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The use of radiofrequency neuroablation for pain syndrome in patients with gonarthrosis grade 3 to 4

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Abstract

The aim of the study was to evaluate the effectiveness of treatment of gonalgia, pain syndrome associated with knee osteoarthritis, using radiofrequency neuroablation (RFNA) of nerves. **Materials and methods** The data of 92 patients (92 joints) who underwent outpatient treatment at the State Institution "Institute of Traumatology and Orthopedics of the National Academy Medical Sciences of Ukraine" from 2017 to 2019 were analyzed. The patients' condition was assessed before the RFNA procedure, after 2 weeks, and then 1, 3, 6 and 12 months after the procedure. **Results** According to the results of the VAS before treatment, it was 9.10 ± 0.04 cm. Thus, one month after RFNA in the group of patients, there was a significant decrease in pain syndrome according to the VAS within 3.96 ± 0.28 cm ($p \leqslant 0.05$). After 3 months a stable positive result was retained in the group at the level of 4.33 ± 0.29 cm; after 6 months – 4.46 ± 0.32 cm; after 12 months – 5.01 ± 0.34 cm ($p \leqslant 0.05$). After RFNA treatment, an improvement in the functional capabilities of the damaged joints was observed according to the WOMAC questionnaire (change by more than 15 points), namely, after 2 weeks the indicator was 52.60 ± 1.60 points, after 1 month – 48.80 ± 2.01 points, after 3 months – 51.29 ± 1.99 points, after 6 months – 54.18 ± 2.32 points, after 1 year – 55.48 ± 2.60 points. **Discussion** The results of our study complement the results of randomized controlled trials by Choi, Taverner, Alcidi, Takahashi et al. which state that RFNA is an effective method of treating pain in patients with gonarthrosis in both short-term (2-4 weeks) and long-term follow-up (more than 3 months). **Conclusions** Radiofrequency neuroablation of the articular branches of the knee nerves is an effective and safe method for treating pain in gonalgia, but it is not universal and does not prevent the disease.

Keywords: gonarthrosis, radiofrequency neuroablation, pain syndrome

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INTRODUCTION

Osteoarthritis is one of the most common degenerative diseases affecting the joints [1, 2]. In 20-25 % of cases, the symptoms of gonarthrosis that impair the quality of life are detected at the age of 45-50 years and older. In particular, osteoarthritis of the knee joint is the leading cause of chronic disability in Ukraine and other developed countries [3–9].

Although the loss of hyaline cartilage is pathognomonic for osteoarthritis, the progression of the disease also includes processes such as bone remodeling, chondroosteophyte formation, synovial hyperplasia, and muscle atrophy. Together, these changes are accompanied by local inflammation, causing a nociceptive response of the peripheral nervous system [7–11]. Clinically, patients complain of pain, swelling, crepitus, and decreased range of motion in the knee joints. Refractory pain caused by osteoarthritis of the knee joint is difficult to adequately treat and leads to the fact that 20–28 % of patients are referred for surgical treatment [8]. Replacement of the knee joint yields a fairly quick and effective result. However, the patient and the surgeon strive to perform knee joint replacement as late as possible [3–6, 9, 10]. This is due to the limited life of the implant and the need for revision operations. Attention should be paid to a significant number of young patients who would be better treated not by arthroplasty but using methods that help restore the functionality of the knee joint with minimal damage to its structure [17–22]. Thus, these patients may benefit most from minimally invasive techniques such as radiofrequency ablation [11, 12–16]. In this study, we evaluated the results of the use of radiofrequency neuroablation in the treatment of chronic knee pain, as well as the short-term and long-term effectiveness of the procedure in patients with gonarthrosis of grade 3 to 4.

The aim of the study was to evaluate the effectiveness of the treatment for pain in gonalgia due to osteoarthritis using radiofrequency neuroablation.

