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Research article

EFFICACY OF SOFT TISSUE APPLICATION, MANUALLY-THERAPEUTICAL TECHNIQUES FOR KNEE ARTHROKINEMATICS RECOVERY COMPLEX IN PATIENTS AFTER ARTHROSCOPIC MENISCECTOMY

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ABSTRACT

Introduction: In this article we present the final effect of the application of complex soft tissue manually-treatment system for recovery of joint kinematics in patients with moderate and minimal protective period of rehabilitation after arthroscopic meniscectomy. **Material and Methods:** The study was conducted in 2005-2012 into three medical centers in Bulgaria: Blagoevgrad, Sofia and Pleven. The study included a total of 110 patients divided into three groups (Control and Experimental I and Experimental Group II) who studied the effect of topical application of the manual therapeutic techniques compared to traditional rehabilitation methods applied. For testing the efficacy of a treatment approach in the three groups of patients, the results have processed by the method of variational analysis. **Results:** After analysis of results we find significantly more fully and without residual short violations recovery for all controlled parameters in patients who have implemented comprehensive manually-therapeutic treatment compared with control group patients. **Conclusion:** Application of adequate physiological and pedagogically grounded complex rehabilitation is required in patients after arthroscopic meniscectomy model with motor deficits in tractable routine rehabilitation. Observations allow us to offer a methodology for implementation in general practice rehabilitation in patients after meniscal ruptures treated by arthroscopic meniscectomy and motor deficits, intractable routine rehabilitation.

Keywords: Manually-therapeutic techniques, Rehabilitation, Arthroscopic meniscectomy.

INTRODUCTION

Arthroscopic meniscectomy treated surgical treatment of patients with the most common intra-articular damage-meniscus ruptures[1]. This current and specific surgical approach necessitates adaptation of complex musculoskeletal physiotherapy to this modern minimal invasive medical equipment.

In studying and analysis of complex influence pathogenic factors for the occurrence of primary and secondary motor deficits, impaired joint kinematics in the knee is the basis for the formation of secondary neuro-muscle-skeletal dysfunctions, the kinetic chain of the entire lower limb[2, 3]. Therefore, the current trends in contemporary skeletal muscle rehabilitation impose physiological deterministic resources influencing both the contractile and non-contractile pathogenic factors[3,4], mobilizing massage[4] etc., as well as synergistic interaction between manually-therapeutic methods and physical healing factors[1, 4].

Significant epidemiological prevalence of meniscus ruptures[5, 6] motivates us to explore different pathological mechanisms for disturbance of the joint mechanics, approbating biomechanical and

pathokinesiological manually soft tissue therapeutic techniques, grouped in an appropriate system that have not been used in such patients in Bulgaria**.**

MATERIAL AND METHODS

Study design: A randomized study, before starting rehabilitation all patients are aware of the purpose and the conduct of scientific research, then manually signed document certifying the consent for inclusion in the study. Committed a long-term (7 years) study the effect of topical application of the manual therapeutic techniques to overcome musculoskeletal dysfunctions in patients after arthroscopic meniscectomy and shaped motor deficits.

The study was conducted in 2005-2012 into three medical centers in Bulgaria: Blagoevgrad, Sofia and Pleven.

Grouping:

1. Control group: Numbering 30 patients predominantly treated with active therapeutic agents in the concept of classical kinesitherapeutical procedures applied after arthroscopic meniscectomy model.

2. Experimental group I: It consists of 30 patients, treated by the methods of classical kinesitherapeutical procedures applied after arthroscopic meniscectomy, supplemented with the use of pain suppressed proximal, mobilization stretching knee.

3. Experimental group II: It consists of 50 patients, treated by the methods of classical kinesitherapeutical procedures applied after arthroscopic meniscectomy, supplemented with the use of pain suppressed proximal, mobilization stretching, joint mobilization techniques Mulligan [7] and Maitland [8] and analytical, mobilization muscles stretching knee.

Sample size: The total number of patients, forming our contingent, is 110 people.27.27% from all patients are included in the control group, 27.27% are in the experimental group I and45.45% are taken in the group of Experimental Group II

Inclusion criteria: Diagnosed meniscal lesion with subsequent arthroscopic meniscectomy model; Full range of medical documentation concerning the trauma, imaging results and diagnostic testing methods and course of the postoperative period; Pathokinesiologycal preliminary analysis to establish existing rehabilitation potential; Patients classified as sub acute clinical function (moderate protective period of rehabilitation) average 4-6 weeks (in peripheral meniscal lesions) and 6-8 (with central damage) after surgery; Patients with existing indications for physical therapy, but in later stages of the recovery period with available secondary complications and unsatisfactory results after rehabilitation.

