https://doi.org/10.5272/jimab.2021271.3577

Journal of IMAB - *Annual Proceeding (Scientific Papers).* 2021 Jan-Mar;27(1)

Journal of IMAB
ISSN: 1312-773X
https://www.journal-imab-bg.org

Original article

DEEP OSCILLATIONS- REDUCING EDEMA AND IMPROVING KINESIOLOGY IN THE EARLY STAGES AFTER KNEE JOINT ARTHROPLASTY

Evgeniya Vladeva, Mariyana Mihaylova, Liliya Panayotova
Department of Physiotherapy, Rehabilitation, Thalassotherapy and Occupational Diseases, Medical University - Varna, Bulgaria.

ABSTRACT

Background: Joint arthroplasty is one of the most common modern operations in orthopedics and traumatology. Physiotherapy and rehabilitation are the final phase of the endoprosthesis and are of great importance both for the rate and for the extent of functional recovery. DEEP OSCILLATION® is a patented therapeutic procedure using resonant vibrations of tissues with minimal external mechanical effect and proven analgesic, antifibrotic, anti-inflammatory and anti-inflammatory effect.

Aim of the study: To investigate the effect of deep oscillations and kinesitherapy on the reduction of edema, reduction of pain syndromes and restoration of the range of motion in patients after knee joint arthroplasty.

Materials and methods: The study was conducted on 106 patients -38 men and 66 women randomly assigned to 2 groups - experimental group (EG) with 56 patients and control group (CG) with 50 patients, all after knee joint arthroplasty.

Results: Our preliminary results indicate that there are significant differences in the recovery of patients in EG and CG. Patients who have a deep oscillation procedure are recovering faster and better, both in terms of subjective complaints and in terms of the monitored functional parameters ($p<0.001$).

Conclusions: The results obtained have shown that deep oscillations are an effective method for reducing swelling, suppressing pain and inflammation, and increasing the range of motion (ROM) in early rehabilitation of patients after knee joint arthroplasty.

Keywords: knee joint arthroplasty, deep oscillations, early rehabilitation,

INTRODUCTION

Arthroplasty is one of the most common modern operations in orthopedics and traumatology. The beginning of this orthopedic activity was set at the end of the nineteenth century when Themistocles Gluck attempted to replace a tuberculosis-fused thigh head with ivory [1].

One of the founders of the method Sir John Charnley has formulated the main purpose of an endoprosthesis in 1971: to create artificial articulation that removes the subjective complaints of the patient, restoring his functional activity and improving his quality of life for the longest period of time [2]. The ever-increasing demands on the quality of life also reflect increasing demands on endoprosthesis, related to maximum recovery rates, achieving full functional activity, and even longer survival times for artificial joints. The satisfaction of these requirements depends on the complex application of several interconnected basic factors - the materials from which the joints are made, the way of attachment of the components to the bone, the operative technique and last but not least, the timely beginning of the rehabilitation of the patients who have undergone joint arthroplasty [3,4].

Physiotherapy and rehabilitation are the final phases of an endoprosthesis. Their role is extremely important both for the rate and for the degree of functional recovery. In many cases, neglecting, underestimating or misregarding this last stage of the therapeutic process can totally compromise the outcome of a well-made hip or knee joint arthroplasty.

In hip and knee endoprosthesis, the ultimate goal is to achieve maximum functional recovery. There are, however, some peculiarities concerning the two types of interventions. If the hip endoprosthesis is a major problem in restoring the support of the endoprosthetic joint in order to restore the patient's normal gait, in the knee endoprosthesis the load on the operated joint can start almost immediately. In this case, the difficulty is to restore the full volume of motion in the knee joint, as it is much more susceptible to contractures than the hip joint [4].

In the knee endoprosthesis, the swelling of the tissues around the knee joint, the lower leg, the ankle joint and the foot passes much more slowly and harder, which further limits the ROM and is often accompanied by pain and discomfort of the endoprosthetic limb.

DEEP OSCILLATION® is a patented therapeutic procedure utilizing resonant tissue vibrations by electrostatic attraction and friction that produces mechanical vibration not only in the skin but also in the deeper tissues of treated areas of the patient's body [5]. The procedure itself has a minimal external mechanical effect, which allows using it in cases of acute pain, fresh trauma, and for the treatment of any kind of wounds. Numerous pilot studies have demonstrated the anxiolytic, antifibrotic and anti-inflammatory effect of deep oscillations due to reduction in the release of

inflammatory mediators (histamine, serotonin, prostaglandins, and leukotrienes), inhibition of the ion wall and fluid permeability of the vessel and peroxidation of lipids, reducing the amount of free radicals and increasing the activity of monocytes and T-lymphocytes. [6 - 9]. A number of studies also prove the reduction of pain, reducing of edema and increased joint range of motion, immediately after completion of the therapeutic course. [10] as well as retaining the achieved results six weeks to six months after treatment [11, 12].

