THE EFFECT OF THE GALVANIC BATH FOR THE OSTEOARTHRITIS HANDS THERAPY

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Abstract. Galvanic baths can be a form of therapy that associate the effects of galvanic current and the beneficial effects of warm water, with the possibility of encompassing a much larger body surface in treatment. We apply this form of therapy in a group of 40 patients with hand osteoarthritis like a management approach in a Romanian rehabilitation clinic.
This form of electrotherapy can't cure the osteortritis but has a good impact on the functionality of a hand because the imapairement of the hand led to chronic and disabling disease that can affects the hole human body.
Key words: galvanic bath, therapy, osteoarthritis

The hand is the most complicated segment of the human body, making this appreciation from the anatomy and biomechanic point of view. Both, the structure and the adapted function for the human activities has an enormous evolutive history, hand is the „organ" of prehensiune and discriminative sensibility, being in the same time an organ use to expres the personality and profession.

The hand structures, tegument, tendons, joints, nerves, bomes, muscules, do necessite a complete integrity, a lack or a deficit of any of those components can compromise the functionality of hand and also the functionality of life of individue in the end.

The structure of joints changes with the age, also called osteortritis (OA), and the overuse, this is manifesting a little bit more intense at old age.

At old age we can find osteortritis with deformities due to degradation and loss of the articular cartilage is a central feature that is sometimes attributed to "wear and tear". [1]

The aging changes in joint tissues that contribute to the development of OA include cell senescence that results in development of the senescent secretory phenotype and aging changes in the matrix, including formation of advanced glycation end-products that affect the mechanical properties of joint tissues. [1]

Estimates from the Zoetermeer survey found that radiographic involvement of the distal interphalangeal joint (DIP) affected more than half of men over the age of 65 and more than half of women over the age of 55 [2]. Thirteen percent of men and 26% of women over the age of 70 were found to have symptomatic hand OA involving at least one joint in the Framingham study [3].

Compared with those without symptomatic hand osteoarthritis, subjects with the disease had 10% reduced maximal grip strength, reported more difficulty writing, handling, or fingering small objects (odds ratio = 3.4), and showed more self-reported and observed difficulty carrying a 10-pound (4.5-kg) bundle (odds ratio = 1.7 and 1.6, respectively). [3]

The osteoarthritic joint is characterized by degradation and loss of the articular cartilage, thickening of the subchondral bone accompanied by formation of bone marrow lesions and cysts, osteophytes at the joint margins, variable degrees of synovitis with synovial hypertrophy, meniscal degeneration (knee), and thickening of the joint capsule. [4]

In the case of many year of biomechanical overuse of the hand, the old patient can

present some clinical symptoms the usually are pain when they use their hands for different activities, tremor, lost of range of motion or stiffness, swelling, a crunchy sound (crepitus) when joints move, weak grip.

The changes of hand osteoartritic joints can be generalized or limited like: risartrosis, presence of Heberden or Bouchard nodules, also inflammatory erosive arthrosis (DIP, PIP, rare MCP).

Clinical symptoms of osteoarthritis according to stage

Latent osteoarthritis	Clinical manifestations are absent
Arthrosis with symptoms that are manifested	Arthralgia, joint stiffness, limited movements
Activate osteoarthritis	Arthralgia, joint stiffness, limited movements, signs of inflammation (swelling, articular effusion, etc.)
Uncompensated arthrosis	Joints dysfunction with marked limitation of mobility, periarticular pain

The 2012 American College of Rheumatology Recommendations present the fact that the TEP (The Technical Expert Panel) conditionally recommends that all patients with hand OA should be evaluated by a health professional, either their primary care provider or an occupational or physical therapist, for their ability to perform activities of daily living and receive assistive devices as necessary, instruction in joint protection techniques, and the use of thermal agents for relief of pain and stiffness. [5]

This is also the management approach in many Romanian rehabilitation clinic and the management we use in our study. The only difference is that tha evaluation is made by the rehabilitation clinician, the one that establish the management therapy. Because OA has a poly-articular nature and therefore is complex to study, it warrants special attention [6, 7].

Kloppenburg M. et al talkink about the starting how a study start they suggest that: there is no current consensus on the minimum and maximum pain level required for study entry. It is proposed that on entry to a study there be a hand pain score of 40–80 mm on a 100 mm Visual Analog Scale (VAS) or 4 to 8 on an 11-point Numerical Rating Scale (NRS) (0 = no pain; 10 = extreme pain) after withdrawal of analgesic/anti-inflammatory medications, which is what is currently required in study design of OA clinical trials. [8]

How presented Castrogiovanni and Musumeci**[9]** in one article from 2016 that are many article in the recent literature about the use of (1) endurance training and osteoarthritis; (2) strength training and osteoarthritis; (3) flexibility exercise and osteoarthritis; (4) aquatic exercise and osteoarthritis.

