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COVID-19 lockdown and hip arthroplasty rehabilitation changes: mid-term clinical outcomes

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Abstract. – OBJECTIVE: Hip arthroplasty is one of the most performed surgeries in orthopedics. Rehabilitation process after surgery allows rapid recovery of joint functions in absence of pain in most patients. During COVID-19 pandemic, rehabilitation clinics have reduced the number of beds available. Thus, an increasing number of patients were forced to home rehabilitation programs. Our study aimed at determining any significant differences in clinical and functional outcomes between those patients who underwent a home rehabilitation program and those others who were granted a place in a Rehabilitation clinic during COVID-19 pandemic, at mid-term follow-up.

PATIENTS AND METHODS: An observational retrospective single-center study was designed. The patients included were 63, divided into two groups: Group A (29 patients) for home rehabilitation, and Group B (34 patients) for clinic rehabilitation. Follow-up was performed at 1, 6 and 12 months after surgery. Clinical evaluation was assessed through Oxford Hip Score for hip function, Visual Analogue Scale (VAS) for pain and hip range of motion (ROM) to evaluate joint recovery.

RESULTS: ROM was compared at follow-up with significant differences 12 months after surgery (107.93° group A *vs.* 104.7° group B; *p*=0.0168). Pain felt by patients according to the VAS scale showed no significant differences at follow-up (1 month 3.27 *vs.* 3.65 *p*=0.1489; 6 months 1.89 *vs.* 2.18 *p*=0.105; 12 months 0.58 *vs.* 0.68 *p*=0.6263). Regarding the Oxford Hip score, significant differences emerged at 1-month follow-up (38.75 group A *vs.* 37.94 group B; *p*=0.0498).

CONCLUSIONS: At mid-term follow-up, little differences were found between patients who went through home rehabilitation and those who went to a rehabilitation clinic. Therefore, decreasing the number of beds available in rehab clinics during COVID-19 pandemic was not an obstacle for elective surgery for orthopedic surgeons.

Key Words:
COVID-19, Total hip arthroplasty, Rehabilitation.

Abbreviations

THR (Total Hip Replacement); THA (Total Hip Arthroplasty); OHS (Oxford Hip Score); ROM (Range Of Motion); VAS (Visual Analogue Scale); SD (standard deviation).

Introduction

At the end of 2019, several cases of lower respiratory illnesses of unknown origin were reported in the city of Wuhan, central province of the People's Republic of China. The pathogen was subsequently isolated as a virus belonging to the coronavirus family later referred to as SARS-CoV-2[1-3]. The characteristics of this virus and the related pathology, which resulted in a global pandemic, have led to a change in people's habits and daily life, leading governments to institute total lockdowns in order to contain the transmission of the virus. Due to the severity and the higher level of hospitalization for infected patients, the health system all around the globe faced deep changes aiming at stopping the spread of the virus. Elective surgery was frozen, in order to reserve structure and healthcare workers to the fight against the pandemic. All those activities considered not necessary were hugely re-dimensioned. Among

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those, rehabilitation clinics underwent a progressive reduction of activities. Most of the patients needing post-operative rehabilitation were forced to start home rehabilitation[4-7], leading to an increasingly use of telemedicine also in this particular field[8].

THA (Total Hip Arthroplasty) is a very common procedure, estimated to be performed about 1 million times a year. It represents a successful surgery which can result in important improvement of patients' quality of life, with pain relief and functional restoration[9,10]. There are numerous indications for primary THA. The main ones are hip osteoarthritis (primary or secondary), avascular necrosis of the femoral head, followed by fractures of the proximal femur, dysplasia and inflammatory arthritis[11,12].

The aim of the study is to compare clinical and functional outcomes in patients underwent THR, to evaluate the differences between the group of those who were admitted to rehabilitation clinics and others who spent their post-operative period performing home rehabilitation.

Patients and Methods

A retrospective observational study was conducted according to the PROCESS guidelines. This study respects national ethical standards and the Declaration of Helsinki. Written informed consent for surgical and clinical data collection for scientific purposes was obtained from all patients at the admission and before surgery, according to our institutional protocol.

We included patients admitted to the Department of Orthopedics and Traumatology of our University Hospital between March 2020 and February 2021 and patients aged > 65 who underwent a THR for primary arthrosis in the period from March 2020 to February 2021, with at least 1 year follow-up. We excluded all patients who underwent a partial hip replacement, post-fracture surgery, aged < 65, who underwent revision surgery, and patients who had not completed the 21-days rehabilitation clinic course.

