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Diverse rehabilitation measures applied for restorative treatment of total hip arthroplasty patients (own findings and literature review)

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Introduction Total hip arthroplasty (THA) is one of the most successful orthopedic procedures performed today. Rates of THA have been steadily increasing over the past several decades with increasing number of patients who need proper effective rehabilitation therapy after orthopaedic surgery. Evaluation and introduction of new rehabilitation techniques is crucial for patients undergoing replacement of major joints. **Objective** Review the literature and our own findings with various rehabilitation programs used for THA patients to aid recovery following surgery at a short and long term. **Material and methods** The study included 57 THA patients referred to rehabilitation department of the Kurgan Ilizarov Center to help manage pain at different terms following surgery. The sample was divided into main (n = 29) and control (n = 28) groups. Post-isometric relaxation techniques were included in rehabilitation program of the main group. Clinical outcomes were evaluated with VAS, the Lequesne Index, McGill Pain Questionnaire, WOMAC, and Harris Hip Score. **Results** Outcome measures showed 1.5 times improvement in controls with high statistical significance ($p > 0.01$) and 3.3 times improvement in patients who received post-isometric relaxation therapy with greater significance level ($p > 0.001$). **Conclusion** The findings suggest that post-isometric relaxation techniques applied as a part of restorative treatment facilitate improved outcomes of rehabilitation. The optimal rehabilitation protocols have been shown to be largely unknown for THA patients.

Keywords: rehabilitation measures, post-isometric relaxation, questionnaires, tests, condition following total hip arthroplasty

INTRODUCTION

In Russia during 90-es of the last century joint arthroplasties were performed in leading orthopaedic hospitals and have evolved into one of the most common orthopaedic procedures [1]. Di Monaco et al. (2009) suggest that total hip arthroplasty (THA) has revolutionized the care of patients with end-stage joint disease, leading to pain relief, functional recovery, and substantial improvement in quality of life [2]. With the advances in technology and improvements in design and manufacture of implants, diligent attention to surgical technique, THA as a safe and efficient procedure can ensure immediate and prominent effects from rehabilitation of patients with end-stage arthritis [3–5]. Arthroplasty provides radical rehabilitation for severely damaged joints of lower limbs improving functional mobility and relieving pain [5]. Despite the excellent success rates of THA some patients can develop hip pain at the side of surgery at a short- or long-term follow-up (in the absence of periprosthetic joint infection and osteolysis) or a pain of a different localization [6, 7]. The pain can be often associated with optimal movement patterns developing with the transition to full weight-bearing using the operated limb and considerably subside or improve at a long-term follow-up closer to one year following the surgery [8, 9]. Proper rehabilitation after surgery is required for 100 % of THA patients to improve range of motion, increase strength and function, and improve quality of life [10, 11]. Inpatient-based rehabilitation following orthopaedic surgery cannot be provided for THA patients in many hospitals for organizational reasons, and the surgeons have to rely rather on terms of ambulation accepted in a particular medical institution than functionality of the patients. According to many researchers, inpatient rehabilitation is a comparatively costly pathway after THR [12]. Most of the THR patients use home exercise program as recommended by orthopaedic surgeons at discharge for the recovery of mobility and function after THA [13]. Due to the circumstances home-based programs are unmonitored with rehabilitation resources to be inappropriately used and underestimated by surgeons. These considerations remain problematic in rehabilitation of patients after arthroplasties [11]. Literature review has shown that there is no optimal rehabilitation program available for THA patients to achieve good functional results of the

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operated hip joint [4, 14]. Manual therapy and post-isometric techniques were included in rehabilitation program in our series at a late and long-term follow-up of THA [15].

Objective Review the literature and our own findings with various rehabilitation programs used for THA patients to aid recovery following surgery at a short and long term.

MATERIAL AND METHODS

Patients were examined and treated by qualified personnel. The investigation was performed in accordance with the ethical standards as laid down in the Declaration of Helsinki "Ethical principles for medical research involving human subjects" and the amendments. The patients gave informed consent for publication of the findings without identification.

Orthopaedic status of 57 THA patients was evaluated at different terms following orthopaedic surgery. The patients presented with pain in the ipsilateral or contralateral limb and pain in other joints were admitted to the rehabilitation unit of the RISC "RTO". The sample was subdivided into two groups. The groups of patients were matched for sex ratio, length of the disease prior to THA and postoperative follow-up period with nearly equal number of males and females in both groups (Table 1).

