone itself with its osteoreceptors. Innervation of bone, periosteum and their receptors is performed by the sympathetic nervous system only. From the works of G.A. Yankovskiy it is known that the representation of bone receptors in the brain is more than from skin and muscle coverings.

Pathogenesis of formation of the pathology in the joint may be represented as follows. The initial changes in osteoarthritis occur first in the bone tissue in the places of attachment of capsule of the joints or ligaments. These places bear a heavy load and a limited blood supply (bradytroph zones). In the bone tissue first small areas of local osteoporosis with destruction of bone trabeculars appear, they gradually increase, and against this background in the microcavities stagnation of venous blood and increase of intraosseous pressure occur. Bone tissue is rich in osteoreceptors, their irritation occurs with a decrease of the partial pressure

of oxygen in the bone vessels, i. e., during the hypoxia caused by circulatory disorders with venous stasis. It has been proved that the worse the bone circulation, the more enhanced the pain intensity of pain is.

Pathology of bone tissue progresses gradually, often with the course of years. Henceforth, the changes cover the periosteum and joint capsule, their swelling and palpation tenderness occur. This stage can already be identified clinically. The impairment of circulation and bone hypoxia create pain syndrome - a bone pain syndrome.

The impairment of circulation in the bones is the primary link at degenerative phenomena in all joints. As far as is known, the nutrition of hyaline cartilage takes place by diffusion of the bone epiphyses. Even small blood circulation disorders of the adjacent bone lead to a sharp decrease in diffusion processes of the nutrients into the cartilage matrix. The impairment of this nutrition is the basis for the occurrence of biochemical abnormalities and later of degenerative phenomena in the hyaline cartilage of the joint.

The existing treatment methods do not solve the problem of bone and cartilage degeneration. It is known the basic methods of conservative treatment: medication, vascular therapy and physiotherapy, unfortunately, they do not affect the circulation of the bone. The insufficient effect is explained by the absence of response of the vascular wall in the bone vascular to antispasmodic medications.

Physiotherapy treatment is ineffective, since the electric current is attenuated by skin by 200–500 times. The attenuated current entered the body does not actually reach the bone. The bone is covered by the endplate having a high resistance.

We have tried the intraosseous administration of various drugs, but have not obtained a lasting effect. It has been determined experimentally that a specific electric current improves the blood circulation by affecting the osteoreceptors and activation of trophic function of the sympathetic nerves. We have developed a method of the bone pain treatment.

We have developed an electric current which is close to the physiological characteristics. This is a low-frequency difficultly-modified pulse current. Standard physiotherapy devices have high-frequency components of pulses and have a damaging effect on the myelin sheath of nerves. This treatment has been named the intratissual electrical stimulation.

## TREATMENT METHOD

An electrode needle is introduced into a skin at a depth of the contact with the painful area of the periosteum into the places of attachment of the joint capsule. The needle is supplied with the current within

5–10 minutes. In one procedure 3–5 pain points of the joint may be treated. The course of treatment depends on the stage and severity of osteoarthritis inflammation. These criteria increase the number of pain points in the joint area. Typically, the course consists of 3–6 procedures.

The objective of the study is to determine the effectiveness of the intratissual electric stimulation treatment (ITES) in comparison with the traditional combined treatment and optimization of the treatment with intra-articular synovial injections.

## STUDY MATERIAL

A comparative evaluation of the treatment results in the two homogeneous enough groups of patients with gonarthrosis at the age of 51–68 years has been performed. The traditional conservative complex has been used in 23 patients of the control group (physiotherapy, medication, intra-articular injection of corticosteroids). In the treatment group of 32 patients the method of intratissual electric stimulation (ITES) has been used only. The choice of treatment has been made by the blind envelope method. The patients have been allocated roughly equally according to the stages of the process.

Evaluating the effectiveness of the treatment has been performed based on the complex of the objective criteria. A positive result has been evaluated at the gain of motion in the joint, the complete absence of pain, the positive dynamics at the biomechanical examination in statics and when walking, a significant decrease in muscle tone at rest.

The satisfactory result has been evaluated at improving of the joint motions; pain relief has been evaluated according to the visual analogue scale (VAS) at 10 points, improving of single factors of the combined biomechanical study, a slight decrease in hypertension of joint muscles. The unsatisfactory result has been evaluated in the absence of any positive dynamics of the clinical picture and additional study methods.

Positive results at electric stimulation have been observed 2.5 times more often, and unsatisfactory results 3 times more rarely than at the traditional complex (see table 1). The unsatisfactory results during the ITES have been observed in patients with stage IV of the disease, and during the traditional treatment such results have been observed with stages II–IV of gonarthrosis.

During the ITES the amplitude of motions has increased in all patients, without exception, who had painful contractures, and after the traditional treatment - only in half of the patients. The latter had the increase of the amplitude at stage II–III by 2 times less than after the ITES treatment.