All total hip replacement procedures were performed by an orthopedic surgeon experienced in hip surgery. A posterolateral approach was used for each patient, and 2 g of cefazolin as preoperative antibiotic prophylaxis, if not contraindicated, was administered to all. The prosthesis was implanted according to the manufacturer technique, after performing osteotomy of the femoral neck and removing the head[13,14]. After surgery, full weight-bearing was allowed. The average hospital stay was 5.3 days (min 3 days - max 8 days, depending on patients' vitals, bed availability in rehabilitation clinics, or personal arrangements for returning home). All patients performed the same rehabilitation protocol: sitting position was allowed from the first postoperative day, orthostatic position from the second. Weight-bearing was progressive, initially with a walker support, later with two crutches support. Both groups of patients were given instructions on the exercises and mobilization to be performed aiming at increasing hip muscle strength and range-of-motion. During hospitalization and until discharge, all patients were mobilized with the help of physical therapists in the same indications. During the hospital stay, the patients performed 20 min/day of exercises with the resident physiotherapist from the first day following the surgery. Patients received a booklet with the exercises to be performed: weight-bearing exercises with hip-abductor strengthening, early mobilization including transfer training (bed-to-standing and toilet transfer), gait training with two crutches for first 14 days after-surgery and then with only 1 crutch for another 15 days. Outpatient clinical and radiographic evaluation was performed at 1, 6, and 12 months. All patients involved in the study were assessed through the Oxford Hip Score (OHS) questionnaire and by measuring the hip range of motion (ROM); Visual Analogue Scale (VAS) was used to evaluate the pain. These evaluations were performed at each follow up.

The Oxford Hip Score is an objective and reproducible over time measurement tool that has been drawn up to exclusively evaluate patients undergoing total hip joint replacement surgery[15]. The OHS is a questionnaire made up of twelve questions that correspond to a scale of points ranging from a minimum score of 1 to a maximum value of 5 for each answer. The result of the questionnaire allowed us to evaluate the functionality of the hip, joint mobility and pain perceived by patients.

ROM of the hip joint in flexion movement of the thigh on the pelvis was evaluated, taking the numerical value with an anatomical goniometer. Patients were asked to squat down slowly so that the degrees of active flexion of the thigh could be assessed. Finally, the VAS system was used to assess the pain perceived by the patient. This scale allowed recording a subjective clinical measurement, asking the patient to indicate a point on a straight line, whose extremes corresponded to

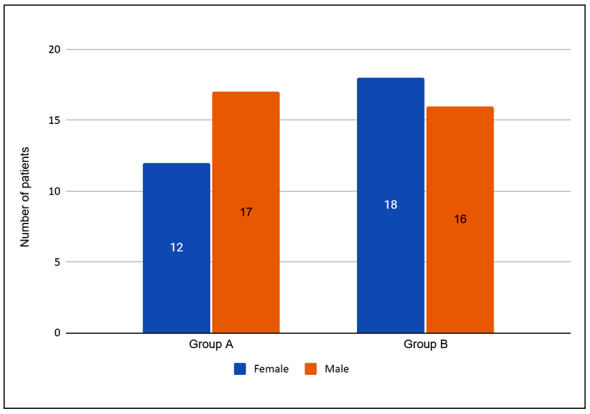

Figure 1. Patients involved in the study: subdivision into group A and group B, with further subdivision by gender.

two opposite values: no pain and the worst pain ever felt by the patient. The length of the segment ranged from 0 to 10 cm and, through a ruler, the value indicated by the patient was identified (and for convenience it could be approximated). The advantage of this visual scale is that it does not influence the choice of the subject and is a tool that can be reproduced over time and is easily accessible[16-18].

The patients were divided into two groups according to personal preference linked to the current historical moment (Figure 1). Patients of group A carried out a home rehabilitation program under the supervision of a physiotherapist: these patients performed 1 h/day of exercise for 5 days/week for three weeks following surgery. Group A was made up of 29 subjects, 12 female (41.37%) and 17 male (58.63%). Patients of group B carried out a rehabilitation program within a rehabilitation clinic: these patients performed 2 hours/day exercise for 6 days/week for three weeks following surgery. Group B was made up of 34 subjects, 18 female (52.94%) and 16 male (47.06%).

Statistical Analysis

Statistical analysis was performed using the Excel program (Microsoft, Redmond, USA). An independent-samples *t*-test was used to compare means between groups. Statistical significance was set for $p<0.05$.

