Acta Biomed 2017; Vol. 88, Supplement 4: 56-61 DOI: 10.23750/abm.v88i4 -S.5154 © Mattioli 1885

Original article

Early rehabilitation after elective total knee arthroplasty

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Summary. *Background and aim of the work:* Outcomes after TKA surgery are supposed to be related to the intensity and type of post-operative rehabilitation. Aim of this paper is to describe our early rehabilitation protocol following TKA with mini-invasive surgery in the immediate post-operative period and analyze functional recovery and changes in pain scores in these patients. *Methods:* in this observational study, data were collected on 215 total knee arthroplasty patients referred to Orthopedics and Traumatology inpatient ward from July 2012 to January 2014, treated with the same early start rehabilitation protocol. We recorded times to reach functional goals (sitting, standing and assisted ambulation) and pain after the treatment. *Results:* length of hospital stay in TKA was 4.6±1.8 days, with a rehabilitation treatment lenght of 3.3±1.3 days. The mean time needed to achieve the sitting position was 2.3±0.7 days, to reach the standing position was 2.6±1.0 days to reach the walking functional goal was 2.9±1.0 days. Pain NRS scores remained below 4 in the first and second post-operative day and below 3 from the third post-operative day. *Conclusion:* Our study confirms that rehabilitation started as soon as 24 hours after surgery with mini-invasive approach, enables early verticalization of patients and early recovery of walking with a good control of pain. (www.actabiomedica.it)

Key words: early rehabilitation, knee, arthroplasty

Introduction

Total Knee Arthroplasty (TKA) is a surgical procedure used to relieve pain and restore function in patients with severe disease of the knee joint, mainly knee osteoarthritis. In recent years there has been considerable development of Minimally Invasive Surgery techniques (MIS); these techniques for knee arthroplasty, introduced with the aim of reducing the damages to the extensor mechanism, have evolved rapidly over the last few years. MIS preserves the tissues and the biomechanics of the knee joint, leading to better functional outcomes with less postoperative pain, reduced blood loss with lower need of transfusions, an early rehabilitation with a faster functional recovery and a more rapid achieving of functional goals (1-8). MIS can be obtained modifying the standard approaches, reducing the size of the incision, and of the instruments and improving the components in order to facilitate the implanting technique; to avoid the patella eversion the "mobile window" concept was also introduced as a way to approach the joint (9). In particular, in recent years, the mini-trivector approach was introduced to extend the benefits of the MIS techniques also in cases where it was difficult to apply before; in fact, one of the major limitation for the use of MIS in knee arthroplasty is the poor adaptableness in case of major deformity or rigidity of the knee joint and the mini-trivector approach for knee arthroplasties has been used as a valid alternative to classic approaches, permitting to extend the benefits of MIS also to patients that wouldn't be suitable for classic MIS techniques (3). MIS knee ar-

throplasty accelerates and facilitates the rehabilitation of the patient (8).

There are evidences of a relationship between the postoperative timing of rehabilitation and the frequency of complications like periprosthetic infections and deep vein thromboses (10), making rehabilitation a complementary procedure to surgery (11).

Outcomes after TKA surgery are supposed to be related to the intensity and type of post-operative rehabilitation, with bare evidence of this relationship; in particular, rehabilitation protocols with early post-operative ambulation are highly effective (12), leading to shorter postoperative hospital stays and lower analgesic intake (13) but most studies do not precisely describe rehabilitation protocols (14,15).

Aim of this prospective observational study is to describe our early rehabilitation protocol following TKA in the immediate post-operative period and analyze functional recovery in patients following mini invasive surgery knee arthroplasty, reporting times to reach functional goals (sitting, standing and assisted ambulation) and changes in pain scores.

Patients and methods

Our sample consists of 215 total knee arthroplasty patients referred to Orthopedics and Traumatology inpatient ward from July 2012 to January 2014. In all cases, the MIS surgical procedures were performed by the same senior surgeon. Every patient admitted for total knee arthroplasty was included in this study. No other selection or exclusion criteria were employed. All the patients were treated with the same early start rehabilitation protocol. All the patients received a tailored analgesic therapy; in the event that a patient did not respond to the pain therapy, the anesthetist was contacted to re-evaluate the patient. Data on all patients were collected by means of a specifically designed electronic data capture system.