**Table 1.** Comparative evaluation of the results of treatment of the patients with gonarthrosis

Treatment method	Treatment results, %			Total, %
	positive	satisfactory	unsatisfactory	
Traditional complex	8–33	12–54	3–13	23–100
Intratissual electric stimulation	25–78	5–16	1–4	32–100

Before the treatment, the pain intensity according to the visual analog scale (VAS) in both groups was identical of 5–8 points. After the ITES the complete pain management mostly occurred at the early stages of up to 1–2 points. At stage III the pain management achieved in 25% of patients. After the traditional complex the pains remained in the patients almost in all cases and all stages of the disease (the pain score according to VAS decreased down to 2–5). The comparison of the radiographs produced before the start and after the ITES treatment has shown that the changes in the X-ray pattern have not occurred.

Therefore, a comparative analysis of the data of clinical and biomechanical studies has shown the solid benefits of treatment of the patients with gonarthrosis by the method of intratissual electric stimulation (ITES).

The important medical and economic indicator of the treatment effectiveness is the treatment duration. The duration of treatment by a traditional complex was equal to  $25.3 \pm 3.2$  days, during the ITES the term was  $11.6 \pm 2.4$  days ( $p < 0.05$ ).

The possibility of recurrence after the electric stimulation in the first 2 years has been reduced by 2.5 times. Any complications from use of the electrical stimulation have not been observed.

In order to study the effect of intratissual electric stimulation on the tissue local blood circulation in 20 patients, polarographic and rheographic studies of the bone, periosteum and soft tissues of the joint have been conducted with needle electrodes before and after the treatment. In 5–7 days after the ITES treatment there has been a significant acceleration of latency delivery periods (from 29.2 to  $11.3 \pm 5.7$  with  $p < 0.05$ ) and oxygen uptake (from  $60 \pm 6.9$  to  $23.8 \pm 7.3$  with  $p < 0.05$ ) compared with those before the treatment. The correlation analysis of the pain syndrome degree, the processes of oxygen uptake and blood circulation intensity has shown that in addition to management of the pain syndrome, the electrical stimulation enhances the oxidative processes of the periosteum and tissues adjacent to the joint. Blood circulation and microcirculation in bone recover, the processes of energy metabolism strengthen, which is consistent with the literature data [15]. Taking into account that

the impairment of blood circulation is one of the main causal factors in the development of gonarthrosis, the method of intratissual electric stimulation may relate to pathogenic therapy.

Thus, the intratissual electric stimulation (ITES) is a rapid and highly effective method for treatment of the patients with stage I–II of gonarthrosis of joints, completely eliminating the clinical symptoms. The ITES facilitates the rapid management of the pain syndrome and elimination of clinical and biomechanical disorders of the extremities. At arthritis of stage III the ITES method brings a significant improvement, but the symptoms and disorders may partially remain. The treatment terms of the patients are reduced by 2 times and are equal to 11.6 days. A positive effect is achieved in 83% of cases, with the traditional methods — in 32%.

Intra-articular injections. To improve the results of treatment of the patients with satisfactory and unsatisfactory results in both groups, the treatment with intra-articular injections synvisc has been continued. The course consisted of three injections of 2.0 ml per 1 week.

In the group treated with the ITES the introduction of synvisc was performed in four patients with stage III and IV of osteoarthritis, and after the traditional methods — in six persons with stage III and two persons with stage IV. In the group after the ITES management of pain senses reached after two procedures in all patients. The motion range in the joint and dynamics of movement increased slightly. At long dates the complaints of pain occurrence were observed in two persons after 6 months, and in two persons with stage III there was no pain within 1 year of the follow-up.

In the group of patients treated with the traditional combined method the pain senses in four patients decreased down to 2–4 points according to the VAS. Two persons achieved a complete pain management. The motion range in the joint and dynamics of movement were not improved. Recurrence of pain was noticed in three patients in 4–6 months, and in two patients in 7 months.

Therefore, to obtain a positive and long-lasting effect the intratissual electric stimulation (ITES) in

combination with intra-articular injection of hyaluronic acid medications (synvisc) should be used. This is a preliminary analysis of the results of such treatment, the studies are being continued.

This combination has a major advantage: the treatment methods creating a synergy to each other due to the influence from different sides of the cartilage have been used. Synvisc acts inside the joint cartilage creating a lubricating function as an implant of synovial fluid, and a therapeutical function reducing the dystrophy process.

The intratissual electric stimulation affects the blood circulation of the bones adjacent to the joint. Improvement of blood circulation, especially of micro-circulation, activates a diffuse nutrition of the hyaline cartilage and thereby restores the biochemical proc-

esses in the cartilage. Therewith, the recovery effect occurs from the bone side.

## CONCLUSIONS

1. The combination of intratissual electric stimulation and intra-articular injection of synvisc is effective at all stages of the disease, even at stages III–IV and may completely manage the pain syndrome. Such combination may be an alternative to surgical treatment, especially in the cases with contraindications to surgery.

2. The combination of intratissual electric stimulation (ITES) and intra-articular injection of synvisc is an effective pathogenetic therapy. Both methods affect different pathogenic mechanisms, increasing the effect of each other.