AIM OF STUDY

To investigate the effect of deep oscillations and kinesiotherapy on the reduction of edema, reduction of pain syndromes and restoration of the range of motion in patients after knee joint arthroplasty.

MATERIAL AND METHODS:

The present study was conducted with 106 patients - 38 men and 66 women aged between 28 and 83 years (69.5) were randomly assigned to 2 randomized groups (experimental consisting of 56 patients and control group consisting of 50 patients) all of them after knee joint arthroplasty.

A 7-day physiotherapeutic course of treatment was administered to patients with knee joint arthroplasty in the EG 3-7 days after the suture removal with the following regimen:

1. Exercise program, including positional treatment of the operated leg, passive and active skeletal, muscular exercises and joint mobilization techniques, for strengthening the thigh and gluteal muscles, as well as for increasing the volume of movement in the knee joint. The program also included active exercises for the ankle joint for antithrombotic prophylaxis, sitting and raising training, treadmill training with aids, including climbing and descending stairs [13, 14].

2. Deep oscillations in the area of the endoprosthetic joint lower leg and ankle joint with the following parameters and duration:

1. 120Hz-180Hz - 10min for softening of seals and increasing the threshold of pain

2. 10Hz-30Hz - 10min for effective tissue dehydration and disintegration of obstructions, activation of the venous function, powerful movement of the tissues

3. 85Hz - 5min for improving blood and lymphatic circulation and tissue relaxation

A 7-day physiotherapeutic course of treatment was also given to the KG patients 3-7 days after the suture removal including only an exercise program identical to that of the EG.

The recovery was followed in parallel in patients with EG and CG.

Protocol for study the effect of administered treatment:

1. Anamnestic data - pain, discomfort, stiffness, and other subjective complaints of the patient detected by the visual-analogue scale (VAS) evaluated from 0 to 10.

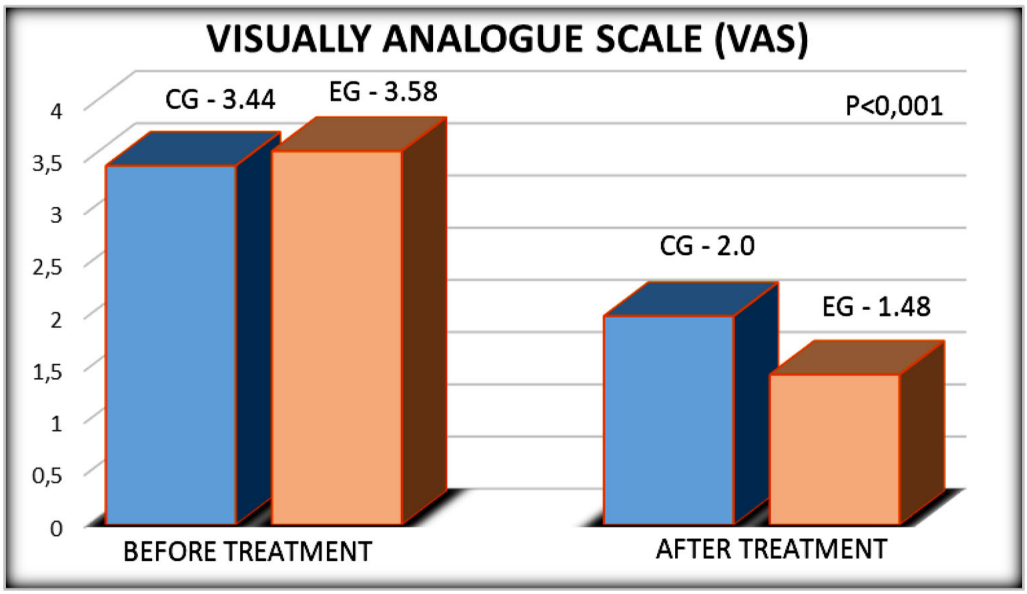
2. Functional status: an examination of increasing the angle of the range of motion of the knee joint by goniometry and comparative centimeter of girt of the knee joint and shank of the endoprosthetic and the undamaged leg.

Testing in the experimental and control groups was performed before and immediately after the end of the physiotherapeutic treatment.

