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Section IV – Behavioural Sciences in Sport - Adaptive Sports

DE GRUYTER OPEN

Sports Activity Following Cementless Metaphyseal Hip Joint Arthroplasty

by

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An adequate level of physical activity has a substantial effect on both mental and physical human health. Physical activity is largely dependent on the function of the musculoskeletal and articular system. One of the most frequent diseases of this system is degenerative joint disease. Due to the changing and more demanding lifestyles and patients' willingness to be involved in sports activity, the expectations of hip joint arthroplasty are becoming increasingly high. Alleviating pain ceases to be the only reason for which patients choose surgical interventions, while the expectations often include involvement in various sports. Only few studies contain recommendations concerning the frequency, type and intensity of sports activity which are acceptable after hip joint arthroplasty. The aim of the study was to evaluate function and physical activity of people following cementless short-stem hip joint arthroplasty in the observation of at least five years. The study group comprised 106 patients who underwent total hip arthroplasty due to degenerative joint diseases, chosen according to inclusion criteria. Patients underwent routine physical examinations following the Harris Hip Score protocol, responded to the UCLA scale and questionnaires concerning pre-surgical and current physical activity. Our results demonstrated that hip joint arthroplasty in people suffering from degenerative joint diseases has a beneficial effect on their level of functioning and physical activity. Although physical activity and the level of functioning obviously reduced as a person aged, the level of physical activity continued to be very high in both groups, with function of the hip joint evaluated as very good.

Key words: *physical activity, hip, musculoskeletal system, hip replacement.*

Introduction

An adequate level of physical activity has a substantial effect on both mental and physical human health. Its role has been documented in both preventive healthcare and supporting treatment of diseases of the cardiovascular system, obesity and diabetes (Lee et al., 2012; Ravi et al., 2014). Furthermore, physical activity has been found to reduce stress and help combat depression (Dunn et al., 2001; Nabkasorn et al., 2006). Human physical activity is largely dependent on the function of the musculoskeletal and articular system. One of the most frequent diseases of this system is degenerative joint disease. According to certain studies, this disease affects even 40% of total population of older adults aged over 70 years (Dieppe and Lohmander, 2005), whereas the most frequent locations are knee and hip joints. The degenerative joint disease is numbered among age-related diseases, with common symptoms including articular cartilage defects, formation of juxtaarticular osteophytes, changes in the subchondral region and chronic inflammations of the synovial membrane. Its main symptoms are pain and progressing dysfunction of the joint affected by the disease. However, this disease

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does not concern only older people. With greater availability and quality of diagnostic tests, degenerative joint disease is more and more frequently diagnosed in younger people. Unfortunately, conservative treatment is rarely effective, and, consequently, the mean age of patients qualified for joint replacement surgeries is constantly decreasing (Ravi et al., 2012). Due to the changing and more demanding lifestyles and patients' willingness to be involved in sports activity, the expectations of hip joint arthroplasty are becoming increasingly high. Alleviating pain ceases to be the only reason for which patients choose surgical interventions, while the expectations often include involvement in various sports (Niederle and Knahr, 2007).

In most cases, patients who want to return to sport following hip joint arthroplasty rely on the recommendations and experiences of case physicians. Some sport activities, such as walking, cycling, swimming or dancing, are considered in the literature as acceptable without major contraindications and adequate for any patient after hip joint replacement. The activities that cause a greater load to the joint and those linked to greater injury rates, such as running, contact sports, team sports, squash, ice skating, roller skating, skiing and snowboarding, are commonly regarded as not recommended for most patients or possible to be practised by trained and experienced athletes (Klein et al., 2007; Ritter and Meding, 1987; Swanson et al., 2009). Only few studies contain recommendations concerning the frequency, type and intensity of sports activity which are acceptable after hip joint arthroplasty.