Exclusion criteria: Neoplastic processes in injured knee, an advanced degree of demineralized bone diseases (severe metabolic osteoporosis, osteopenia and the like.); Abnormally increased joint mobility and instability; Unclear clinical and/or functional diagnosis; Patients with evidence of objective deterioration following a single application of approbation methodology, 24 hours after the first procedure.

Sampling technique: A randomized study was conducted with patients-contingent of our research is structured as follows:

Methodology: The patients were randomly selected and included in the treatment groups defined by differentiating, pathokinesiological analysis and according to the indications for use of manually-therapeutic techniques for recovery of arthrokinematic knee complex recovery. We analyzed the patients by the following individual characteristics: age; sex; athletes; non-sports people; after partial meniscectomy model; after total meniscectomy model (Table. 1).

All patients were diagnosed with meniscus lesion with subsequent arthroscopic meniscectomy. All patients have a complete set of medical documentation concerning trauma, the results of imaging and diagnostic methods (magnetic resonance imaging, computerized axial tomography) made before and after the operation, dataflow comprehensive set of tests to establish the initial rehabilitation potential, monitoring the effectiveness of the applied therapy and the establishment of its final effect**.** The study included all patients classified in clinical functional group II and III by Maitland (i.e. at the end of moderate-protective recovery period), where we applied manual techniques which are appropriate and risk-free.

Table1: Distribution of the contingent of study as defined individual indicators.

Gender	Age		Athletes	Not athletes	With partial meniscectomy	With total meniscectomy	Total patients
	17±3	25±5					
Men	31	32	48	15	52	11	63
Women	25	22	26	21	34	13	47
Total	**56**	**54**	**74**	**36**	**86**	**24**	**110**

When starting treatment, all patients moved with facilities and locked protective orthosis of the injured knee, which is removed during procedures.

The initiation of treatment procedures proceed only after detailed informing patients about the purpose and methods of the study, respectively, after obtaining consent.

Pathokinesiologycal analysis and functional diagnostics: We applied a complex set of Pathokinesiologycal and functional diagnostic tests for establishing the initial rehabilitation potential, individual indications for including the patients in the appropriate treatment groups, monitoring the effect of treatment and establishing the final result. For this purpose we worked out the required personal documentation. The selected tools for functional diagnostics are:

1. Standard algometry movements in the sagittal plane.
2. Girth measurements of hip circumference standard in two levels.
3. Manual muscle testing (MMT) to establish the degree of muscle weakness of the main muscles in the knee complex.
4. Isometric muscle strength testing, the maximum analytical directed to individual sections for m. quadriceps femoris.
5. A complex test of locomotor skills (length of step with the operated lower limb and the number of steps) for covering the distance of 5 m., without facilities.

Statistical analysis: For testing the efficacyof a treatment approach inthe three groups of patients, the results have processedby the method of variation alanalysis. Software packages used inthe analysisareMS OFFICE 2010 with application of Excel 2010 and SPSS 17.0. For this purpose, we introduced data for each of the three patient groups representing the initial and final results of the monitored indicators. The differences between the final and initial data checked with ΔX**.**

For statistical analysis we determined zero (H0)and alternative hypothesis (H_1).

For selection of statistical methods of research analysis identified independent samples (choice of units in a sample is not predetermined by the choice of units in the other sample)with consistent criteria for checking the reliability.

The general aggregate of sampling is considered by the variation analysis; therefore the decisions have got a probabilistic nature. Therefore, in our study we determined guarantee probability (P) for each of the indicators and the level of significance (α) reflects the risk of errors in the acceptance of true alternative hypothesis. We used the standard values for the guarantee probability (P) and a significance level (α):

- P=95%, which corresponds to α = 0, 05 (5% error margin).
- P=99%, which corresponds to α=0,01 (1% error margin).
- P=99,9%, which corresponds to α=0,001 (0,1% error margin).

For statistical verification of results we use independent-criteria of Student by some formula.

To determine the tabulated value of criteria (criteria α) it is taken from statistical tables depending on the degrees of freedom(k)and the level of significance(α). For independent samples, we calculated the degree of freedom by the standard model (k = n1 + n2-2, where n =the number of compared cases). To establish the level of significance (α) we compared calculated t-criteria on standard tabular value. For taking decisions, we compared the empirical value (calculated according to data from the sample) with the tabulated value of the criteria.

