Chapter 10

Physical Therapy Based on Closed Kinematic Chain Patterns for Patients after Total Hip Replacement

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Additional information is available at the end of the chapter

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Abstract

In this chapter I will focus on the importance of properly managed movement therapy for patients after total hip replacement. It is necessary to find correct movement patterns which can help patient to become more independent in ADL and locomotion. It seems to be much more effective to choose therapy based on closed kinematic chains (CKC). In CKC we have bigger amount of motor units and it is easier to maintain postural reactivity. The main aim is to use similarity in movement patterns. In therapy we choose patterns that are similar to ADL activities. Acral Coactivation Therapy (ACT) is a movement therapy that works with these principles. The effects of the therapy are seen in different areas: improvement of patient's ADL skills, better postural reactivity and stability (lumbo-pelvic stability), decrease subjective level of pain. In the subacute and chronic phase of therapy, we can follow up previous aims and focus on restoring full function and condition.

Keywords: total hip replacement, closed kinematic chain, Acral Coactivation Therapy, balance therapy, motion abilities for ADL, reduce pain

1. Introduction

This chapter deals with movement therapy management in patients after total hip joint replacement (THR). Primarily it is about setting movement patterns which are the most beneficial for patients in terms of postural reactivity, next about reducing subjective perception of pain, renewing functional abilities from the perspective of activities of daily living (ADL) and last but not least about satisfaction with surgery.

Degenerative changes of weight-bearing joints rank, without hesitation, among diseases of civilization of the musculoskeletal system. In the final stage of this disease the patients are significantly limited, in particular their movement abilities in ADL, and they suffer from strong pain which is frequently alleviated by pharmaceutical drugs. In the final stage total replacement of the afflicted joint, a hip joint in this case, is indicated in the patients. There is no doubt that postoperative care of the patients is a multi-branch matter and that rehabilitation managed by a qualified physiotherapist is its integral part [1, 2].

In total hip replacement the joint capsule is damaged, which results in the reduction of statesthetic and kinetic proprioception and aggravation of postural stability mainly in vertical positions and deterioration of locomotion skills. Postoperative recovery is accompanied by other problematic factors, e.g. pain caused by the surgical intervention itself or limited mobility of the operated limb due to anti-luxation regime. All the named factors reflect on the patient's final movement expression.

The aim of the managed postoperative rehabilitation should be not only motor recovery of the operated lower limb but also setting stereotyped physiological movement concerning ADL. The selected movement patterns, which the patient performs within the therapy, should reflect on their daily performance. The therapy should not lack a principle of similarity, i.e. the patients are provided with such movement patterns that can be integrated in activities of daily living.

Many authors consider learning and mastering closed kinetic chain (CKC) activities as a factor indispensable for carrying out physiological movements in an open kinetic chain (OKC). It means that the therapy itself should always start in a position which is relatively easy for muscle chains activation, i.e. applying pressure. Closed kinetic chain movements optimize activity of the engaged muscle groups which besides other things helps reduce subjective pain perception [3–7].

For the purposes of our study we chose the Acral Coactivation Therapy (ACT) that meets all the above mentioned criteria for the management of high quality rehabilitation of the patients after total hip joint replacement.

This study also aims at pointing out that minimum objectivization means are used in the branch of rehabilitation, which results in interpretation of movement therapy as an empirical branch lacking objective values. The patients´ subjective feedback concerning evaluation of therapy results is certainly important, however, efficacy of therapy cannot be objectively assessed without recorded data. For this reason we chose a measurement system of a force plate by Tekscan or specific questionnaires tailor-made for patients with a given diagnosis in order to make the results objective.

2. The Acral Coactivation Therapy (ACT) characteristics

The Acral Coactivation Therapy is a physiotherapeutic method based on neurophysiology. The founder of the ACT is PhDr. Ingrid Palaščáková Špringrová Ph.D. and the basic ideas are inspired by Roswitha Brunkow's method.

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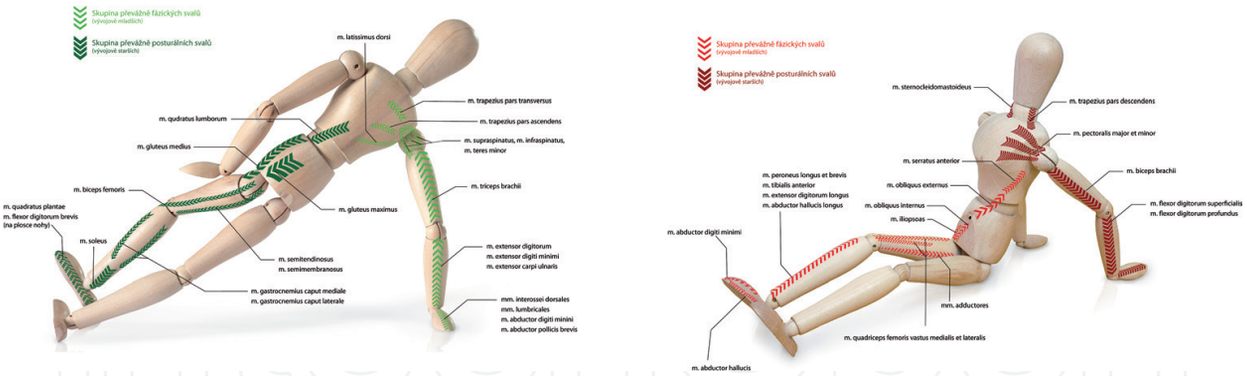

Figure 1. Dorsal and ventral muscle chain.