MATERIAL AND METHODS

In our prospective study, we analyzed the data of 92 patients (92 joints) who underwent outpatient treatment at the Institute of Traumatology and Orthopedics of the National Academy of Medical Sciences of Ukraine from 2017 to 2019. The mean age of the patients was 61.7 ± 4.3 years (age range, 45 to 79 years) (Fig. 1).

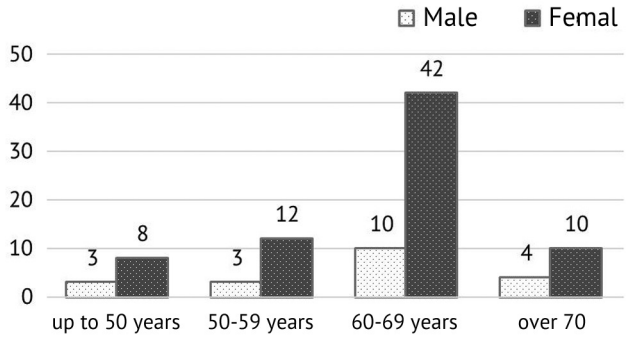

Fig. 1 Distribution of patients according gender and age (n = 92)

Among the patients who referred to the clinic, there were 11 patients under the age of 50, 15 at the age of 50–59, 52 at the age of 60–69, and 14 over 70.

All patients were examined clinically and radiographically. The main complaint was pain in the knee joint. Radiographic assessment of the stage of the disease was performed according to the Kellgren-Lawrence classification. Stage 3 of gonarthrosis was found in 24 (26 %) patients, stage 4 in 68 (74 %) patients (Table 1).

Table 1

Distribution of patients according to gonarthrosis grade (Kellgren and Lawrence classification) at primary examination [13]

Patients	Grade		
	Grade 3	Grade 4	Total
Males	7 (7.6 %)	13 (14.1 %)	**20 (21.7 %)**
Females	17 (18.4 %)	55 (59.9 %)	**72 (78.3 %)**
Total	**24 (26 %)**	**68 (72 %)**	**92 (100 %)**

Inclusion criteria upon admission to the clinic were:

⇒ Pain (gonalgia) more than 5 cm VAS due to knee joint osteoarthritis;

⇒ Inefficient conservative treatment;

⇒ Systematic intake of NSAIDs for relieving pain;

Exclusion criteria were:

⇒ Chronic systemic inflammation process;

⇒ Local septic inflammation in the area of application of the procedure;

⇒ Coagulopathy.

Quantitative and qualitative assessment of the pain syndrome was performed using a visual analogue scale (VAS) of pain. The functional restriction of the knee joint was assessed using the WOMAC questionnaire.

Technology of performance of the RFNA procedure

The initial position of the patient is supine. The first step was denervation of the superomedial and superolateral genicular nerves. Sonography identified the lateral and medial neurovascular bundle. A 20 G cannula with an active part of 10 mm was brought to the artery, which was identified using the Doppler mode. Under fluoroscopic control, the location was monitored in the anteroposterior and lateral projections. After fluoroscopic confirmation of the position of the needle, an electrode was inserted into the cannula. Next, sensitive stimulation was performed at a frequency of 50 Hz and a voltage of 0.7V. Increase in pain syndrome and paresthesia in the area of the knee joint was considered positive, by analogy with pain typical for the patient. Then motor stimulation was performed at a frequency of 2 Hz and a voltage of 0.9 V to exclude possible damage to the central nervous branch near the electrode. Local anesthesia was performed with 2 ml of 1 % lidocaine solution.

The second stage was the denervation of the inferomedial articular branch. Sonography identified the inferior medial neurovascular bundle. A cannula was brought to it. After that, under X-ray control in 2 projections, sensitive and motor stimulation was performed. Then 2 ml of 1 % lidocaine solution was injected. Radiofrequency neuroablation of the inferomedial articular branch was performed 2–3 minutes after the injection of a local anesthetic at a temperature of 90º for 90 seconds.

The patient's condition was assessed after RFNA, after 2 weeks, and then 1, 3, 6 and 12 months after the procedure.