Results

The mean age in group A was 73.4 age ± 5.67, in group B was 75.69 age ± 6.42. Baseline patients' characteristics are described in Table I. The only statistically significant difference in baseline characteristic between groups was the height ($p=0.0062$) (Table I).

The mean of ROM in patients who went home (group A) was 89.13° at 1 month, 97.58° at 6 months e 107.93° at 12 months. The mean of ROM in patients who went to the rehabilitation clinic (group B) was 88.52° at 1 month, 90.29° at 6 months and 104.7° at 12 months (Figure 2).

The mean Oxford Hip Score in patients of group A was 38.75 after 1 month, 40.65 at 6 months and 42.75 at 12 months; in the other group, the score was 37.94 after 1 month, 40.15 at 6 months and 42.12 at 12 months (Figure 3).

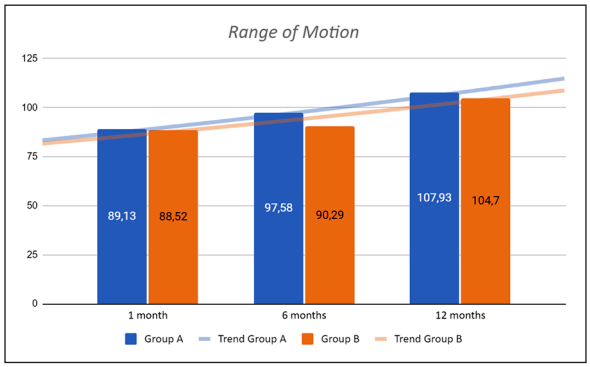

Figure 2. Range of Motion (ROM, degrees of active flexion).

Table I. Baseline characteristics.

	Group A	Group B	*p*
Age	73.4 (SD 5.67)	75.9 (SD 6.42)	0.07
Gender	F 41.37% (12); M 58.63% (17)	F 52.94% (18); M 47.06% (16)	3.07
Weight	80.75 Kg (SD 16.45)	75.52 Kg (SD 12.68)	2.47
Height	170.96 cm (SD 8.19)	164.23 cm (SD 12.68)	**0.0062***
Body Mass Index	27.6 (SD 5.71)	27.9 (SD 3.28)	0.966
Smoke	yes 48.27%; no 51.73%	yes 38.23% (13); no 61.67% (21)	0.1785

In brackets: absolute numbers or SD (standard deviation); *: Statistical significance.

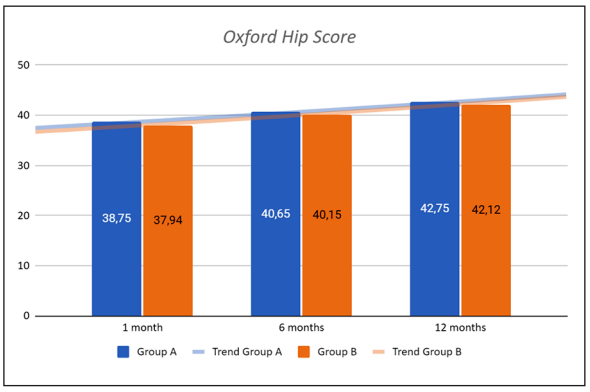

Figure 3. Oxford Hip Score (OHS).

The mean pain value of the patients was calculated according to the VAS scale. In patients transferred home, the value was 3.27 at one month after surgery, 1.89 at 6 months and 0.58 at 12 months; in patients transferred to the rehabilitation clinic the mean value was 3.65 at 1 month, 2.18 at 6 months and 0.68 at 12 months after surgery (Figure 4).

The results in the two groups of patients are in agreement. The range of motion progressively improves both in patients transferred to rehabilitation clinics and in patients followed by a physiotherapist at home. The means were compared with the student t-test and there was statistically significant difference between the two groups at 12 months from surgery (p=0.6379 at 1 month, p=0.327 at 6 months and p=0.0178 at 12 months).

Functional improvements were evident in the two groups of patients and better scores in the Oxford Hip Score were observed as the follow-up progressed (p=0.0498 at 1 month, p=0.1583 at 6 months, p=0.0932 at 12 months).