One of the basic ACT principles is applying pressure on the acral parts of extremities (both upper and lower). Applying pressure on the acral parts leads to straightening the spine and activating posture against external forces. Setting and maintaining correct posture is fundamental for creating a physiological movement programme, thus part and parcel of a movement itself. Muscle contraction proceeds in the disto-proximal direction, i.e. from the acral parts toward the trunk. Applying pressure aims at co-activation of muscle chains (see **Figure 1**). In order to improve movement pattern quality, thus better co-activation of muscle chains, manual techniques are used. Muscle tone balance of co-activated muscle chains is achieved by exteroceptive and proprioceptive inputs [7].

The ACT works on the principle of repetition of a movement pattern based on applying pressure on the acral parts. These conscious repetitive presses form the basic element of mastering the practised movement skills (motor learning). Mastering new skills by means of conscious repetition of movement patterns is one of the basic principles of the ACT. Motor learning can be simply characterized as a set of processes connected with training or experience leading to relatively constant changes of the ability to react [7, 8].

The acres are significantly represented in human brain matter so they initiate motor activity in the ACT. Unlike proximally placed muscle groups, which are significantly represented in the pre-motor brain area, the acres are located mainly in the primary motor cortical areas [7, 8–10].

During the workout patients carry out planned (intentional) movements. It is presumed that applying pressure activates the limbic system. Motivation is indispensable for movement as well. Activation of the limbic system is followed by a sensory analysis of the movement, the function of which is to draw up an ideal plan of the press. While pressing up the central nervous system (CNS) uses peripheral information and assesses quality of the press, in particular straightening the spine apparatus. If the spinal alignment is not correct (the spine is not straightened), the posture is adjusted, i.e., the angle of the acres is changed. After adjusting posture, pressure is applied again and a new movement pattern with the identical objective of straightening the spine apparatus is ingrained [7, 9, 11, 12].

The ACT therapy exploits positions from ontogenetic development of human motor activity. The early motor activity of newborns manifests itself in open kinetic chains. However, during development the postural activity caused by confrontation of the CNS and external

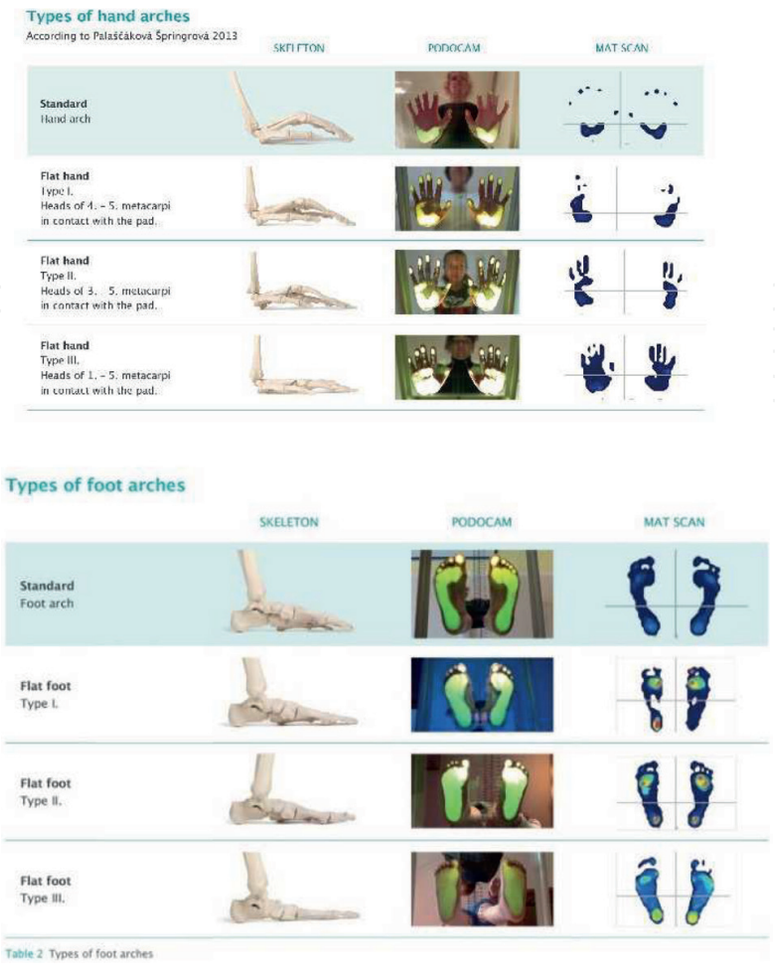

Figure 2. Evaluation of arches of the hand and the foot by means of the ACD.

stimuli increases. Movement patterns in closed kinetic chains are involved. Due to increasing demand on movement patterns the CNS is forced to choose an adequate movement pattern in terms of its economy and function [7, 13–15].