RESULTS:

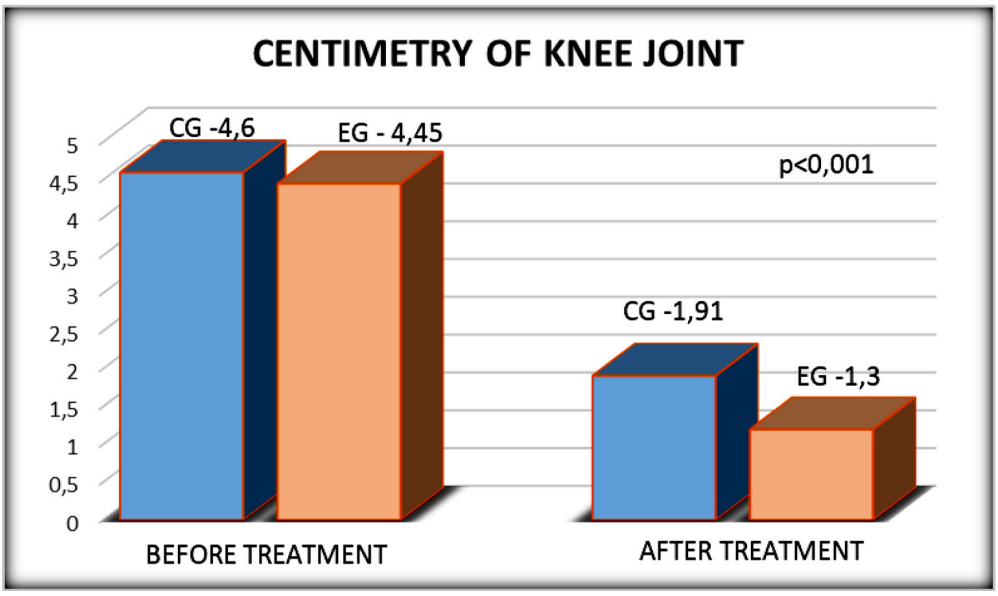
In our study, the analysis of the change in subjective complaints of the patients in both groups assessed by the VAS shows a tendency for the reversal in the patient's subjective complaints studied in both groups. Patients who have deep oscillation procedure recover faster and better. The mean value of VAS is 1.48 ± in the EG and 2 ± at CG ($p < 0.001$). (Fig. 1)

Fig. 1. Changes in the sensation of pain, stiffness and discomfort measured by VAS.



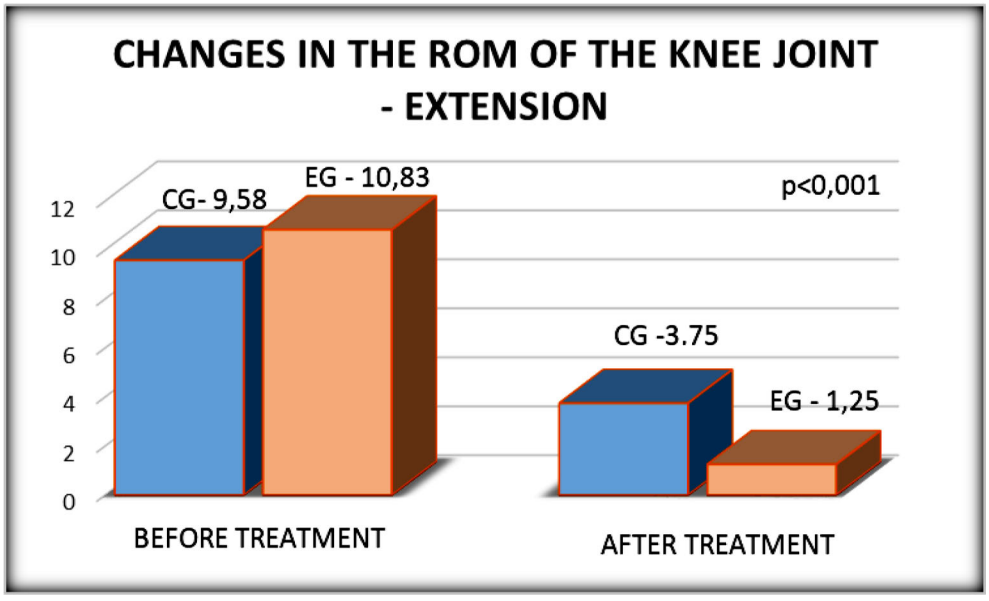
The results in fig. 2 show the comparative centimeters performed on the operated and healthy knee joint of each patient. At the end of the treatment course, the mean value of this marker is 1.3 ± at EG, to 1.91 ± at CG (p<0.001). The swelling of the operated dysfunction decreases more rapidly and to a greater extent in the patients in the experimental group, which we consider is due to the use of deep oscillations.