Statistical analysis of the study materials was carried out using the MedStat program using descriptive statistics methods: in the study group, quantitative indicators were calculated, such as the sample mean (M) and the error of the mean (m), qualitative indicators are given as frequencies and their percentages. For all types of analysis, differences were considered statistically significant at $p < 0.05$.

RESULTS

The initial examination revealed that 79 (85.8 %) patients who applied to the clinic took non-steroidal anti-inflammatory drugs (Table 2).

Table 2

Ratio of patients that took NSAIDs at the stage of the initial examination at the time of admission to the clinic

Patients	NSAIDs	
	daily	Irregular intake
Males	11 (20 %)	9 (24 %)
Females	44 (80 %)	28 (76 %)
Total	**55 (59.8 %)**	**37 (40.2 %)**

All patients underwent radiofrequency neuroablation of the articular branches of the nerves of the knee joint.

The dynamics of subjective pain sensations before and after treatment, reflected in the results of the VAS questionnaire, is shown in Figure 2.

According to the results of the initial examination, the average level of pain syndrome according to VAS before treatment was 9.10 ± 0.04 cm. A decrease in pain syndrome by 3 points or more was considered reliable. So, one month after RFNA, a significant decrease in pain syndrome according to VAS was noted in the

group of patients within 3.96 ± 0.28 cm ($p \leq 0.05$); a stable positive result remained in the group at the level of 4.33 ± 0.29 cm after 3 months, 4.46 ± 0.32 cm after 6 months, after 12 months 5.01 ± 0.34 cm ($p \leq 0.05$).

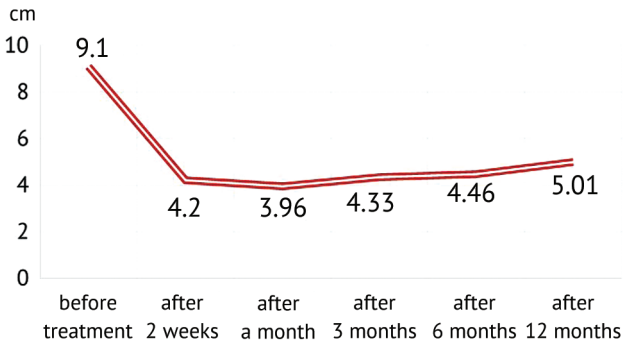

Fig. 2 Dynamics of subjective pain sensations before and after treatment

Thus, in the group of patients who underwent the RFNA procedure of the articular branches of the nerves of the knee joint, a positive result was recorded within a year. The procedure is significant in the treatment of gonalgia in the short term.

Evaluation of the effect of pain on functional disorders of life using the WOMAC questionnaire resulted in the following. A at the stage of preliminary studies, significant functional limitations of the affected joints were found in patients, corresponding to the average level of 76.88 ± 0.71 points for the group.

On average, an improvement in the functionality of the damaged joint was observed in the group, after treatment with the RFNA method which is reflected in a significant decrease in the score according to the WOMAC questionnaire (a change of more than 15 points). After 2 weeks, the average score was 52.60 ± 1.60 points, after one month 48.80 ± 2.01, after 3 months 51.29 ± 1.99, after 6 months 54.18 ± 2.32, after one year 55.48 ± 2.60 points (Fig. 3).

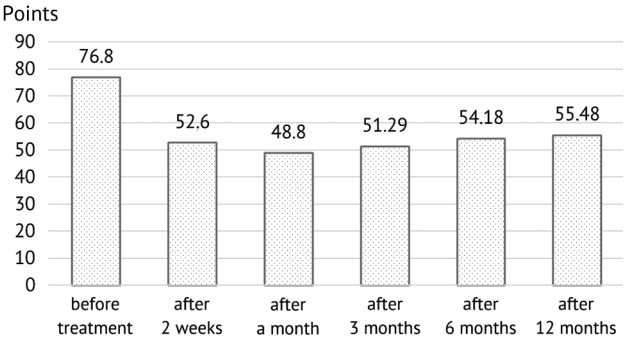

Fig. 3 Results of functional evaluation of knee OA patients by WOMAC at follow-ups

The stability of the obtained results and the preservation of positive dynamics during the year allows us to recommend the RFNA procedure as an alternative treatment for gonalgia, as well as to improve the functionality of the knee joint in patients with stage 3 and 4 of gonarthrosis.