Literature studies about hand osteoarthritis talk about different terapeutic management possibilities like: occupational therapy, periodic rest, heat, splinting, topical pain medications and oral pain medications.

In comparison to the 2012 guidelines recommended by the American College of Rheumatology for the use of nonpharmacological and pharmacological therapies in OA of the hand, we see that the latest studies provide additional options to help treat patients. [5]

Concerning nonpharmacological recommendations, which are limited to evaluation of activities of daily living, joint protection techniques, provision of assistive devices, use of thermal modalities, and provision of splints for TM joint OA, there is no mention of therapies such as Kaltenborn manual therapy, radial nerve mobilization, Maitland's passive accessory mobilization, custom-made splinting, balneotherapy, magnetotherapy, and paraffin bath therapy. [10]

Table 1. Classification criteria for osteoarthritis of the hand, classification tree format* [11]

1. Hand pain, aching, or stiffness

and

2. Hard tissue enlargement of 2 or more of 10 selected joints

and

3. Fewer than 3 swollen MCP joints

and either

4a. Hard tissue enlargement of 2 or more DIP joints

or

4b. Deformity of 2 or more of 10 selected joints

* The second and third distal interphalangeal (DIP) joints may be counted in both item 2 and item 4a. The 10 selected joints are the second and third DIP, the second and third proximal interphalangeal, and the first carpometacarpal joints of both hands. This classification method yields a sensitivity of 92%and a specificity of 98%.

We propose another view reguarding the treatment approach, the one that is frequently used in Romanian balneo-rehabilitation clinics for the treatment of hands osteoarthritis.

In Romania, the use of different electric therapy is usually applied for the cure of osteoarthritic joints. One of this very used method is the galvanic bath, a form of electrotherapy that provide a therapeutic form of continuos current thru the water to human body.

We find also that the mainly use method to evaluate the outcomes is the pain at rest and during the ADL (activities of daily living) assessed with a visual analog scale (0-10cm), loss of range of motion (ROM), grip and pinch strength and we decide to use the same evaluation form for our patients.

STUDY GROUP

Using the ACR critheria to diagnose the hand osteorthritis, we evaluate on an 8-month period of time the patients that address to Phoenix Physical medicine and reabilitation clinic from Craiova.

Using some criteria, we choose 40 patients for our study, 20 that undertake kinetotherapy for the hand, terapeutic masage and galvanic bath therapy (galvanic bath group - BG), and other 20 were treated only with kinetotherapy and terapeutic masage (control group - CG).

We establish some rigourous criteria to include the patients in the survey.

First of all, we start with the sign consent from all of the patients after they decide to fully participate to our study and furfill all study criteria.

Study inclusion criteria:

- patients who did not use anti-algic and anti-inflammatory drugs 2 weeks before the enrolling in the study.

We use ACR Clinical Criteria for Hand-Arthropathy to select the patients:

- Pain or stiffnes in the hand plus 3 of the following 4 criteria

- swelling to no more than 2 MCFs
- subchondral bone condensation at least one IFD
-deformation to at least one joint of the 10 selected
- pain at least 2 of the 10 joints (trapezometacarpine, IFP, IFD fingers II and III bilateral)

Exclusion criteria are created also based on the galvanotherapy contraindications:

▪ patients that do not like this type of therapy because the hypersensitivity or galvanic intolerance
▪ patients who use medication (pain and antiinflamatory) 2 week before the presentation in the clinic
▪ high blood pressure
▪ patients with inflammatory rheumatic diseases (eg rheumatoid arthritis, psoriatic arthritis), cancer, cognitive dysfunction
▪ patients that present one of the contraindication for the galvanotherapy:
▪ after careful examination of the skin of the treated area, the detection of abrasions, wounds, dermatological injuries, infection in the treated area, applications of cosmetic creams, is also an exclusion criterion for the study
▪ epilepsy
▪ acute haemorrhage
▪ osteomyelitis
▪ malignant tumors
▪ febrile patients, cachets or those at risk of visceral or somatic decompensation
▪ superficial and deep vein thrombophlebitis

The study group consisted of 28 women and 12 males, by age group the patient was randomized like in the table below:

Table 2. Distribution of the study group by age and sex

Age	Women	Mens
31-40 years	1	0
41-50 years	6	2
51-60 years	10	4
over 60 years	11	6

The preponderance of patients are over 60 years of age (42.5%), followed closely by those aged 51-60 years (35%). 20% of patients were between 41 and 50 years of age and only one patient was under the age of 40 years (2.5%).
We continue to refer to the patient's background and characteristics.