The closed kinetic chain activities provide the basis for postural presumptions of all motor activities of a child. The open kinetic chain motor activity is focused mainly on movements with a particular purpose, i.e. teleological movements [3, 4, 7, 13].

Many authors consider learning and mastering closed kinetic chain (CKC) activities as a factor indispensable for carrying out physiological movements in an open kinetic chain (OKC). It means that the therapy itself should start in a position which is relatively easy for muscle chain activation, i.e. applying pressure. Closed kinetic chain movements optimize activity of the engaged muscle groups. Correct involvement of muscle groups as well as centration of key joints in closed kinetic chains requires correct physiological position of the trunk and the limbs. The ACT method uses mainly closed kinetic chain movements since many authors consider them more functional, thus more effective in the therapy [3–5, 7].

The Acral Coactivation Diagnostics (ACD) is irreplaceable in the Acral Coactivation Therapy. It includes evaluation of position of upper and lower extremities and straightening of the

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spine. The ACD exploits measuring instruments, e.g. PodoCam or Tekscan, thanks to which position of the acral parts of limbs can be objectively evaluated. If a pathological position of arches (of a hand or a foot) occurs, a press is not possible in the quality ensuring physiological muscle coactivation that results in straightening the spine and centration of root joints. The ACT uses also entry and exit questionnaires including, beside other things, basic case history, visual analog scale (VAS) and questions targeted at early motor development [7] (**Figure 2**).

3. Methodology of the study

Thirty patients of the Department of Orthopedics and Traumatology of Přerov Hospital (SMN Přerov), branch of the business Středomoravská nemocniční a.s., took part in the study. In order to be included in the study the patients had to meet the following criteria: they had not undergone any endoprosthesis or lower extremities surgery in the past and they were not diagnosed with any mental illness or neurological disorder of central or peripheral nervous system.

"Only" 30 patients out of total 352 applicants who had undergone total hip joint replacement in Přerov Hospital met these criteria. Collecting data for this study took 12 months.

3.1. The CKC group (CKC=closed kinetic chain)

The CKC group consisting of 15 patients (7 men and 8 women) of the Department of Orthopedics and Traumatology of SMN Přerov went through postoperative rehabilitation according to the Acral Coactivation Therapy principles. The average age of the patients was 59 ± 13.9 years.

3.2. The OKC group (OKC=open kinetic chain)

Also the OKC group included 15 patients (8 men and 7 women) of the Department of Orthopedics and Traumatology of SMN Přerov who underwent postoperative therapy, which is based mostly on open kinetic chain exercises, according to the standard procedures of SMN Přerov. The average age of the patients was 58 ± 9.7 years.

The probands were divided into individual groups by means of adaptive randomization. At the beginning of the study both groups of the patients did not differ considerably in terms of the observed parameters (**Table 1**). At-entry differences of the observed groups did not show any statistical significance.

3.3. The CKC group therapy

The CKC group therapy followed the basic principles of the Acral Coactivation Therapy. The rehabilitation plan consisted of (on average) six 30-min workout units under the guidance of a qualified physiotherapist who supervised quality of the carried out motor patterns. The therapy itself began the second postoperative day and continued until the patients were discharged and took part in subsequent rehabilitation treatment.

	CKC group (μ)	P	OKC group (μ)
Age	59	SID	58
B.E.S.S.	5.3	SID	5.3
FT	36.1	SID	35.5
HHS	48.1	SID	52.8

Table 1. Entry parameters.

The managed therapy took place only during working hours of the physiotherapist (i.e. working days). In order to improve quality the patients got an aid: Functional Hand Arch Support (only for the purpose of the managed therapy). These gloves, specially tailored for the ACT method, maintain optimum setting of arches of the hand. Outside the time set aside for the therapy (i.e. at weekends, in free time) the probands carried out autotherapy according to the ACT without the physiotherapist's intervention. For these purposes the patients got the publication of The Acral Press Up Exercises for Straightened Spine where the ACT positions used in the therapy were marked. First, the patients carried out all the safe exercises in the managed therapy conducted under the guidance of a physiotherapist to avoid wrong fixation of motor patterns and subsequent errors in autotherapy. The therapy took place in SMN Přerov in the gym of the department of orthopedics and traumatology. This place was calm with suitable conditions for working out. Selected positions from the CKC group therapy are depicted in **Figures 3–10**.