RESULTS

1. Measurement the volume of movement in the knee in the sagittal plane

1.1. Flexion measurement: There is the greatest improvement in patients EG II (38,60 °), followed by EG I (27,33 °) and CG (21,83 °). When the results between CG and EG I are compared, there is a

marked improvement in patients from EG I with 5,5 °. (t=5, 38; α<0,001; P=99,9%). When the results between CG and EG II are compared, there is a difference of 16,77 ° (t = 17,65; α <0,001; P=99,9%) in favor of a approbation complex methodology. When we compare the results obtained in patients from EG I and EG II there is a greater improvement in patients with EG II 11,27 ° (t=15,72; α<0,001; P=99,9%).

1.2. Measurement of the extension: There is a greatest improvement in patients from EG II (16,20 °), followed by EG I (13,83 °) compared to the results in CG (13°). The analysis of the results showed no significant difference between the results for the improvement of knee extension in patients CG and EG I (ΔX = 0,83 °; t = 0,81; α> 0,05; P <95%). The data obtained are illustrated in Figure 1

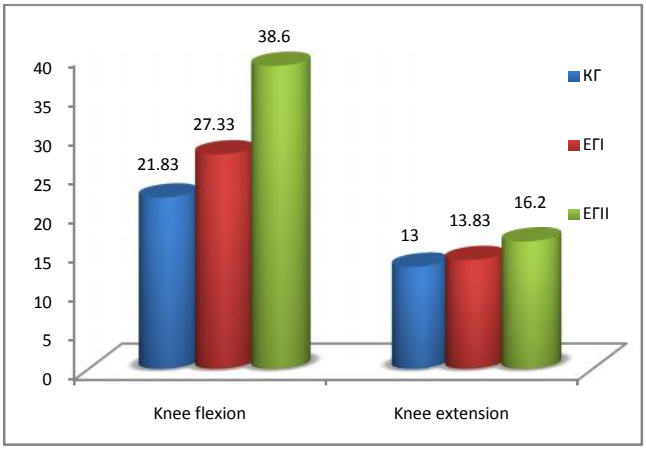

Fig1: Average improvement of angular movements in the sagittal plane (ΔX) in the three groups of patients (in centimeters). CG – control group; EG I – experimental group I; EG II – experimental group II

2. Hip girth measurement: When we measure hip circumference of standard I-st level (5-7 cm cranial from tuberositas as tibiae) it occurs at a distinct outcome in patients - contingent EG II (1,42 cm), followed by those in the composition of the EG I (1,18 cm) compared with CG (1.12 cm).When we measure hip circumference of standard II-nd level (10-12 cranial from tuberositas tibiae), we establish the greatest improvement in patients EG II (2,48 cm), followed by the results of EG I (2,03 cm) and CG (1.95 cm). Results of the study are presented in Figure 2.

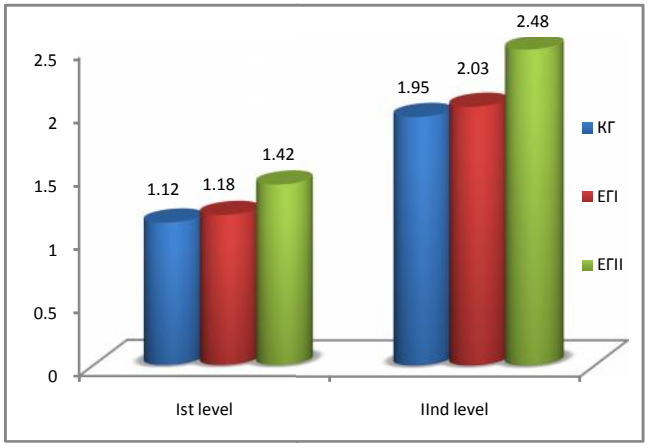

Fig 2: Average improvement of hip rate (in centimeters)

3. Manual muscle testing: To verify the degree of muscle weakness in patients - contingent of study, we tested the major muscles in the knee complex: mm. quadriceps femoris; tensor fascialatae; semimembranosus; semitendinosus et biceps femoris. We present the data in a tabular form (Table. 2).

Table. 2. Statistical analysis of the results from MMT of major muscles in the area of the knee, in patients from all three groups

Group	Tested muscle	ΔX	S	t	P %
CG	M. quadriceps femoris	0,60	0,20	16,15	99,9
	M. tensor fascia latae	0,70	0,25	15,38	99,9
	MM. semitendinosus et semimembranosus	0,78	0,25	17,02	99,9
	M. biceps femoris	0,75	0,25	16,15	99,9
EG I	M. quadriceps femoris	0,75	0,28	14,35	99,9
	M. tensor fascia latae	0,81	0,20	16,08	99,9
	MM. semitendinosus et semimembranosus	0,88	0,28	17,02	99,9
	M. biceps femoris	0,86	0,29	16,26	99,9
EG II	M. quadriceps femoris	1,07	0,17	43,17	99,9
	M. tensor fascia latae	1,07	0,18	43,17	99,9
	MM. semitendinosus et semimembranosus	1,09	0,19	39,72	99,9
	M. biceps femoris	1,08	0,18	41,24	99,9

4. Testing of isometric muscle endurance

In order to verify the final effect from the treatment, in respect restore contractile muscle performance in

isometric mode, we applied the analytical test of timing of individual sections for m. quadriceps femoris. The presented results are synthesized in Table 3.