There was no correlation between VAS and WOMAC index ($r = 0.04$) at the time of the initial examination. At the observation stages after 14 days, the relationship was strong ($r = 0.8$, $p < 0.05$) and remained so after 1, 3, 6 and 12 months: $r = 0.79$ ($p < 0.05$); $r = 0.88$ ($p < 0.05$); $r = 0.92$ ($p < 0.05$); $r = 0.97$ ($p < 0.05$), respectively. Thus, the reduction of pain syndrome by applying RFNA allowed to improve the quality of life of patients and increase their physical activity in everyday life. And, conversely, severe pain syndrome significantly limits the life of patients, affecting the quality of life of such patients. Complications Most of the procedures ran without any complications. Among those examined, it is worth noting one infectious inflammation with the formation of an abscess, followed by drainage of the pathological focus and administration of antimicrobial therapy.

DISCUSSION

The efficiency of radiofrequency ablation in randomized controlled trials. The randomized trials included in our analysis were performed by Alcidi et al. [23], Taverner et al. [24], Choi et al. [25], Takahashi et al. [26].

Choi et al. found that patients with chronic osteoarthritis of the knee who underwent radiofrequency ablation of the knee nerve had a significant reduction in VAS pain ($p < 0.001$) compared with the control group [25]. The functional outcome of treatment was assessed using the Oxford Knee Scale (OKS). The OKS score showed that in the RF group, 10/17 (59 %), 11/17 (65 %) and 10/17 (59 %), there was at least 50 % pain relief in the KJ. The authors of this study also conclude that RF ablation of the knee nerves may lead to pain reduction and joint functional improvement in patients with chronic knee pain associated with osteoarthritis.

In another randomized controlled trial by Taverner et al., the patients that referred for total arthroplasty underwent percutaneous pulsed radiofrequency ablation [24]. VAS was used to assess the level of pain. That study showed a reduction in VAS pain with radiofrequency therapy compared with the baseline. The authors also noted that the decrease in VAS was more pronounced from the 4th week compared with the first week after the procedure. The maximum improvement seen in this cohort was 19/100 VAS. Functional activity was not assessed in this study.

Alcidi et al. studied the use of continuous ablation in the treatment of pain. It was noted that the level of pain after the procedure significantly reduced from 60/100 before the procedure to 40/100 after the procedure. Functional outcomes were assessed using the Lequesne index, a marker of functional impairment. Before treatment, the

Lequesne index was 11/2. Immediately after treatment, the results improved significantly and remained at this level for 30 days after the procedure [23].

Pain relief was considered long term if there was a reduction in pain that persisted for more than 12 weeks. Eight out of 20 studies showed that radiofrequency ablation of the knee joint provides long-term pain relief [13, 17, 19–21, 27, 28, 29]. Two studies reported analgesic effects that persisted for more than 3 months [19, 22]. In a case-control study by Shen et al., continuous radiofrequency ablation was applied to a non-specific group of nerves. VAS scores decreased significantly by the end of the three-month follow-up, and functional assessment measured using SF-36 indicated an improvement in the quality of life [30]. Another study showed that the analgesic effect of the procedure lasted for 3 months after continuous ablation of the knee nerves. The study also reported improvements in range of motion and strength in the limbs after the procedure [29].

CONCLUSIONS

Radiofrequency neuroablation of the articular branches of the knee joint nerves is an effective and safe method for the treatment of pain in gonalgia associated with degenerative osteoarthritis. However, it is not universal and does not prevent the progression of the disease. It should be used in combination with other orthopedic treatments.

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The authors declare that they do not have any conflicts of interest.