3.4. List of CKC group static positions and their variants

When selecting static positions for therapy in a closed kinetic chain we took into consideration regime measures (anti-luxation regime) that the patients had to observe. The applied positions were chosen from the publication of The Acral Press Up Exercises for Straightened Spine in order to make autotherapy easier [16].

Figure 3. A press up in the supine position variant of flexion: Static coactivation.

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Figure 4. A press up on the healthy hip: Static coactivation.

Figure 5. A press up in the low oblique sitting: Static coactivation.

Figure 6. A press up on all fours: Static coactivation.

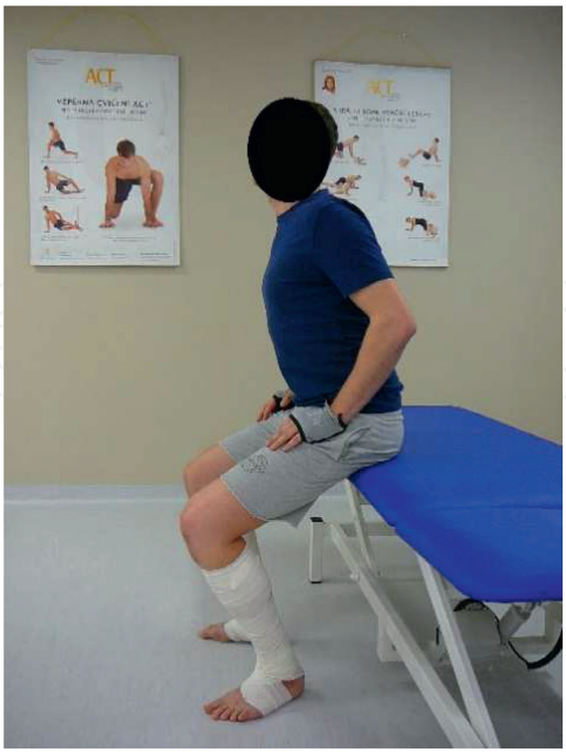

Figure 7. A press up in the sitting position, initial stage of dynamic transition from the sitting to the standing position.

Figure 8. A final stage of dynamic transition from the sitting to the standing position.

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Figure 9. A press up in the standing position with 2 forearm crutches; putting a foot forward on the step: Static coactivation.

Figure 10. A press up in the standing position with 2 forearm crutches, extension against the wall: Static coactivation.

1. A press up in the supine position and its variants:

- gait movement pattern: alternating flexion and extension of lower extremities in the CKC (after mastering the OKC exercises)
- alternating flexion of lower extremities in the CKC

2. A press up in the side-lying position (lying on the healthy hip) with neutral position of lower extremities and its variants:

- abduction of the operated leg in the CKC after mastering OKC exercises

3. A press up in the side-lying position while pressing up the upper body with an arm.
4. A press up in the prone position and its variants:

- alternating knee joint flexion

5. A press up in the position on all fours and its variants:

- alternating flexion and extension of lower extremities
- pressing up on all fours while lifting the knees above the floor
- abduction of lower extremities while lifting the knees above the floor

6. A press up in the upright kneeling position.
7. A press up while sitting on the chair and its variants:

- gait movement pattern: alternating flexion and extension of lower extremities in the CKC (after mastering the OKC exercises)

8. A press up while standing with two forearm crutches and its variants:

- putting a foot forward on the step (alternating lower extremities) with subsequent support
- training of extension while leaning against the wall (alternating lower extremities)

3.5. List of dynamic transitions in the CKC group

The patients carried out dynamic transitions from individual press up (static) positions. These were functional dynamic changes in positions according to the ACT principles. Two sets of dynamic transitions selected in advance were applied. Dynamic transitions were chosen on the basis of the similarity principle in order to evoke the movement patterns the patients used in ADL. The therapy was aimed at integration of physiological movement patterns into motor expression of the patients in ADL [16].

Dynamic transitions for verticalization from the supine to the standing position (i.e. getting up from the bed).

1. A press up from the supine to the side-lying position.
2. A press up from the lateral to the side-lying position while pressing up the upper body with an arm and having lower extremities hanging off the bed.
3. A press up from the side-lying position while pressing up the upper body with an arm to the sitting position with lower extremities hanging off the bed.
4. A press up from the sitting position with lower extremities hanging off the bed to the standing position (hands on thighs – the CKC).

Dynamic transitions for verticalization from the supine to the standing position (from the floor).

1. A press up from the supine to the lateral position.
2. A press up from the lateral to the prone position.
3. A press up from the prone position to the position on all fours.
4. A press up from the position on all fours to the upright kneeling position.
5. A press up from the upright kneeling position to putting the foot forward (i.e. the healthy leg); with support of 1 forearm crutch if needed.
6. A press up from the position of having a foot forward to the standing position (with support of a chair or a forearm crutch if needed).