Undoubtedly, the final result of the surgery and patient's health status after total hip replacement are affected by a plethora of factors, among which there are the type of the implant used and the method of its fixation to the bone. The most popular implants used in surgical interventions in patients with degenerative joint diseases aged under 65 years are cementless metaphyseal prostheses (Canadian Joint Replecement Registry, Annual Report 2015; Australian Orthopaedic Association National Joint Replecement Registry, Annual Report 2016). With various substances used to coat the endoprosthesis surface (e.g. hydroxyapatite, calcium phosphate), it is possible to implant them into the bone without using additional stabilizers such as bone cements. The use of cementless prostheses leads to their osseointegration i.e. overgrowing the implant with the osseous tissue. The time necessary for complete stabilization of the prosthesis in the bone ranges from around 6 to 8 weeks. However, the secondary stabilization achieved in the process is much better than that observed when bone cement is used. These prostheses are also termed anatomical, as the major part of the proximal end of the femur is maintained and, if properly fixed, allows for full replication of the anatomical relations in the hip joint. This solution offers patients the opportunities for the return to good health status and quality of life following hip joint arthroplasty.

The aim of the study was to evaluate function and physical activity of people following hip joint arthroplasty in the observation of at least five years using cementless metaphyseal hip joint arthroplasty.

Methods

The study group included patients who underwent surgical treatments in the 1st Department of Trauma and Orthopaedic Surgery of the District Hospital of Trauma Surgery in Piekary Śląskie, Poland, due to degenerative joint diseases, chosen according to inclusion criteria. The inclusion criteria were: age below 65 years, hip joint arthroplasty using the specific metaphyseal implant, primary hip joint arthroplasty, male patients, no prior surgeries in the area of the femur. The minimum period of observations was set at 5 years. All patients had been operated by two senior assistants in the 1st Department of Trauma and Orthopaedic Surgery who were specialists in the field of trauma and orthopaedics. The R3 acetabular system with Verilast articulation and Nanos hip stem (Smith&Nephew) were used in all patients.

All patients who fulfilled the inclusion criteria were invited for a medical appointment to the hospital outpatient clinic. Among 137 patients who fulfilled criteria, 106 subjects accepted the invitation. During the appointment, the patients underwent routine physical examinations following the Harris Hip Score protocol, responded to the UCLA scale and questionnaires concerning pre-surgical and current physical activity. Next, the patients were divided into two age groups and the results were analysed

statistically.

The Harris Hip Score (HHS) protocol was used to evaluate the activity of the hip joint, rehabilitation outcomes and surgical treatment of the hip joint (Frihagen et al., 2008; Hoeksma et al., 2003). It contains a set of questions and requires further examination of the range of movement in the hip joint and assessment of the patient's walk. The scale evaluates pain intensity (max. 44 points), function (max. 47 points), deformations (max. 4 points) and joint mobility (max. 5 points). The maximal score is 100 points, with the results over 90 points considered as very good, 80-90 points as sufficient and below 70 as poor. The scale was first described and used in 1969 (Harris, 1969).

The UCLA activity score was used to evaluate and monitor the physical activity level in the population. The scale is composed of 10 levels of physical activity, from complete inactivity, inability to move independently and dependency on others through amateur involvement in swimming or bicycling to regular participation in such sports as ballet, acrobatics, mountain backpacking, skiing, tennis or running.

Results

The considered variables were evaluated for the whole study group and with division into two age categories: patients aged below 60 years and over 60 years. The age group of ≤ 60 years (Group I) included 48 patients, whereas the > 60 group (Group II) was comprised of 58 patients. Mean age was 52 years (SD = 5 years) in Group I and 64 years (SD = 1) in Group II. No statistically significant differences were found between all the patients concerning body height, body mass and BMI (Table 1).

Function of the hip joint after hip joint arthroplasty: HHS scale

All patients obtained poor results of hip joint function before the surgery on the HHS scale (< 70 points). The mean pre-surgical HHS score for the whole study group was 35.54 (SD = 14.22), with 87.42 (SD = 8.53) after the intervention, which resulted in statistically significant differences ($p < 0.001$) with a mean of 51.88 (SD = 14.47). Patients from Group I showed a statistically better HHS score before surgical interventions ($p = 0.016$) of 39.56 (SD = 12.33), compared to patients from Group II, with a mean score of 32.21 (SD = 14.90). Statistically better results ($p = 0.005$) after surgical treatment were documented for patients from the < 60 group compared to the > 60 group. Mean values for these groups were 89.97 (SD = 6.29) and 85.32 (SD = 9.56), respectively (Figure 1).