Fig. 2. Knee joint centimeters (the assessment is given by the difference in plus centimeters of the affected joint).



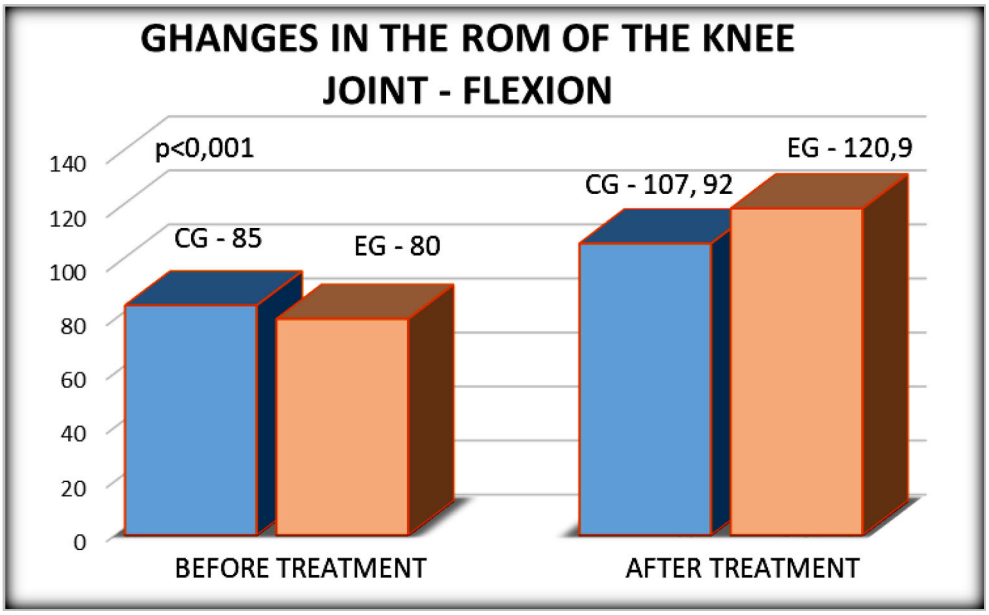
The results are similar in terms of the change in the range of motion in comparison to the experimental and control groups. Fig. 3 shows the change in the extent of ROM of the knee joint in patients with EG and CG. Prior to physiotherapeutic treatment, the deficit in the extension of the knee joint was approximately the same in both groups (about 10 degrees), but at the end of treatment, the loss of ROM in patients with EG 1.25 ± was statistically significantly less than at CG 3.75 ±).

Fig. 3. Changes in the ROM of the knee joint–extension.



The dynamics in the volume of flexion in patients with EG and CG before and after the treatment is presented in Fig. 4. The deficiency of flexion before the start of the treatment was almost the same in EG and KG. There is a statistically significant increase in the volume of flexion in both groups. Similarly, here we have better results in EG, which we render to deep oscillations.

Fig. 4. Changes in the ROM of the knee joint – flexion.



DISCUSSION

By reducing the release of inflammatory mediators (histamine, serotonin, prostaglandin, leukotrienes), deep oscillations inhibit ionic and fluid permeability, peroxide lipid oxidation and increase the activity of monocytes and T lymphocytes. This results in a powerful anti-inflammatory effect that at a functional level manifests itself with a rapid change to an improvement in subjective complaints - pain, discomfort and stiffness.

The swelling of the operated dysfunction decreases more rapidly and to a greater extent in the patients in the experimental group, which we consider is due to the use of deep oscillations. Tissue oscillations increase the absorption surface, and mechanical activation stimulates the interstitial fluid drainage through endothelial spaces, improves blood and lymphatic circulation deep into the skin and subcutaneous layers, resulting in the pronounced reducing of swelling because of the deep oscillation procedure.

The better recovery of EG concerning the range of motion is again associated with the use of deep oscillations, which, because of its analgesic effect and the reduction of edema, allows kinesitherapy to be performed in larger volume, giving better results in compensating the motor deficit.

Though we have a significant increase in the volume of flexion, in both groups, we have better results in EG, and this is again due to Deep oscillations, which by their analgesic, antifibrotic and anti-inflammatory effect indirectly influence the ROM of the operated joint while facilitating the conduct of kinesitherapy.