3.6. The OKC group therapy

Also the patients in this group went through managed (on average) six 30-min workout units. These patients worked out according to the standardized SMN Přerov rehabilitation plan intended for patients after total hip joint replacement. The exercises were analytical exercises mostly in an open kinetic chain, without a direct link to the ADL therapy. The beginning and the end of the therapy collided with the CKC group. In order to maintain the same conditions this group worked out in the same gym of the department of orthopedics and traumatology of Přerov Hospital as well. In their free time the probands performed autotherapy based on a list of standardized SMN Přerov exercises intended for patients after total hip joint replacement (see below). First, the patients carried out all the exercises under the guidance of a physiotherapist, next the exercises became part of their autotherapy.

3.7. The list of exercises for patients after total hip joint replacement according to the SMN Přerov standards

1. In the supine position

- point and flex your feet rhythmically
- flex your feet, straighten your knees and squeeze your buttocks
- move the extended leg sideways (on the bed) and back to the body axis

- bend the knee (i.e. move the heel along the bed)
- bend the knees, put a pillow between them and squeeze you knees together
- bend your knees, lift your buttocks (hold for a few seconds), your arms rest along your body
- lie on your side and raise your top leg

2. In the prone position

- squeeze your buttocks and push your pelvis toward the floor
- push your toes to the floor and straighten your knees
- alternate flexion and extension of your knees
- lift the entire extended leg

3. Sitting with legs hanging off the bed

- straighten your knee while pushing your thigh toward the bed (hold for a few seconds)
- put your hands on your thighs, squeeze your buttocks and then release
- raise your feet slightly

4. Standing at the head of the bed:

- stand on your toes
- move your operated leg sideways and back
- flex your operated hip (no more than 90 degrees)
- extend your operated leg backwards

3.8. Common therapy

Both groups of probands went through the same locomotion training using stairs and mobility aids, i.e. two forearm crutches in this case. Another common therapy element was practising forward bends (picking things up off the floor) while extending the operated hip joint.

3.8.1. Evaluation of postural stability by means of MobileMat™ Programme

Postural stability and reactivity was evaluated by means of a force plate by Tekscan using the MobileMat™ programme. This programme works on the Balance Error Scoring System (B.E.S.S.) principle developed by researchers Guskiewitz, Riemann and Shields.

MobileMat™ programme was developed mainly in order to improve the accuracy of B.E.S.S. evaluation, which can be influenced by a human factor, i.e. subjective inputs of a testee. It is a

computer-based evaluation of B.E.S.S. The studies show that the MobileMat™ programme can run a more precise analysis of B.E.S.S., in particular lifting a part of the foot off the force plate, lifting an arm from the base position or changing the position of a non-weight bearing hip (i.e. when standing only on the other leg). However, MobileMat™ programme cannot evaluate if the testee closes their eyes. In this case, this factor is supervised by a qualified physiotherapist [17–19].

Evaluation of postural stability took place in a calm environment of the department of orthopedics and traumatology in the gym of SMN Přerov. The measurement included three positions that were repeated three times by the probands. With regard to an early postoperative stage alternative positions were chosen (see below) which could be carried out by the patients without being exposed to dangerous positions or inadequate physical load of the operated leg. The patients held each position for 20 seconds and had their eyes closed during the whole measurement.

3.8.1.1. Selected positions

1. Standing with feet hip-width apart on both feet; the entire feet are in touch with the Tekscan force plate; standing straight with the hands on the hips.
2. Standing on both lower extremities, in tandem left forward position; the entire feet are in touch with the Tekscan force plate; standing straight with the hands on the hips.
3. Standing on both lower extremities, in tandem right forward position; the entire feet are in touch with the Tekscan force plate; standing straight with the hands on the hips.

Two physiotherapists made measurement while one of them operated the computer and the other one supervised correct posture of the probands in the selected positions. Due to personnel reasons the persons who were not familiar with classification of the probands into the test groups could not make measurement. Evaluation was carried out properly without any intervention leading to distorting results. Measurement was performed 1 day before surgery, the fourth postoperative day and finally on the tenth postoperative day (i.e. the last day of the managed rehabilitation). During evaluation of postural stability the measured values of the individual positions were counted up and the arithmetic mean was calculated.

Both groups had the same average values, i.e. 5.3 postural errors, during entry measurement. In the postoperative stage the CKC group showed 5.1 errors per patient, while the OKC group had 3.5 errors on average. The measured values were entered in a table (see **Table 2**). **Graph 1** shows the differences in the reached B.E.S.S. values of the observed groups.