Level of physical activity: the UCLA activity score

Examination of the level of physical activity on the UCLA scale showed that mean physical activity in the whole group before surgical intervention was 2.75 (SD = 0.82), whereas after the surgery, the mean score was 5.32 (SD = 1.65). The difference in the scores (2.58, SD = 1.60) was statistically significant ($p < 0.001$). Patients from the ≤ 60 group had statistically better results in both the pre-surgical and post-surgical level of physical activity compared to the patients from the > 60 group. These results were 2.96 (SD = 0.68) and 5.98 (SD = 1.56), respectively for Group I and 2.57 (SD = 0.88) and 4.78 (SD = 1.52), respectively, for Group II. Statistical significance was set at $p = 0.001$ for comparison of pre-surgical activity and $p < 0.001$ for post-surgical activity (Figure 2).

Type of physical activity: questionnaire survey

Among the patients from Group I, 73% (35 patients) reported more frequent physical activity following hip joint arthroplasty than before the surgery, whereas in Group II this value was only 43% (25 patients), which is statistically better ($p = 0.02$) for Group I. In the first group, none of the patients reported inactivity following the surgical interventions, with 12% of such patients from Group II (7 patients). Other subjects reported a similar level of physical activity before and after the surgery (Table 2). It should be emphasized that the respondents were asked about amateur involvement in sports.

In Group I, 92% of patients declared that the only form of physical activity before the surgery was walking and only 6% of them reported another form of pre-surgical physical activity (4% of patients cycled and 2% practiced swimming). After the surgery, 50% of the patients from Group I started cycling, 29% started swimming, 23% were involved in team sports (including volleyball and soccer) and 19% started skiing. It should be emphasized that only 58% of the patients reported walking following the surgery, which is attributable to being involved in other more demanding forms of physical activity.

In this age group, all forms of physical activity were significantly more frequent after the treatment compared to before the treatment.

In the second age group, none of the respondents reported skiing and participation in team sports after the hip joint arthroplasty. In this age group, 26% of the respondents were involved in cycling and 12% reported swimming after the treatment, which points to statistically significant results after than before the surgery. In this group, frequency of walks also declined in the post-surgical period (with 81% before to 69% after the surgical intervention) (Table 3).

Table. 1

Characteristics of the subjects

	Age ≤ 60 (n=48)		**Age > 60 (n=58)**		*p*
	Mean	SD	Mean	SD	
Age	52	5	64	1	**<0.001**
Body Mass (kg)	82.3	9.27	83.8	8.59	0.480
Body Height (cm)	177	6.32	177	4.83	0.584
BMI	26.1	2.38	26.8	2.43	0.117

Table 2

Frequency of physical activity following surgical interventions

	Age ≤ 60		**Age > 60**		*p*
	Percentage	Number	Percentage	Number	
Inactivity after surgery	0%	0	12%	7	**0.013**
More frequent activity after surgery	73%	35	43%	25	**0.002**

Table 3

Types of physical activity before and after surgery

	Age ≤ 60		**Age > 60**		*p*
	Percentage	Number	Percentage	Number	
Cycling, pre-surgery	4%	2	0%	0	0.121
post-surgery	50%	24	26%	15	**0.011**
p *	**<0.001**		**<0.001**		
Skiing, pre-surgery	0%	0	2%	1	0.373
post-surgery	19%	9	0%	0	**0.003**
p *	**0.008**		1.000		
Walking, pre-surgery	92%	44	81%	47	0.121
post-surgery	58%	28	69%	40	0.260
p *	**0.003**		0.159		
Swimming, pre-surgery	2%	1	0%	0	0.280
post-surgery	29%	14	12%	7	**0.029**
p *	**0.001**		**0.018**		
Team sports, pre-surgery	0%	0	0%	0	1.000
post-surgery	23%	11	0%	0	**0.003**
p *	**0.003**		1.000		