CONCLUSION

Deep oscillations are an effective method for removing swelling, suppressing pain and inflammation, and increasing the ROM in early rehabilitation of patients after knee joint arthroplasty. The ability to apply them to metal implants and endoprostheses at a very early stage of postoperative treatment, as well as working in close proximity to open wounds, makes them a good choice in early rehabilitation of patients after knee joint arthroplasty. Reducing edema and limiting the release of inflammatory mediators leads to extremely rapid analgesia and significantly reduces stiffness and discomfort in the endoprosthetic joint. The rapid and powerful anti-inflammatory and analgesic effect facilitates kinesitherapy, which contributes to better results in reducing motor deficiency and stabilizing gait in patients with knee joint arthroplasty. The combined application of deep oscillations and kinesitherapy has proven to have better results with regard to the timing and extent of recovery of knee joint function after endoprosthesis. Based on the results obtained, we can recommend the complex methodology used by us as a reliable and effective method in early postoperative rehabilitation after knee endoprosthesis. Finally, yet importantly, there are limited contraindications for the use of deep oscillations.

REFERENCES:

1. Learmonth ID, Young C, Rorabeck C. The operation of the century: total hip replacement. *Lancet.* 2007 Oct 27;370(9597):1508-19. [PubMed]

2. Charnley J. Low Friction Arthroplasty of the Hip. Theory and Practice. Springer-Verlag Berlin Heidelberg. 1979. [Crossref]

3. Jotov A. Rusimov V. Modern aspects of knee and hip joint arthroplasty. *Physical Medicine, Rehabilitation, Health - Sf.* 2013; 15(2):3-15 [in Bulgarian]

4. Cheng T, Feng JG, Liu T, Zhang XL. Minimally invasive total hip arthroplasty: a systematic review. *Int Orthop*. 2009 Dec;33(6):1473-81. [PubMed]

5. Aliyev RM. Better Functional Results of Conservative Treatment in Fresh Lateral Ligament Injuries of the Ankle with Additional Deep Oscillation. *Phys Med Rehab Kuror.* 2012; 22(01):9-15. [Crossref]

6. Brenke R, Siems W. [Adjuvant therapy in lymphedema] [in German] *Z Lymphol*. 1996 Jun;20(1):31-5. [PubMed]

7. Jahr S, Schoppe B, Reisshauer A. Effect of treatment with low-intensity and extremely low-frequency electrostatic fields (Deep Oscillation) on breast tissue and pain in patients with secondary breast lymphoedema. *J Rehabil Med.* 2008 Aug;40(8):645-50. [PubMed]

8. Korkina L, Reinhold J, Rota L, Primavera G, and Raskovie D. Treatment of Gynoid Lipodystrophy (Cellulite) with DEEP OSCILLATION®: A Pilot Clinical Study. *29th Annual Meeting of The Bioelectromagnetics Society, Japan,* Kanazawa. 2007

9. Mikhalchik E., Titkova S., Anurov. M., Suprun M., Ivanova A., Trakhtman I, at. Al. Wound Healing Effects of DEEP OSCILLATION®.–*1st International Conference on Skin and Environment,* Moscow-St. Petersburg 71, 2005

10. Mratskova G, Petrov D, Dimitrov N. Short Term Effects of Low Frequency and Low Intensity Electrostatic Field in Patients with Knee Joint Osteoarthritis. *Knowledge International Journal - Skopje*. 2018 Dec; 28(2):547-551. [Crossref]

11. O'Brien CP, Watson A. Deep Oscillation® Therapy in the Treatment of Lateral Epicondylalgia: A Pilot Randomized Control Trial. *J Sports Med Doping Stud.* 2016; 6(3):1-4. [Crossref]

12. Mratskova G, Dimitrov N, Petrov D. Effectiveness of complex rehabilitation with deep oscillation and kinesitherapy for pain relief in patients with gonarthritis. *Knowledge International Journal - Skopje*. 2019 Mar *26*(4), 1071-1077. [Internet]

13. Evans M. Rehabilitation protocol for knee replacement surgery. Physiotherapy Guidelines. Melbourn Orthopaedic Group. [Internet]

14. Knee arthroscopy rehab protocol. Care First Ortho. 2018. [Internet]

Please cite this article as: Vladeva E, Mihaylova M, Panayotova L. Deep Oscillations- Reducing Edema and Improving Kinesiology in the Early Stages after Knee Joint Arthroplasty. *J of IMAB.* 2021 Jan-Mar;27(1):3577-3581.
DOI: https://doi.org/10.5272/jimab.2021271.3577

Received: 04/02/2020; Published online: 10/01/2021

Address for correspondence:
Liliya Panayotova-Ovcharova
Department of Physiotherapy, Rehabilitation, Thalassotherapy and Occupational Diseases, St. Marina Univesity Hospital of Varna,
1, Hr. Smirnenski Blvd., Varna, Bulgaria.
E-mail: dilli_lilli@abv.bg,