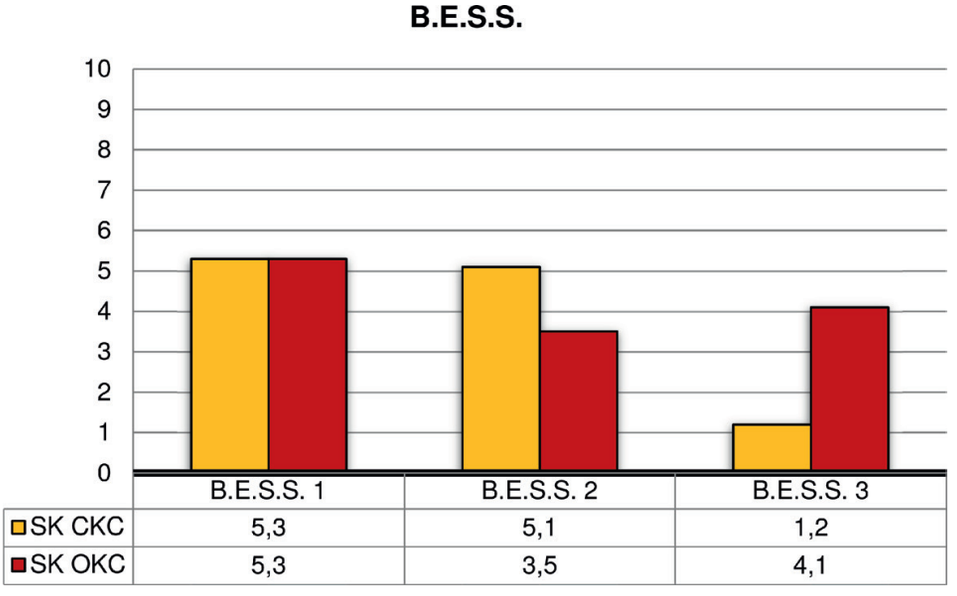
The final measurement showed a significant statistical difference ($p = 0.008975$) between the entry values of the individual groups. The CKC group reached 1.2 error, while the OCK group had 4.1 errors on average. This difference shows also high effect size (Cohen's $d = 0.875$). Non-parametric Mann–Whitney U test was used to determine statistical significance of two selected files.

3.8.2. Evaluation of the patient functional movement skills

A day before surgery a qualified physiotherapist evaluated functional skills of the patients according to the Functional Test Questionnaire (see **Table 3**). This specific questionnaire was

	CKC group (μ)	P	OKC group (μ)
B.E.S.S. 1	5.3	SID	5.3
B.E.S.S. 2	5.1	SID	3.5
B.E.S.S. 3	1.2	SSD	4.1

Table 2. B.E.S.S. evaluation.



Graph 1. Results of the balance error scoring system explanatory notes: B.E.S.S. 1-evaluation of postural errors according to the balance error scoring system in the MobileMat™ programme (preoperative measurement), B.E.S.S. 2-evaluation of postural errors according to the balance error scoring system in the MobileMat™ programme (postoperative measurement), B.E.S.S. 3-evaluation of postural errors according to the balance error scoring system in the MobileMat™ programme (after termination of the managed rehabilitation), SK CKC-the CKC group, SK OKC-the OKC group.

developed solely for the purpose of this study. The Functional Test Questionnaire included those movement patterns that the patients used in ADL. Evaluation of functional movement skills consisted in assessment of a manner of execution of the selected movement patterns. Finally, these results were quantified in the questionnaires. The highest achievable score was 50.

Functional skills were evaluated again on the fourth postoperative day in order to visualize the differences between the preoperative and postoperative physical condition of the patients. Exit measurement took place on the tenth postoperative day (i.e. the last day of the managed rehabilitation). The testing was done by one qualified physiotherapist in order to avoid data distortion.

Before surgery the CKC group patients reached 36.1 points on average. The fourth postoperative day the average value of functional skills fell to 11.1 points. However, the patients reached 38.1 points on average within the final measurement. The OKC group showed an

		before surgery	after surgery	after rehabilitation
Turning from the supine to the side-lying position (on the healthy hip)				
Without any aids (without a wedge)	5 p.			
With a pillow, without difficulties	3 p.			
With a pillow, with difficulties	1 p.			
Cannot manage to do it	0 p.			
Turning from the supine to the prone position				
Without any aids (without a wedge)	5 p.			
With a pillow, without difficulties	3 p.			
With a pillow, with difficulties	1 p.			
Cannot manage to do it	0 p.			
Verticalization from the supine to the sitting position with legs hanging off the bed				
Without any aids (without a wedge)	5 p.			
With a pillow, without difficulties	3 p.			
With a pillow, with difficulties (using a bar)	1 p.			
Cannot manage to do it	0 p.			
Verticalization from the sitting to the standing position				
Without any aids (without crutches)	5 p.			
With support of 1 crutch	3 p.			
With support of 2 crutches	1 p.			
Cannot manage to do it	0 p.			
Picking things up off the floor				
Can manage to do it without any aids	10 p.			
Can manage to do it with 1 forearm crutch	5 p.			
Can manage to do it with support of the furniture	2 p.			
Cannot manage to do it	0 p.			
Verticalization from the floor				
Can manage to do it without any aids	20 p.			
Can manage to do it with 1 forearm crutch	10 p.			
Can manage to do it with support of the furniture	5 p			
Cannot manage to do it	0 p.			