***p** * - comparison of values before and after the surgery*

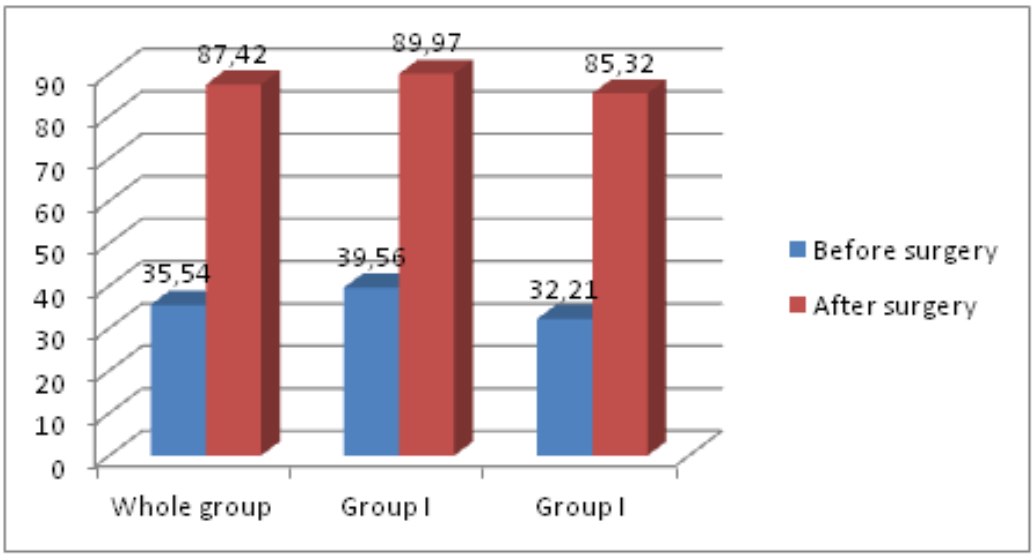

Figure 1

Mean HHS with division into age groups

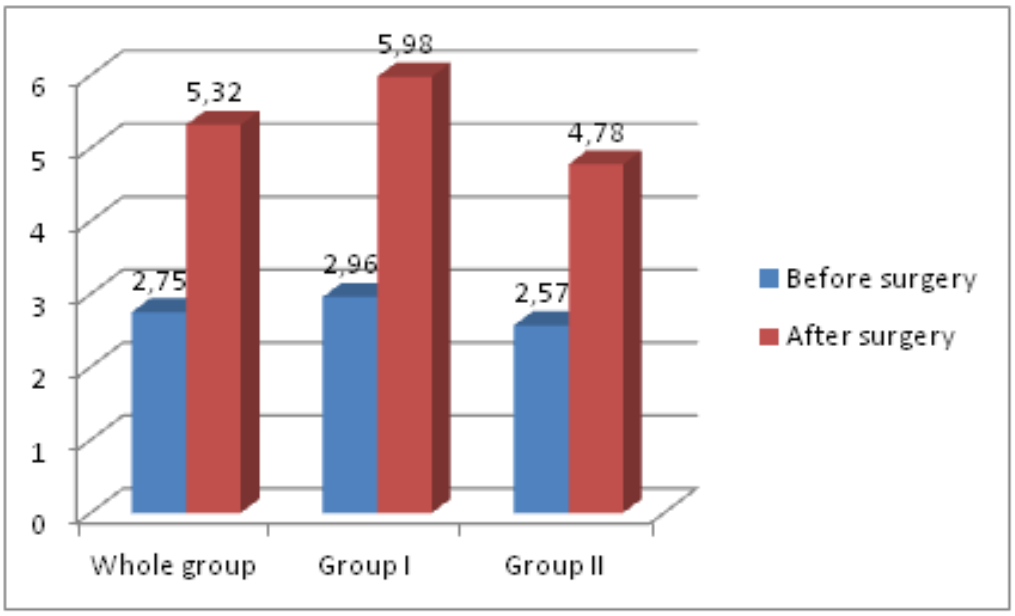

Figure 2

Mean UCLA score results with division into age groups

Discussion

The problem of sports activity following hip joint arthroplasty is very complex. The results presented in this study show that cementless metaphyseal hip joint replacement relieves patients from pain problems and improves function of the joint affected by the degenerative joint disease; furthermore, it helps patients return to physical activity and, in most cases, increase its level.