The main group (Group I) consisted of 29 THA patients aged from 22 to 76 years who underwent conservative treatment with post-isometric relaxation techniques at a late and long term following orthopaedic surgery. Duration of the disease prior to THA in the group ranged between 2 years to 46 years. Follow-up period was 0.3 to 4.0 years. THA was performed bilaterally (n = 9) and unilaterally (n = 20), on the right (n = 11) and on the left side (n = 9). THA was cementless (n = 20), cemented (n = 7) and hybrid (n = 2).

The control group (Group II) consisted of 28 THA patients aged from 39 to 74 years who underwent conventional conservative treatment. Duration of the disease prior to THA ranged between 6 months to 50 years in Group II. Follow-up period was 0.3 to 6.5 years. THA was performed bilaterally (n = 3), on the right (n = 17) and on the left side (n = 9). THA was cementless (n = 11), cemented (n = 7) and hybrid (n = 10).

Outcome measures included VAS (cm), the Lequesne Index (scores), McGill Pain Questionnaire modified by V.V. Kuzmenko (number of descriptions chosen and pain index score), WOMAC (mm), and Harris Hip Score (points). In our opinion, major clinical and functional characteristics could be fully described with the questionnaires applied with greater significance level. Statistical data analysis was performed with Microsoft Office Excell 2010 and incorporated Attestat computer program. The Wilcoxon signed-rank test was used to analyze data in two related paired samples ($p < 0.05$).

Table 1

Comparison of sampling population by age, duration of the disease, follow-up period and gender

Group	Mean age (years)	Mean duration of disease prior to THA (years)	Long-term follow-up (years)	Sex	
				M	F
Main	54.8 ± 2.6	12.8 ± 2.5	1.4 ± 0.2	10	19
Control	59.2 ± 2.1	14.6 ± 2.4	2.2 ± 0.4	8	20

METHODS OF REHABILITATION

Conventional methods of rehabilitation included exercise therapy, message, different physiotherapeutic procedures, pharmacological therapy as recommended by the European League Against Rheumatism (EULAR, 2005). Disease-modifying drugs of fast and delayed action, vascular drugs and drugs for metabolism correction were administered for the therapy [16]. Post-isometric relaxation (PIR) techniques were added to conventional methods of rehabilitation. PIR was applied to the muscles of the operated joint and ipsilateral limb, lumbar muscles and ligaments of the pelvis as well as the peri-articular thigh muscles and the crural muscles. PIR was produced for the muscles of the operated limb at least 3 months postsurgery. The patient was requested to produce a slight pain free movement with the leg at the command that was recorded by a physician, and isometric strain developed in the relaxed muscles and maintained for 3–5 to 10–15 seconds depending on patient's condition. Then, at the command, the patient was requested to stop exerting strain followed by a 20-to-30-second pause with relaxation of abnormally short myofascial structure, and a movement was then produced to experience limited mobility showing

pain free springing resistance. The procedure repeated 3 to 5 times. The sacrotuberal, sacroiliac and iliolumbar ligaments were tested for pain, and if being positive, underwent PIR. Range of active and passive movements, active movements against resistance of the lumbar muscles at flexion and extension, rotation and lateral flexion to the right and to the left were additionally tested. PIR techniques were applied for particular groups of muscles with some limited movements. PIR therapy included 10–12 sessions arranged either daily or each other day with regard to patient's general condition.

RESULTS

No statistically significant differences in baseline measurements of orthopaedoc status were revealed in the groups with functional impairment being more severe. The pain subscales indicated to considerable decrease in pain intensity (3.3 times, on average) following rehabilitation with PIR techniques in the main group with the high significance level at $p < 0.001$. The standard conservative treatment resulted in moderate decrease in pain intensity (1.5 times, on average) of control patients measured on the same pain subscales with much less statistical significance of $p < 0.01$. Present pain intensity was shown to considerably decrease (4.2 times, on average) in all major groups of descriptors of the McGill Pain Questionnaire used for the main group. Controls demonstrated less improvement on pain subscale (1.7 times, on average). Pain characteristics were noted to change with decreased pain intensity that resulted in improved quality of life. The differences in measurements were statistically significant being greater in Group I at $p < 0.001$ versus Group II, at $p < 0.01$.