At rehabilitative evaluation, medical history, previous and current disability and diagnosis, comorbidities and postoperative complications during their hospital stay for each patient were recorded.

Each day, physiotherapists recorded treatment, functional outcomes, and pain assessment with NRS scores (graded 0-10 with 10 most pain) after the treatment (16).

All the procedures conformed to the standards established by the Declaration of Helsinki and all patients gave their informed consent to the collection and use for research purpose of their clinical data.

Protocol for early rehabilitation after mini-invasive knee arthroplasty

Following the physiatrist examination, rehabilitation is usually started within 24 hours after surgery.

After surgery day 0

Patients are fitted with a compression bandage and suction drainage after surgery, and given pharmacological and cryotherapy treatment for pain. Within 24 hours after the operation, the affected knee joints are treated with continuous passive motion by means of the Kinetec® device for 1 hour, with range of motion gradually increased, pain permitting, to =0° - 90°.

After surgery day 1

The physiotherapist trains the supine patient to carry out active ankle flexion-extension exercises, isometric contraction of the quadriceps with the knee extended and of the gluteus maximus, with repetitions to be carried out independently by the patient, continuous passive motion for an hour, with range of motion gradually increased, pain permitting, to =0° - 90°, active-assisted flexion-extension of the knee, within the limits of pain.

After surgery day 2

The suction drain is removed and an antithromboembolic stocking fitted. Day 1 treatment is repeated. In addition, the physiotherapist trains the patient to carry out isotonic triple flexion exercises for the operated leg, followed by standing and walking with a wheeled walking frame.

After surgery day 3

Day 2 treatment is repeated. In addition, the physiotherapist trains the patient to carry out walking with crutches.

After surgery day 4

Day 3 exercises to improve isotonic strength and stability are repeated and walking rehabilitation continues. In addition, the patient carries out active exercises to improve knee mobility and proprioception, active flexion-extension of the knee, in order to increase range of movement within pain limits, assisted stair climbing with crutches.

After surgery day 5

Most patients are discharged from the Orthopedic and Traumatology inpatient ward and either transferred to the rehabilitation unit or continue to day hospital rehabilitation.

Patients are advised against walking without aids, especially outdoors and on uneven terrain, until full knee extension is regained, and the strength of the quadriceps and hip muscles reaches at least 4/5 on the medical research council scale (MRCS), in order to guarantee control and stability of the operated leg.

Statistics

Categorical variables are expressed as numbers and percentages, while quantitative variables are represented as means and standard deviation. MedCalc 11.2.1 for Windows was used for statistical analysis (MedCalc Software bvba, Ostend, Belgium).

Results

The average age at the time of the surgery of our patients was 69.0±10.0 years; 138 (64%) were females. Table 1 shows mean number of days after surgery to reach functional goals. These data show that the rehabilitative treatment started within 24 hours from evaluation; length of hospital stay in TKA was 4.6±1.8 days, with an associated rehabilitation treatment of 3.3±1.3 days.

The mean time needed to achieve the sitting position was 2.3±0.7 days, the mean time to reach standing position was 2.6±1.0 days. The majority of the patients could walk with aids within four days, with a mean time to reach the walking functional goal of 2.9±1.0 days.

Eleven patients (5% of the total) did not attain the functional goals during their hospital stay because in five cases they were discharged early to be admitted in other rehabilitation facilities, and in the remaining six cases because of medical complications: occurrence of dizziness in two cases, orthostatic hypotension in two cases, need for a blood transfusion in two cases.

In the patients that attained the functional goals, 203 achieved assisted sitting within the fourth day of rehabilitation (94,0%) and 1 of them achieved assisted sitting after the fourth day (0,5%); 195 achieved standing within the fourth day of rehabilitation (90,7 % of TKA patients) and 9 (4,2%) after the fourth day; 190 patients (88,4%) achieved assisted walking with wheeled frames/crutches within four days from the beginning of the rehabilitation program and 14 patients (6,5%) after the fourth day.

Table 2 shows mean pain scores, recorded after each physiotherapy session. Pain NRS scores remained below 4 in the first and second post-operative day and below 3 from the third post-operative day.