Recreational involvement in sports should be recommended for patients after hip joint replacement similar to recommendations for people with healthy joints. It should be emphasized that bone tissue in order to function properly and maintain adequate quality, needs to be exposed to specific loads that can be ensured by participation in sports. For this reason, patients should be encouraged to start active lifestyles, not only in order to improve general health status and physical capacity, but also to enhance implant stability in the bone (Kuster, 2002). On the other hand, increased physical activity and loads to the articular surfaces of the hip joint implant are likely to lead to more intensive friction and wear in the artificial implant. For this reason, the choice of the implant for a patient should be based on the patient's expectation and age, life expectancy, lifestyle and level of physical activity. In the material presented in our study, we did not find the symptoms of wear of the articular surfaces of the implant in any patient.

Another aspect that should be taken into consideration are complications arising from the increased load to the prosthesis and injuries that occur during increased physical activity of people with hip joint endoprosthesis. It is difficult to accurately assess the risk involved in participation in sports after hip joint arthroplasty, but the forces that act on the artificial joint and the surrounding bone during physical exercise are likely to lead to many complications. These include faster wear of articular surfaces of the implant, loosening of implant components, endoprosthesis luxations and bone fractures near the prosthesis (Meira and Zeni, 2014). However, there are reports showing that the direct translation of physical activity into these complications is not quite clear. Gschwend et al. (2000) demonstrated greater wear of the polyethylene insert of the prosthesis acetabulum in a 10-year observation following surgeries in patients actively involved in skiing compared to non-skiers. However, in the same study group, the risk of osteolysis and aseptic loosening of prosthesis was lower than in patients who were physically inactive (Gschwent et al., 2000). The risk of hip joint endoprosthesis luxation is not only linked to physical activity. Numerous studies have found that most of hip joint endoprosthesis luxations have been caused by everyday activities, such as using the toilet, going to and out of bed, changing socks and shoes (Leichtle et al., 2013; Meira and Zeni, 2014). In our study, we did not find any luxation or bone fracture near the implant, but this might be attributable to the character of the study group. Many authors have emphasized that the elevated risk of these complications occurs in female patients aged over 80 years and after previous surgical interventions in the hip joint (Berry et al., 2004; Charissoux et al., 2014; Jolles et al., 2002; Lindahl et al., 2007; Meek et al., 2008), and such patients were not qualified for the study.

A very important determinant of successful return to physical activity following hip joint arthroplasty is also rehabilitation, both before and after the surgery. A high level of muscle strength and adequate proprioception are necessary to ensure proper function of the hip joint. Rehabilitation protocols should be adjusted to the post-surgery period and take into consideration the type of implant or surgical access location.

In conclusion, all patients following hip joint arthroplasty should be encouraged to be involved in physical activity. Physical activity is not only important to maintain good general health status, but it also improves quality of osseous tissue which is critical to many-year functioning of cementless prostheses (Seyler et al., 2006). Our study showed that active involvement in various sports following hip joint replacement is possible. However, an individual approach should be adopted for each patient before the return to sport to fit their expectations, level of fitness, physical capacity and activity, both before and after the surgery.

Conclusions

All patients evaluated in this study obtained HHS scores that pointed to their good

(80 - 89) and very good (> 90) function of the hip joint following surgery, with younger patients (Group I) obtaining significantly better post-surgical results than older patients (89.97 and 85.32, respectively, $p = 0.05$).

Physical activity assessed on the UCLA scale increased in both groups, by 3.02 in Group I and 2.21 in Group II, which indicates statistically better results in Group I ($p < 0.001$). The post-surgery results of the UCLA score in Group I were also statistically significant. However, the results documented in both younger and older patients showed a substantial improvement in the level of physical activity in all patients following hip joint arthroplasty.

The data collected in the questionnaire survey presented in the study lead to the conclusion that most of the patients' active lifestyles improved after the total hip replacement.

The above results demonstrate that hip joint arthroplasty in people suffering from degenerative joint diseases has a beneficial effect on their level of functioning and physical activity. Although physical activity and the level of functioning obviously reduced as a person aged, the level of physical activity continued to be very high in both groups, with function of the hip joint evaluated as very good.

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