PIR techniques provided for patients of the main group resulted in a 2.2 times increase in their functional recovery of the operated limb. Physical functioning subscales indicated to less improvement (1.2 times, on average) in controls. WOMAC Stiffness Score was decreased by 3.5 times ($p < 0.001$) in the main group and by 1.5 times in controls ($p < 0.01$) that appeared to be 2.3 times less than that in patients of Group I. Baseline and postoperative measurements on pain and physical functioning scales following PIR and standard rehabilitation of THA patients are presented in Table 2.

Table 2

Baseline and postoperative measurements on pain and physical functioning scales following PIR and standard rehabilitation of THA patients

Pain and physical functioning scales		Main group		Control group	
		pre-op	post-op	pre-op	post-op
VAS (cm)		4.8 ± 0.3	1.3 ± 0.2	4.6 ± 0.2	2.9 ± 0.3
the Lequesne Index (points)	pain	4.1 ± 0.3	1.4 ± 0.3	4.6 ± 0.3	3.1 ± 0.3
	function	8.5 ± 0.4	4.1 ± 0.6	8.9 ± 0.5	7.1 ± 0.6
McGill Pain Questionnaire (points)	NDC S	5.7 ± 0.6	1.8 ± 0.3	4.9 ± 0.5	2.9 ± 0.5
	NDC A	2.8 ± 0.3	0.9 ± 0.2	3.2 ± 0.3	2.0 ± 0.3
	PPI S	12.3 ± 1.7	2.5 ± 0.5	10.8 ± 1.5	5.3 ± 1.2
	PPI A	4.9 ± 0.6	0.5 ± 0.2	6.1 ± 0.7	3.3 ± 0.6
	PPI E	2.4 ± 0.1	1.0 ± 0.1	2.3 ± 0.1	1.5 ± 0.1
WOMAC Pain Score (mm)	pain	31.1 ± 3.2	6.9 ± 1.5	36.3 ± 3.0	21.3 ± 3.1
	stiffness	32.8 ± 3.7	9.2 ± 1.7	36.3 ± 3.6	22.6 ± 3.5
	function	34.8 ± 3.0	10.8 ± 1.9	39.1 ± 2.9	26. ± 3.1
Harris Hip Score (points)	pain	18.6 ± 1.0	37.6 ± 1.4	17.9 ± 1.5	28.9 ± 2.0
	function	31.9 ± 1.4	41.4 ± 1.5	30.9 ± 1.3	34.9 ± 1.6

Note: NDC, number of descriptors chosen; PPI, present pain intensity; major groups of descriptors: sensory (S); affective (A); evaluative (E)

DISCUSSION

The success of rehabilitation largely relies on specialized inpatient treatment. Comprehensive rehabilitation is crucial for 100% of patients undergoing high-tech operative interventions to be followed by restorative treatment [17]. The majority of joint replacement articles discuss outcomes of surgical interventions. Further treatment is required [8] to address persisting pain [18], improve orthopaedic status [19, 20] including static balance control, normalization of the gait pattern [21] and symmetrical hip loading pattern while sitting [22]. The contributing stress factors include severe

arthropathy associated with duration of pathological process, limb deformity or shortening, decreased proprioception; weakness of periarticular muscles and ligaments [23]. Rates of arthroplasties of lower limbs have been steadily increasing over the past several decades with increasing number of patients who need proper effective rehabilitation therapy after orthopaedic surgery [24]. Evaluation and introduction of new rehabilitation techniques is crucial for patients undergoing replacement of major joints [25]. Restorative treatment of THA patients is to be provided in compliance with changes in biomechanical scenario, implant design and specific person's needs [26, 27]. Enhanced efficacy from arthroplasty and the favorable outcomes are closely associated with postoperative rehabiliotation. Controversies exist over therapy guidelines determining the design and time parameters of the rehabilitation programs for THA patients [4, 28]. Some authors suggest that physical therapy sessions and message, kinesiotherapy exercises, workout with exercise and rehab equipment, etc. can be applied for rehabilitation of THA patients. An optimal evidence-based rehabilitation protocol to enable unambiguous, practical and useful treatment has been unknown for THA patients [2, 4, 29]. Lowe C.J., et al. (2015) concur with Pohl T. et al. (2015) that the sparse evidence prevents the production of a detailed evidence-based exercise protocol following hip arthroplasty, and effective treatment type to be determined via adequately powered trials which incorporate long term follow up [30, 31]. Nazarenko G.I. et al. (2012) suggest that postoperative rehabilitation is to be conducted for at least one year with proper adaptation to the new joint but persistent morphological changes in the periarticular tissues, disturbed gait pattern and physiological imbalance of post-urological system can be observed at a longer term following THA [4–6, 32–36]. Ikutomo H. et al. (2018) support the opinion that rehabilitation interfention is to be continuously provided until the gait improves to the extent to enable prevent falls [37]. It is generally accepted that interdisciplinary team approach is the key to effective rehabilitation of patients following elective THA. Therefore, treatment success of THA and good long-term outcomes in addition to highly qualified surgery strongly rely on comprehensive rehabilitation aimed to recover physical functioning of the operated limb [17, 38] and improve musculoskeletal health [39]. Continuity of care is one of the basic principles of rehabilitative process. There is a question what can be done to speed up rehabilitation and improve functional result [4]. Early postoperative rehabilitation is widely used and can provide good outcomes [39–41] but restorative treatment at a late and long term is the only responsibility of the patient [13]. Sicard-Rosenbaum L. et al. (2002) suggest that rehabilitation services after hip arthroplasty (HA) usually occur in the first 6 months following surgery. Reports in the literature show that THA patients can develop long-term lower extremity muscle weakness, reduced walking ability and decreased mobility performing domestic and social activities at 9 months to 6 years after HA surgery. The authors conclude that intervention beyond the initial post-surgical rehabilitation is needed because of long-term residual impairments and disabilities noted after HA surgery [42].