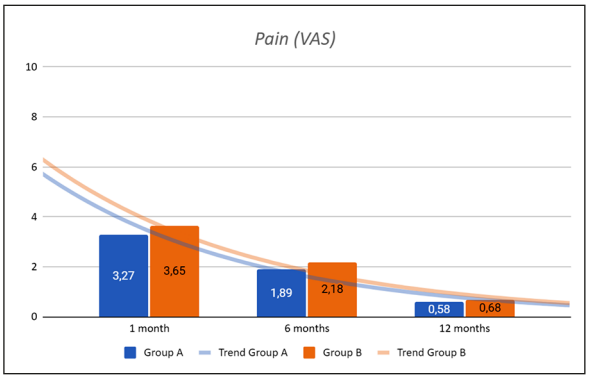

Figure 4. Pain (VAS).

Pain felt by patients according to the VAS scale while performing activities of daily living also progressively decreased in both patient groups, with no significant differences (p=0.1489 at 1 month, p=0.105 at 6 months and p=0.6263 at 12 months) (Table II).

Discussion

This study showed that there were no differences in the parameters analyzed (ROM, VAS, OHS) between the patients followed by a physiotherapist at home after discharge from the hospital and patients transferred to the rehabilitation clinic. Patients transferred to the clinic remain there for approximately 3 weeks after surgery. The beginning of an early and intensive rehabilitation is crucial to determine the functional outcome and the satisfaction post THA. Umpierres et al[25] demonstrated the importance of starting early a good quality rehabilitation. At 15 days after surgery, patients followed by a physiotherapist had better functional outcomes (according to SF-36) and ROM than patients who received only verbal instruction and only one physiotherapy exercise demonstration.

During the COVID-19 pandemic, elective surgery was reduced. Many patients decided to postpone the surgery, while an increasing number of operated patients decided to start home rehabilitation to avoid further hospitalization due to the risk of contracting COVID-19. In a multi-center study, Brown et al[19] showed that elective orthopedic surgery in the United States has slowed down because many patients had chosen to postpone surgery for fear and anxiety of contracting COVID-19.

MacDonald et al[20] assessed the impact of the COVID-19 pandemic on the rehabilitation of limited access to physiotherapy and a no face-to-face follow-up in 48 patients undergoing total hip replacement surgery during February 2020 and March 2020. No significant differences in Oxford Hip Score (OHS) and euroQoL five-domain (EQ-5D) of patients operated in 2019 and 2020 were found with a 6-months follow-up.

In the context of the pandemic, reducing contacts between people using modern technologies to follow patients remotely and monitoring their improvements in exercise after THA has been possibile[21-26]. Hoogland et al[27] and Fang et al[28] demonstrated that a home-based rehabilitation program driven by a tablet app and mobility mon-

Table II. Statistical analysis

Time after surgery	Group A	Group B	p
	Mean Range of Motion (ROM)		
1 Month	89.13° (SD 5.18)	88.52° (SD 5)	0.6379
6 Months	97.58° (SD 6.76)	90.29° (SD 5.74)	0.327
12 Months	107.93° (SD 4.72)	104.7° (SD 5.63)	0.0178*
	Mean Oxford Hip Score (OHS)		
1 Month	38.75 (SD 1.55)	37.94 (SD 1.66)	0.0498*
6 Months	40.65 (SD 1.11)	40.15 (SD 1.61)	0.1583
12 Months	42.75 (SD 1.52)	42.12 (SD 1.45)	0.0932
	Mean Pain (VAS)		
1 Month	3.27 (SD 1.13)	3.65 (SD 0.88)	0.1489
6 Months	1.89 (SD 0.67)	2.18 (SD 0.67)	0.105
12 Months	0.58 (SD 0.73)	0.68 (SD 0.72)	0.6263

In brackets: SD (standard deviation); *: Statistical significance.

itoring seemed to be feasible for THA patients. Adherence was good and patients' experience was positive. When the home-based rehabilitation program proved to be effective, it could be used as an alternative to formal physiotherapy. Busso et al[29] demonstrated the same results in timed up and go test (TUG Test), hip disability, pain intensity, muscle strength and range of motion in 56 patients who had undergone primary THA and afterward went either in rehabilitation clinic for 2-weeks after surgery or home with a tele-rehabilitation system.

An important role is played by the surroundings of each person: a patient who has friends, a strong family support and money will go home more easily than a patient who lives alone, with little family support.

Limitations

A limitation of our work is the fact that we have not assessed any differences in the population discharged at home compared to those transferred to the clinic both in terms of comorbidities and in terms of the social aspect. Fang et al[28] demonstrated that there were no significant differences in gender, BMI, smoking, IV drug use, depression, previous surgery, race/ethnicity, proximity to hospital, diabetes, surgery type and pain level in patients discharged at home or in rehabilitation clinics. Patients were more likely to be discharged and go home if they were younger, employed, active and had a lower ASA score.