Table. 3.Statistical analysis of the results obtained testing the isometric muscular strength in the patients of the three groups

Group	Tested muscle	ΔX	S	t	P %
CG	M. rectus femoris	25,33	4,90	28,31	99,9
	M. vastus medialis	28,83	3,39	46,52	99,9
	M. vastus lateralis	24,66	3,92	34,42	99,9
EG I	M. rectus femoris	29,03	6,40	24,81	99,9
	M. vastus medialis	33,4	2,15	84,72	99,9
	M. vastus lateralis	31,8	1,76	98,43	99,9
EG II	M. rectus femoris	37,04	2,05	127,14	99,9
	M. vastus medialis	39,58	1,40	199,76	99,9
	M. vastus lateralis	38,88	1,76	155,44	99,9

5. Testing gait without facilities

5. 1. Testing the step length of the operated lower limb to overcome the distance of 5 m

Analysis of results showed the clear positive dynamics in patients EG II (19,26 cm.), followed by EG I (12,3 cm.) and CG (10,86 cm.).

5. 2. Testing the number of steps to overcome the distance from 5 m

Table 4: Statistical analysis of the results of testing of locomotor abilities to overcome the distance of 5 m. without facilities in patients in all three groups

Indicator	**Group**	**ΔX**	**S**	**t**	P%
Step width	CG	10,86	1,25	47,53	99,9
	EG I	12,3	1,11	60,21	99,9
	EG II	19,26	1,17	115,93	99,9
Number of steps	CG	2,5	0,50	26,92	99,9
	EG I	2,36	0,49	26,44	99,9
	EG II	3,12	0,32	67,20	99,9

Analysis of results showed the greatest improvement of controlled parameters in patients from EG II (3,12 n.) followed by CG (2,5 n.) and CG I (2,3 n.). The data are synthesized in Table 4.

DISCUSSION

A significant positive dynamics in the recovery of angular movements in the knee complex is established in all patients, contingent of this study. The analysis of the results indicates a most progress in Experimental group II, followed by those in Experimental group I and Control group. With a great statistical reliability, we find also a most significant improvement in the other controlled indicators in the experimental group II (hip circumference, overcome muscle weakness, isometric muscular endurance and recovery of locomotor skills without facilities). Although, in large part approbated manually-therapy techniques aim to restore arthrokinematics of knee complex, we find significantly better results in regard to contractiles of tissue structures, what we give to the possibility for an early and full recovery of muscle function in conditions of various kinetic chains, corrected joint mechanics and suppressed pain. In our opinion, the basis of correct and effective treatment approach is the adjustment of joint mechanics, thus there is an opportunity for completely stimulation of analytical and complex muscle functions and proprioception from the injured knee.

CONCLUSION

Based on the results of the study, we present the following conclusions:

- Application of adequate physiological and pedagogically grounded kinesitherapy (KT) is required in patients after arthroscopic meniscectomy model with motor deficits intractable routine rehabilitation.
- Each of the three KT complex speeds up recovery and return patients to everyday life.
- The inclusion of a proximal mobilization stretching (in addition to traditional physical therapy) accelerates functional recovery of knee complex (by analytical impact on the truncated structures).
- Most effective is a complex manually-therapeutic approach, combined with appropriate stretching techniques and ability to perform in terms of proximal or distal fixation, for correction of motor deficit.
- Our structured and approved methodology is not only convenient and easy to use but highly effective

in patients after arthroscopic meniscectomy and shaped motor dysfunction. It reduces arthrogenic pain, increasing the volume of movement, restoration of intra-articular and physiological mobility, stimulating muscle trophicity, improvement isometric muscular endurance, increasing the muscle strength and overcoming muscle weakness, arthrokinematic recovery of knee complex, improving stability gait. Observations allow us to offer a methodology for implementation in general practice rehabilitation in patients after meniscal ruptures treated by arthroscopic meniscectomy and motor deficits, intractable routine rehabilitation.

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Conflict of Interest: Nil

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