Table 3. Functional tests.

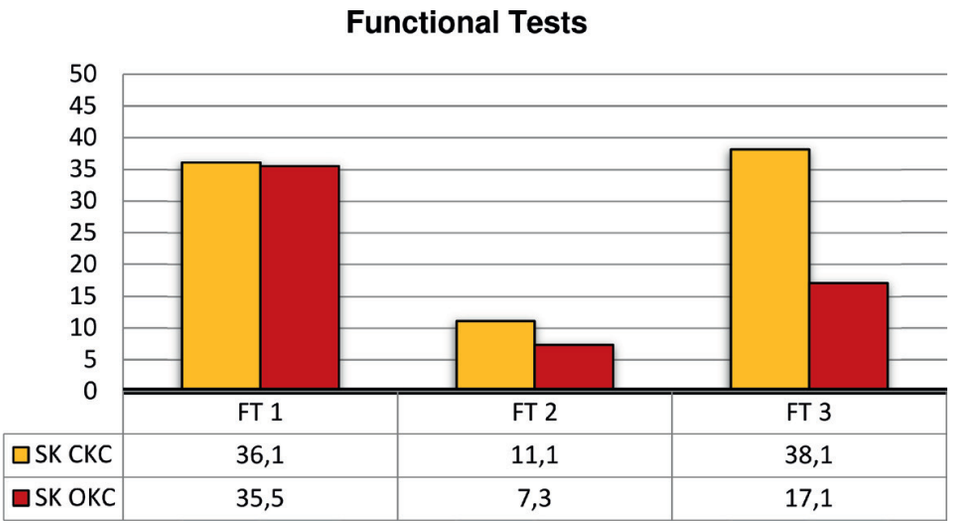
average value of 35.5 points of functional skills at the beginning of the research. The average reached value after surgery was 7.3 points. However, the OKC group reached only 17.1 points on average within the final measurement.

Table 4 shows results of the individual measurements. In order to visualize the results a graph (see **Graph 2**) was developed in order to depict changes in the result values of both groups.

The difference between exit values (i.e. those measured after termination of rehabilitation) of the individual groups was statistically significant ($p = 0.00001$). This result showed also a significant effect size (Cohen's $d = 4.04$). Non-parametric Mann–Whitney U test was used to determine statistical significance of two selected files.

	CKC group (μ)	P	OKC group (μ)
FT 1	36.1	SID	35.5
FT 2	11.1	SID	7.3
FT 3	38.1	SSD	17.1

Table 4. Evaluation of movement skills (Functional tests).



Graph 2. Results of the functional tests explanatory notes: FT 1-functional tests (preoperative measurement), FT 2-functional tests (postoperative measurement), FT 3-functional tests (final measurement after rehabilitation), SK CKC-the CKC group, SK OKC-the OKC group.

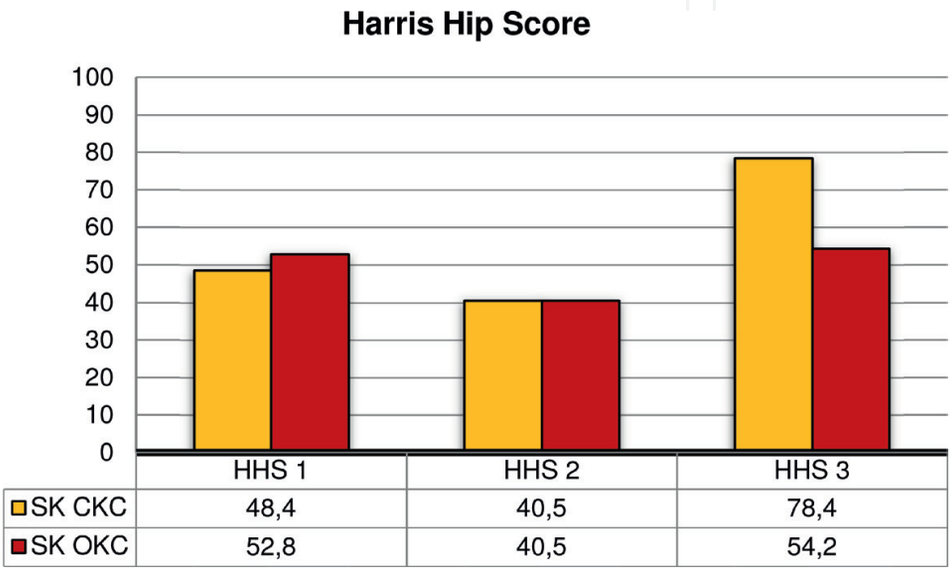
3.8.3. Objectivization of the closed kinetic chain therapy results based on the Harris hip score

The patients who took part in the study filled in a Harris Hip Score questionnaire before their surgery. This is a specialized questionnaire assessing skills within ADL in patients with hip joint diseases (arthrosis, necrosis of the ball). William H. Harris developed this questionnaire in order to evaluate level of pain and movement skills of patients before and after surgery. For the purpose of our study a modified version of the questionnaire was used, i.e. evaluation of the range of motion of the hip joint. The highest achievable score is 100. If a patient reaches 70 points or less, their physical condition is considered bad. Willim H. Harris considered a surgery successful when the score reached after surgery was at least 20 points higher than before surgery [20–24].