Conclusions

Primary hip arthroplasty surgery for coxarthrosis proves to be a safe operation with a high percentage of success and patient satisfaction. During the COVID-19 lockdown, many rehabilitation clinics were converted into COVID-19 Hospital for COVID-19 positive patients. Many patients had therefore decided to postpone the interventions thinking that they could not obtain an optimal recovery at home.

In mid-term follow-up, post-hip arthroplasty rehabilitation at home gave results comparable to those of rehabilitation in the clinic in terms of pain, range of motion and functional outcomes. During the COVID-19 pandemic, elective surgery could go on and patients could achieve excellent results, even if followed at home by a physiotherapist.

Conflict of Interest

The Authors declare that they have no conflict of interests.

Ethical Approval

The study design was approved by the Orthopedic and Traumatology Institute and School Council "Policlinico Universitario Agostino Gemelli IRCCS". All procedures performed in the current study were in accordance with the 1964 Helsinki declaration and its later amendments.

Informed Consent
Written informed consent was obtained from all individual participants included in the study.

Availability of Data and Materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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References

1) Rizkalla JM, Gladnick BP, Bhimani AA, Wood DS, Kitziger KJ, Peters PC Jr. Triaging Total Hip Arthroplasty During the COVID-19 Pandemic. Curr Rev Musculoskelet Med 2020; 13: 416-424.
2) Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, Zhao X, Huang B, Shi W, Lu R, Niu P, Zhan F, Ma X, Wang D, Xu W, Wu G, Gao GF, Tan W. China Novel Coronavirus Investigating and Research Team, A Novel Coronavirus from Patients with Pneumonia in China N Engl J Med 2020; 20: 727-733.
3) Sun P, Lu X, Xu C, Sun W, Pan B. Understanding of COVID-19 based on current evidence. J Med Virol 2020; 92: 548-551.
4) De Mauro D, Rovere G, Smimmo A, Meschini C, Mocini F, Maccauro G, Falez F, Liuzza F, Ziranu A. COVID-19 pandemic: management of patients affected by SARS-CoV-2 in Rome COVID Hospital 2 Trauma Centre and safety of our surgical team. Int Orthop 2020; 44: 2487-2491.
5) Chatterji G, Patel Y, Jain V, Geevarughese NM, Haq RUI. Impact of COVID-19 on Orthopaedic Care and Practice: A Rapid Review. Indian J Orthop 2021; 55: 839-852.
6) Green G, Abbott S, Afzal I, Kader D, Radha S. The impact of the COVID-19 pandemic on the length of stay following total hip and knee arthroplasty in a high-volume elective orthopaedic unit. Bone Jt Open 2021; 2: 655-660.
7) Attarde D, Patwardhan S, Patwardhan S, Shyam A, Sanchetia P. Orthopaedic surgeons and covid- 19, the fear quotient "What are we really worried about?". J Clin Orthop Trauma 2021; 23: 101-647.
8) Ferrara P E, Codazza S, Ferriero G, Ricciardi D, Foti C, Maccauro G, Ronconi G. The effectiveness of telerehabilitation after hip or knee arthroplasty: a narrative review. J Biol Regul Homeost Agents 2020; 34: 75-79.
9) Ferguson RJ, Palmer AJr, Taylor A, Porter ML, Malchau H, Glyn-Jones S. Hip Replacement. Lancet 2018; 392: 1662-1671.
10) Varacallo M, Luo TD, Johanson NA. Total Hip Arthroplasty Techniques. Stat Pearls 2021; PMID: 29939641
11) Registro Italiano ArtroProtesi. Report Annuale 2020. Available at: https://riap.iss.it/riap/it/attivita/report/2021/10/29/registro-italiano-artroprotesi-report-annuale-2020/
12) Agha RA, Sohrabi C, Mathew G, Franchi T, Kerwan A, O'Neill N. The PROCESS 2020 Guideline: Updating Consensus Preferred Reporting Of Case Series in Surgery (PROCESS) Guidelines. Int J Surg 2020; 84: 231-235.
13) Saracco M, Passiatore M, Cazzato G, Ziranu A, Piconi C, Maccauro G. Use of ceramic bearings in hip arthroplasty: correct implantation and review of clinical and radiographic results. J Biol Regul Homeost Agents 2020; 34: 237-242.
14) Malerba G, Basilico M, Bonfiglio N, Vitiello R, Ruberto P, D' Adamio S, Sirgiovanni M, De Santis V, Maccauro G. Ceramic-on-ceramic versus ceramic-on-polyethylene in total hip arthroplasty: a comparative study at a minimum of 13 years follow-up. BMC Musculoskelet Disord 2022; 22: 1062.
15) Dawson J, Fitzpatrick R, Carr A, Murray D. Questionnaire on the perceptions of patients about total hip replacement. J Bone Joint Surg Br 1996; 78: 185-190.
16) Younger J, McCue R, Mackey S. Pain outcomes: a brief review of instruments and techniques. Curr Pain Headache Rep 2009; 13: 39-43.
17) Yakkanti RR, Sedani AB, Baker C, Owens PW, Dodds SD, Aiyer AA. Telemedicine in orthopaedic surgery during the COVID-19 pandemic: patient attitudes and barriers. Bone Jt Open 2021; 2: 745-751.
18) Ulivi M, Orlandini L, Meroni V, D'Errico M, Fontana A, Viganò M, Mangiavini L, D'Anchise R, Parente F, Pozzoni R, Sansone V, Zagra L, Peretti GM. Remote Management of Patients after Total Joint Arthroplasty via a Web-Based Registry during the COVID-19 Pandemic. Healthcare (Basel) 2021; 9: 12-96.
19) Brown TS, Bedard NA, Rojas EO, Anthony CA, Schwarzkopf R, Barnes CL, Stambough JB, Mears SC, Edwards PK, Nandi S, Prieto HA, Parvizi J; AAHKS Research Committee. The Effect of the COVID-19 Pandemic on Electively