Table 3. Distribution of the study group by sex and area of origin

The living environment	Women	Mens	Total
Urban	12	2	14
Rural	16	10	26

From the environmental point of view, 14 patients came from the urban environment and 26 from the rural areas near the town.
Percentually, urban patients accounted 35% in totaly compared to 65% of those caming from the rural area.
The difference appears, as can be seen from the previous table due to the prevalence of womans cases from rural areas (40%). As regards the group of women, there are a small difference between urban and rural cases.
Concerning the working daily activity of the patients all the patients were physically active, especialy thse from the rural area, the household in the country implied hard work evry day.
We also studied the time since the onset of the first symptoms of the disease: in 62.5% of cases (25 patients) the disease began less than 10 years ago, with only 37.5% (10 patients) declaring a symptom onset for more than 10 years.

Tabel 4. Distribution of patients depending on the time from beginning of simptomatology

Years from beginning of simptomatology	No.of patients
0-5 years	15
6-10 years	10
Peste 10 years	15

The patients presented also the followings conditions associated with hand and osteoarthritis:
- Hypertension: 6 women and 3 men
- Obesity: 8 women and 2 men
- Diabetes type II: 3 women and 2 men
- Chronic ischemic heart disease: 5 women and 2 men
- osteoporosis: 10 women

In the selection of patients, we considered that the drug therapy for the associated diseases makes possible the establishment of complex rehabilitation therapy, which does not negatively affect the respective diseases.

The treatment of fist and hand osteoarthrosis is complex. The treatment aims to fight against pain, functional impotence and muscle contraction, as well as against deformations and aggravation of articular degeneration.

The main therapeutic goals in applying any of this type of treatment are as follows:
- reducing the simptomatology, mostly the pain
- mentaining / improving joint mobility
- maintaining / improving the muscle tone
- obtaining stability of joints
- preventing further damage to joint cartilage
- improving the local circulation.

Electrotherapy is a form of conservative physical therapy that uses different forms of electric currents. Galvanic bath is a form of therapy used in the treatment of osteoarthritis that can not correct the etiological links but can improve and control:
- pathophysiological elements (inflammation, edema, hypotonia, muscular hypotrophy, pain);
- clinical, symptomatic and functional elements (pain, muscle contraction, joint stiffnes, etc.);
- systems of biological retroactivity using feed-back circuits.

Bi- or quadri-cell galvanic baths are positive effects using the continuous current. These forms of electrotherapy include the possibility of immersing the upper and /or lower limbs, alternative or in the same time, in water-filled cuvettes connected to a continuous current generator.

Biophysiological effects due to galvanic current are:

It manifests with maximum intensity around the axis connecting the two electrodes, being specific to each pole.

1. an analgesic effect - manifested especially at the anode, due to its action on the sensory receptors of the pain from the skin and on the sensory nerve fibers. The analgesic-sedative effect is also explained by the effect of current that increase the peripheral receptor sensitivity threshold, CNS and local microcirculation.

2. a stimulation effect - stimulation manifested at the cathode, performs muscle contractions as a result of current action on motor nerve fibrils.

3. sedative effect - due to action on the CNS, resulting in osteo-articular hyporeflexion, in the case of application of the descending form of the galvanic current (cranial anode +, podal catod -).

4. hypermiant - vasodilator - biotrophic effect due to local vascular activation, but with effects on general circulation.

5. nonspecific neuro-vegetative regulation effect when applied to the cervical region.

Galvanic baths

This technique associates the effects of galvanic current and the beneficial effects of warm water (analgesic, vasodilator, miorelaxant, sedative, etc.) with the possibility of encompassing a much larger body surface in treatment. Water becomes a mediating medium between electrodes and skin, so the current is distributed over a larger body surface, and the current density becomes smaller, without the risk of burns at the applied intensity.

Galvanic baths consist of a therapeutic technique in which the patient's limbs are disposed in four/two small reservoir, in porcelain or glass fiber reinforced with polymerized plastic (the modern version), in which case the procedure is called the "quadricellular/bicellular galvanic bath".

Two/Four-cell galvanic baths

The galvanic bath is provided with an electric stimulator, this provide the continuous voltage required to supply the four reservoirs. Each electrode (in some models even 2) is made of graphite or stainless steel, so the electrical circuit is established through the patient body. These electrodes are rectangular in shape, having a thickness of approx. 10 mm, width 60 mm, length 200 mm (for hands – the superior reservoirs) and 400 mm (for feet– the inferior reservoirs.

The present appliance is made up of two main components:

- the electrostimulator and cell assembly (2 for upper limbs / 2 for lower limbs) and two auxiliary components: the adjustable and shelf seat on which the electrostimulator.