Atchabahian A. et al. (2015) suggest that regional analgesia is more effective than conventional analgesia for controlling pain and may facilitate rehabilitation after large joint replacement in the short term but it can hardly be effective for the function at a long term [43]. Romakina N.A. and colleagues (2017) report improved motor function of musculoskeletal system with the method of artificial locomotion correction using controlled muscle electrical stimulation in patients after arthroplasty of major joints. The authors report positive results following a course of treatment and at least two courses of electrical stimulation are required for the patients to obtain better rehabilitation effect [23].

Our findings are on par with those reported by Wójcik B. et al. (2012) who applied the techniques of fascial relaxation that significantly reduced pain and muscular recovery around the hip joint after THA, thus contributing to improvements in the range of motion [44]. Howard P.D., Levitsky B. (2007) reported similar results in a 73-year-old active woman who developed hip and buttock pain 2 years after the revision THA surgery, subsequent to inadequate movements. The patient was successfully treated with manual therapy techniques and a home exercise program and reported no recurrences of hip or buttock symptoms at 4 years [45].

The research performed by Wisdo J.J. (2004) are consistent with our series. The author described a 45-year-old man involving postsurgical hip pain that radiated down the lateral thigh to the knee after bilateral THA that was successfully treated with a combination of chiropractic manipulation of the lumbar and pelvic region and low-tech rehabilitation.

The patient improved pain, flexibility and strength, had increases in active ranges of motion and Harris Hip scores [46]. Keating E.M. et al. (2007) explored the outcomes of manipulation in 90 THA patients at a mean of ten weeks after surgery measuring flexion at six months, and at one, three, and five years postoperatively. Manipulation was shown to generally increase ultimate flexion following TKA, and patients with severe preoperative pain were more likely to require manipulation [47].

Preliminary study results obtained by Licciardone J.C. et al. (2004) suggest that osteopathic manipulative treatment may reduce pain, improve ambulation, and increase rehabilitation efficiency in patients undergoing knee or hip arthroplasty. Osteopathic manipulative treatment was found to be associated with low rehabilitation efficiency in patients who recently underwent knee or hip surgery [48]. The results of the study performed by Krastanova M.S. et al. (2017) are in line with those obtained in our series and suggest that the complex rehabilitation program can facilitate a considerably faster recovery and optimal functional results [49]. Our findings are consistent with those reported by the majority of the above authors and have shown that PIR techniques incorporated into rehabilitation program of THA patients at a late and longer term allowed for improvement in functional recovery after THA [15].

CONCLUSION

The present study showed efficacy of rehabilitation programs provided for patients of Group I and Group II. Outcome measures showed 1.5 times improvement in orthopaedic status of THA patients who underwent standard rehabilitation at a late and longer term and 3.3 times improvement in THA patients who received post-isometric relaxation therapy as compared to baseline values. Intermittent courses of post-isometric relaxation techniques applied as a part of restorative treatment can facilitate improved outcomes of rehabilitation and quality of life. Many authors report favorable results from manual therapy in THA patients. However, the optimal rehabilitation protocols are largely unknown for THA patients and comprehensive outpatient approaches have not been well outlined in the literature.

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