As far as the following discharge from our ward is concerned, 29 (13.5%) prosecuted their rehabilitation route as DH patients, 166 patients (77.2%) were admitted to rehabilitation units, 20 patients (9.3%) were transferred to a Nursing Home.

Discussion and conclusion

Our study demonstrates that our rehabilitative protocol permits to quickly reach functional goals (sit-

Table 1. Time (mean number of days after surgery) to reach functional goals

Functional goal	Days between evaluation and treatment	Length of stay	Length of rehabilitation treatment	Days to sitting position	Days to standing position	Days to walking with aids
Days	0.1±0.4	4.6±1.8	3.3±1.3	2.3±0.7	2.6 ± 1.0	2.9±1.0

Table 2. Mean NRS pain scores after physiotherapy

After surgery day	Patients (n)	Mean NRS pain scores after treatment
1	215	3,6±1.5
2	215	3,3±1.6
3	153	2,8±1.4
4	56	2,7±1.2
5	33	2,6±1.2
6	17	2,8±1.2
7	10	2,6±1.3
8	9	2,3±0.6
9	3	2,5±0.7
10	2	2,5±0.7

ting, standing and assisted ambulation) with a good control of pain. In fact, a rehabilitation project aiming at achieving a functional recovery as soon as possible is considered pivotal for a proper management of patients undergoing total knee arthroplasty.

A Cochrane review reports that an early multidisciplinary rehabilitation can improve outcomes after joint replacement, tough it has to still be studied the optimal intensity, frequency and effects of rehabilitation (17). Latest evidences suggest that early rehabilitation can optimize patient management, allowing early discharge from the acute ward and reducing risk of hospital-acquired complications like hospital acquired infections and thromboembolic events. For example, Chen presented a retrospective study on patients that underwent TKA divided into 3 groups based on the timing of their rehabilitation after discharge (within two weeks, after two weeks and without rehabilitation) and found that patients in the within-2-weeks rehabilitation group had lower incidences of prosthetic infection and deep venous thrombosis than the other groups' patients, concluding that timing of rehabilitation may be a factor affecting TKA complications. In the rehabilitative program presented by Chen patients initiate isometric exercise and continuous passive motion from the first post-operative day till the second week, and from the tenth day ambulation with a walker is started; this differs from our protocol in which ambulation is started within the third day (10).

Tayrose, instead, showed that rapid mobilization within the same day of the surgery of total joint replacement patients can be accomplished safely and reduces the length of hospital stay from 4.4 days in the standard group to 3.9 days in the rapid rehabilitation group with consequent direct savings due to the reduced utilized hospital resources (18).

In literature, several protocols with early ambulation have already been described and showed an high success rate; Nophakun presented a 3 day protocol for early ambulation that starts the same day of the surgery with active mobilization of the operated limb and continues in the first post-operative day with sitting, standing and walking, highly efficient without complications related to early ambulation (12). Many other authors encouraged early ambulation, within the day after the surgery (19-22). Berger et al proposed for TKA patients a protocol with ambulation starting in few hours after surgery and following discharge on the same day of surgery; however this protocol may lead to an increase in readmission rates (23,24).

In our sample, patients underwent a physiatrist evaluation and then started rehabilitation in the immediate post-operative acute period, within 24 hours from surgical procedure. The mean duration of rehabilitation treatment was 3.3 days. Mean hospital stay data are in line with the data presented by Isaac (19) that reported a mean discharge time of 3.6 days in patients undergoing accelerated rehabilitation after total knee replacement, time significantly lower compared to the control group patients that did not follow this accelerated protocol and that showed a mean discharge time of 6.6 days. Previous studies reported that mean hospital length of stay following knee arthroplasty: Oldmeadow (25) described a mean length of stay of 6.5 days; Crawford described a mean lenght of hospital stay for patients following primary total knee arthroplasty at a military medical center of 4.3 days (26). This result is very important since early discharge is in fact considered pivotal in achieving a faster functional recovery with a faster return to independent living after the surgical procedure (19). To the best of our knowledge, the shortest discharge time was reported by Beard that proposed in his paper and early discharge protocol within one day after surgery; however, this protocol was applied only on seven patients undergoing medial unicompartmental replacement with strict exclusion criteria (27).