Scheduled Hip and Knee Arthroplasty Patients in the United States. J Arthroplasty 2020; 35: S49-S55.

20) MacDonald DJ, Clement ND, Howie CR, Scott CEH. The effect of COVID-19 restrictions on rehabilitation and functional outcome following total hip and knee arthroplasty during the first wave of the pandemic. Bone Jt Open 2021; 2: 380-387.
21) Diaz A, Sarac BA, Schoenbrunner AR, Janis JE, Pawlik TM. Elective surgery in the time of COVID-19. Am J Surg 2020; 219: 900-902.
22) Oussedik S, Zagra L, Shin GY, D'Apolito R, Haddad FS. Reinstating elective orthopaedic surgery in the age of COVID-19. Bone Joint J 2020; 102: 807-810.
23) Brown TS, Bedard NA, Rojas EO, Anthony CA, Schwarzkopf R, Stambough JB, Nandi S, Prieto H, Parvizi J, Bini SA, Higuera CA, Piuzzi NS, Blankstein M, Wellman SS, Dietz MJ, Jennings JM, Dasa V. The Effect of the COVID-19 Pandemic on Hip and Knee Arthroplasty Patients in the United States: A Multicenter Update to the Previous Survey. Arthroplast Today 2021; 7: 268-272.
24) Wijnen A, Bouma SE, Seeber GH, van der Woude LHV, Bulstra SK, Lazovic D. The therapeutic validity and effectiveness of physiotherapeutic exercise following total hip arthroplasty for osteoarthritis: A systematic review. PLoS ONE 2018; 13: e019451
25) Umpierres CS, Ribeiro TA, Marchisio ÂE. Rehabilitation following total hip arthroplasty evaluation over short follow-up time: randomized clinical trial. J Rehabil Res Dev 2014; 51: 1567-1578.
26) Viliani T, Huber U, Pasquetti P, Poli P, Marcucci M, Popolizio A. Rehabilitation after primary total hip replacement. Comparison between Italian and international protocols. Eura Medicophys 2004; 40: 67-74.
27) Hoogland J, Wijnen A, Munsterman T. Feasibility and Patient Experience of a Home-Based Rehabilitation Program Driven by a Tablet App and Mobility Monitoring for Patients After a Total Hip Arthroplasty. JMIR Mhealth Uhealth 2019; 7: e10342.
28) Fang C, Lim SJ, Tybor DJ, Martin J, Pevear ME, Smith EL. Factors Determining Home Versus Rehabilitation Discharge Following Primary Total Joint Arthroplasty for Patients Who Live Alone. Geriatrics (Basel) 2020; 5: 7.
29) Busso C, Castorina G, Di Monaco M. Effectiveness of a home-based telerehabilitation system in patients after total hip arthroplasty: study protocol of a randomized controlled trial. Trials 2020; 21: 852.