The patients filled in the Harris Hip Score questionnaire again on the fourth postoperative day in order to visualize the difference between the preoperative and postoperative physical condition. The final evaluation took place on the last day of the managed rehabilitation, i.e. on the tenth postoperative day.

	CKC group (μ)	P	OKC group (μ)
HHS 1	48.4	SID	52.8
HHS 2	40.5	SID	40.5
HHS 3	78.4	SSD	54.2

Table 5. Harris Hip Score values.



Graph 3. Harris hip score results explanatory notes: HHS 1 - Harris hip score (preoperative measurement), HHS 2 - Harris hip score (postoperative measurement), HHS 3 - Harris hip score (final measurement after rehabilitation), SK CKC – The CKC group, SK OKC – The OKC group.

Within the entry measurement of the Harris Hip Score the CKC group reached 48.4 points on average. The OKC group's average score in the questionnaire was 52.8. Both groups reached equal values in the postoperative measurement, i.e. 40.5 points per patient on average. The measured values were entered in a table (see **Table 5**). **Graph 3** shows the differences between the reached values of the individual group.

The exit measurement showed a significant statistical difference ($p = 0.00001$), where the CKC group reached 78.4 points and the OKC group 54.2 points on average. This difference showed also a high effect size (Cohen's $d = 3.63$). Non-parametric Mann–Whitney U test was used to determine statistical significance of two selected files.

3.8.3.1. Two-year study assessing Harris hip score results

The Harris Hip Score questionnaire has been used in the department of orthopedics and traumatology of SMN Přerov since the beginning of 2015 and it replaced the Staffel Score questionnaire used formerly, which is not globally recognized and is less specific in terms of evaluation activities of daily living.

	168 CKC group patients (μ)
HHS 1	43.3
HHS 2	74.3
HHS 3	94

Table 6. Harris Hip Score results of two-year observation.

On the grounds of the two-year research efficacy of the therapy based on the ACT principles, i.e. therapy in a closed kinetic chain, was assessed. In order to get long-term results the time during which the patients filled in the questionnaire was modified.

The first time the patients filled in the questionnaires was standard, i.e. 1 day before surgery, next after termination of the managed rehabilitation in the department of orthopedics and traumatology of SMN Přerov (6 therapies on average) and the last time was 4 months after hip joint replacement, i.e. within a regular orthopedic check-up. The patients were observed from the beginning of 2015 until the end of 2016. During this period 168 patients who underwent total hip joint replacement went through the therapy based on the ACT principles. The measured values were entered into a table (see **Table 6**). Before surgery the patients had 43.3 points of Harris Hip Score, after termination of the managed rehabilitation they reached 74.3 points on average. After leaving the department of orthopedics and traumatology of SMN Přerov the patients started subsequent rehabilitation treatment, they followed up the existing therapy and went on improving their functional and conditional skills. Within the regular orthopedic check-up, i.e. during the fourth month after surgery, the patients reached on average 94 points in the Harris Hip Score questionnaire.

The benefit of the therapy applied in a CKC consists mainly in relatively easy performance and understanding of exercises which can be modified according to the skills and needs of an individual. The therapy based on the ACT principles helps to reduce subjective perception of pain and to improve motor skills in patients. Patient satisfaction with surgery depends on improvement of the quality of their life, i.e. on reduction or elimination of pain and renewal of motor skills they could do with a healthy hip joint [25–29].

4. Conclusion

The results of this study show that the managed rehabilitation in a closed kinetic chain has demonstrably better results compared to the therapy conducted in an open kinetic chain. The similarity principle, which integrates functional movement patterns into patients´ activities of daily living, is considered the key element. The patients agree that if the movement therapy is aimed at improvement of specific motion skills applicable in ADL, their motivation to perform the exercises is higher. Correctly set up CKC therapy leads to reduction of subjective perception of pain, which has already been proved in various studies. The results of our study show not only significant improvement of functional skills of patients in ADL but also significant reduction of a number of postural errors concerning standing positions and locomotion.

Patients undergo total hip joint replacement in particular in order to improve the quality of their life. On the grounds of our study's results it can be stated that the ACT based therapy, compared with the open kinetic chain therapy, influences the quality of the patients´ life after total hip joint replacement in a significant way.

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