Our patients achieved the possibility to sit at a median time of 2.3 days. The mean time needed for

reaching the standing position was 2.6 days. The majority of the patients could walk with aids within four days, since the mean time to reach the walking functional goal was 2.9 .

The high rate of patients re-acquiring possibility to have sitting, ambulation and reaching of erect position is an important result since this permits to the patient to be autonomous in most of the activities of daily life.

Pain was not intense, with NRS scores of 2-4 recorded from the first postoperative day, in line with the results of Tripuraneni that reports and confronts pain scores of patients following TKA that underwent femoral nerve block or local infiltration analgesia (28).

Passive and active mobilization were well tolerated, with a good control of pain, with pain NRS scores remaining below 4 in the first and second post-operative day and below 3 from the third post-operative day; this was possible thanks to the analgesic therapy that permitted pharmacological pain control.

Isaac already stated that pain levels in his accelerated rehabilitation group were lower than those in the control standard rehabilitation group; however, in this study, the accelerated rehabilitation protocol involved modifications to normal knee replacement surgical procedure, including infiltration of adrenaline and bupivacaine in the divided tissue layers during surgery, spinal anaesthesia, and mobilization on the same day of surgery. Pain NRS scores in the accelerated group stayed between 1 and 3, pain NRS scores in the standard rehab group ranging from 4 to 6; the pain control is very important in increasing the patient's confidence in their ability to move and probably hastening the rehabilitation process (19).

Patients were discharged to Rehabilitation Units, to home to continue their rehab work as DH patients or to Nursing Home depending on individual needs.

The main limitations of our study are the absence of a control group and the lack of follow-up data. In fact, the early post-discharge period after TKA surgery with rapid recovery is generally understudied in literature; Van Hegmond reports, on a 20 patients sample, that patients are mostly satisfied by the rapid recovery program after joint arthroplasty and the short length of hospital stay, but further studies need to be performed to examine which problems the patients encounter during the first weeks after joint arthroplasty surgery with rapid recovery (29).

Our study confirms that rehabilitation started as soon as 24 hours after surgery with mini-invasive approach, enables early verticalization of patients and early recovery of walking with a good control of pain.

References

1. Brown NM, Sheth NP, Davis K et al. Total Knee Arthroplasty Has Higher Postoperative Morbidity Than Unicompartmental Knee Arthroplasty: A Multicenter Analysis. J Arthroplasty 2012; 27: 86-90.
2. Dabboussi N, Sakr M, Girard J, Fakih R. Minimally invasive total knee arthroplasty: a comparative study to the standard approach. N Am J Med Sci 2012; 4: 81-5.
3. Benazzo F, Rossi SM. The trivector approach for minimally invasive total knee arthroplasty: a technical note. J Orthop Traumatol 2012; 13: 159-62.
4. Bozic KJ, Beringer D. Economic considerations in minimally invasive total joint arthroplasty. Clin Orthop Relat Res 2007; 463: 20-5.
5. Shankar NS. Minimally invasive technique in total knee arthroplasty-history, tips, tricks and pitfalls. Injury 2006; 37: S25-30.
6. Tria AJ Jr. Advancements in minimally invasive total knee arthroplasty. Orthopedics 2003; 26: s859-63.
7. Tria AJ Jr, Coon TM. Minimal incision total knee arthroplasty: early experience. Clin Orthop Relat Res 2003; 416: 185-90.
8. Ohnsorge JA, Laskin RS. Special surgical technique of minimally invasive total knee replacement. Z Orthop Ihre Grenzgeb 2006; 144: 91-6.
9. Benazzo F, Rossi SM. Modular tibial plate for minimally invasive total knee arthroplasty. Knee Surg Sports Traumatol Arthrosc 2012; 20: 1796-802.
10. Chen HW, Chen HM, Wang YC, Chen PY, Chien CW. Association between rehabilitation timing and major complications of total knee arthroplasty. J Rehabil Med 2012; 44: 588-92.
11. Nazzal MI, Bashaireh KH, Alomari MA, Nazzal MS, Maayah MF, Mesmar M. Relationship between improvements in physical measures and patient satisfaction in rehabilitation after total knee arthroplasty. Int J Rehabil Res 2012; 35: 94-101.
12. Nophakhun P , Yindee A, Amornpiyakij P, Hlekmon N, Tanavalee A. The efficiency of the patient care team on 3-day protocol for early ambulation after MIS-TKA. J Med Assoc Thai 2012; 95: 537-43.
13. Den Hertog A, Gliesche K, Timm J, Mühlbauer B, Zebrowski S. Pathway-controlled fast-track rehabilitation after total knee arthroplasty: a randomized prospective clinical study evaluating the recovery pattern, drug consumption,