The quadricellular bath electric stimulator supplies a max. 100 V for a current of maxim of 100 mA. The working current does not usually exceed 30 mA, being regulated by the tolerance of the patient.The water introduced into the cells should be at body temperature (34˚C to 38˚C). In warm water (37˚-38˚C), we can apply higher, better tolerated intensities, as opposed to cold water, which accentuates the unpleasant sensation of passing electric current.

For the modality 2 galvanic bath only one circuit is used when referring to upper or lower limb therapy, the condition being the closure of the circuit (a cell being +, another cell being-) and the polarity depending on the required therapeutic effect.

For the modality 4 galvanic bath, all cells are used simultaneously, closing two circuits, with the polarity respecting the fixed therapeutic objective.

The amount of water in the reservoirs defines the size of the surface of the contact of water to the skin so if we want to have a more active pole, we minimize the amount of water in the reservoir on which we want to act.

It is recommended to perform the daily procedure, with a 20-30 minutes session, in 10 sessions, repeted after more then 20 weeks.

Results and Discussion

Patients from the study followed daily, 3 times of week, and 4 times/week at home, a 30-minute program of active hand and finger mobilizations, bilateral, flexi-extensions and exercises with various resistance balls. Also, a predetermined set of physical procedures, daily for 2 weeks. In addition, patients in the BG group followed daily, for 30 minutes a 4 cellular galvanic baths procedure.

An evaluation was performed at the start of the study and at the end of the study, using: a visual pain analogue scale VAS (100 mm), a rapid hand test for Moberg Picking Up Test (MPUT).

Taking into account the objectives of the recovery treatment we followed the evolution of the patients in by balance the values obtained in a data sheet for each patient.

We analyzed the evolution of the VAS score on the two groups of patients: the galvanic bath group BG and the control group CG.

Table 5. Mean of the values based on pain progression on VAS scale (mm)

Group	VAS initial score	VAS final score
BG	57	27
CG	54	34

Data analysis shows that the initial mean VAS score recorded in patients from the galvanic bath group BG (mean 57) and it was lower for the patients in the CG control group (mean 54).
The best outcome was recorded for the BG patients group where during the treatment we recorded the decrease of the score from 57 to 27, respectively a variation of 30 points, which is a percentage decrease of 53% of the pain intensity.
The lowest incidence of VAS on admission was noted in the control group CG: 54. This group recorded the VAS score at the end of treatment of 34, which means that the decrease in pain intensity was only 38%.
The Moberg Picking Up Test (MPUT) test was performed according to the protocol described in the literature, with the timer recording the time (in seconds) to the dominant hand and then to the other, then the two times obtained were gathered and divided bytwo, obtaning an average score that underline the hand functionality.
At the end of the study the Moberg test show that galvanic baths therapy has also improved hand functionality (better MPUT times: 12.6 sec.vs 16.78 sec).

Table 6. Evolution of media MPUT score in the two groups

Group	Media MPUT inițial	Media MPUT final
BG	17,9	12,6
CG	18,5	16,7

Conclusions

From the study, correlated with the data from the literature, the following conclusions can be formulating:
1. Osteoarthritis is a chronic and disabling disease that can affects all the joints.
2. From a morphopathologic point of view, the arthroses are characterized by regressive degenerative lesions of hyaline articular cartilage, that will interest oalso the subcondular bone, synovial and soft periarticular tissues, and the clinical signs will be pain, deformity of joints and limiting movements at the respective joints.
3. The etiology hand osteoarthritis of the disease is multifactorial. Consideration can be given to: repetitive mechanical stress, age, genetic predisposition, biochemical changes of cartilage etc.
4. The evolution of fist and hand osteoarthritis, like in the case of all of the osteoarthritis is a long-time disease and has some peculiarities due to the different degree of morpho-pathological changes characteristic to each patient and his life style.
5. The rehabilitation therapeutic approach of patients with hand osteoarthritis should include all pathophysiological caractheristics and require the association of diferent recovery resources: medication, physical therapy, electrotherapy, hygiene-education rules.
6. The recommended and correctly performed application of galvanic therapy is a valuable therapeutic option for those patients for whom antiinflamatory drug therapy has contraindications due to other diseases or risks.
7. During the course of this study, no patient showed worsening of the symptoms, unpleasant side effects due to the therapeutic application.
8. Correct and complete patient assessment is an important component of the

rehabilitation management program, highlighting the need for standardized scales to quantify and compare improvement.

9. The best evolution was observed in the patients with the galvanic BG group where during the treatment we experienced a decrease in the pain intensity of 53% versus only 38% in the patients in the CG control group.

10. The significant efficiency of the galvanic current and the retention of the positive effects obtained justify us considering physical electrotherapy treatment as the fundamental therapeutic tool in the functional rehab of the osteoarthritic hand.

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