and length of stay. Arch Orthop Trauma Surg 2012; 132: 1153-63.
14. Pozzi F, Snyder-Mackler L, Zeni J. Physical exercise after knee arthroplasty: a systematic review of controlled trials. Eur J Phys Rehabil Med 2013; 49: 877-92.
15. Di Monaco M. Rehabilitation after hip and knee arthroplasty: where are we now? Work in progress to build up evidence-based protocols. Eur J Phys Rehabil Med 2013; 49: 875-6.
16. Williamson A, Hoggart B. Pain: a review of three commonly used pain rating scales. J Clin Nurs 2005; 14: 798-804.
17. Khan F, Ng L, Gonzalez S, Hale T, Turner-Stokes L. Multidisciplinary rehabilitation programmes following joint replacement at the hip and knee in chronic arthropathy. Cochrane Database Syst Rev 2008 16; (2): CD004957. doi: 10.1002/14651858.CD004957.
18. Tayrose G, Newman D, Slover J, Jaffe F, Hunter T, Bosco J 3rd. Rapid mobilization decreases length-of-stay in joint replacement patients. Bull Hosp Jt Dis 2013; 71: 222-6.
19. Isaac D, Falode T, Liu P, I'Anson H, Dillow K, Gill P. Accelerated rehabilitation after total knee replacement. Knee 2005; 12: 346-50.
20. Sanders S, Buchheit K, Deirmengian C, Berger RA. Perioperative protocols for minimally invasive total knee arthroplasty. J Knee Surg 2006; 19: 129-32.
21. Walter FL, Bass N, Bock G, Markel DC. Success of clinical pathways for total joint arthroplasty in a community hospital. Clin Orthop Relat Res 2007; 457: 133-7.
22. Cook JR, Warren M, Ganley KJ, Prefontaine P, Wylie JW. A comprehensive joint replacement program for total knee arthroplasty: a descriptive study. BMC Musculoskelet Disord 2008 19; 9:154.
23. Berger RA, Sanders S, Gerlinger T, Della Valle C, Jacobs JJ, Rosenberg AG. Outpatient total knee arthroplasty with a minimally invasive technique. J Arthroplasty 2005; 20: 33-8.
24. Berger RA1, Kusuma SK, Sanders SA, Thill ES, Sporer SM. The feasibility and perioperative complications of outpatient knee arthroplasty. Clin Orthop Relat Res 2009; 467: 1443-9.
25. Oldmeadow LB, McBurney H, Robertson VJ. Hospital stay and discharge outcomes after knee arthroplasty: implications for physiotherapy practice. Aust J Physiother 2002; 48: 117-21.
26. Crawford DA, Scully W, McFadden L, Manoso M. Preoperative predictors of length of hospital stay and discharge disposition following primary total knee arthroplasty at a military medical center. Mil Med 2011; 176: 304-7.
27. Beard DJ, Murray DW, Rees JL, Price AJ, Dodd CAF. Accelerated recovery for unicompartmental knee replacement - a feasibility study. The Knee 2002; 9: 221-224.
28. Tripuraneni KR, Woolson ST, Giori NJ. Local infiltration analgesia in TKA patients reduces length of stay and postoperative pain scores. Orthopedics 2011; 34: 173.
29. Van Egmond JC, Verburg H, Vehmeijer SB, Mathijssen NM. Early follow-up after primary total knee and total hip arthroplasty with rapid recovery: Focus groups. Acta Orthop Belg 2015; 81: 447-53.

Received: 22 January 2017
Accepetd: 22 February 2017
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