Rehabilitation after fast-track knee arthroplasty: A scoping review on evidence-based challenges

Federico Pennestri*, Negrini Francesco and Banfi Giuseppe1,2
1IRCCS Galeazzi Orthopedic Institute, Via Riccardo Gaelazzi 4, 20161 Milano, Italy
2Vita-Salute San Raffaele University, Via Olgettina 58, 20132 Milano, Italy

Abstract

Purpose: The purpose of this scoping review is to identify post-operative prognostic factors associated to the outcomes of rehabilitation, in terms of functional recovery and patient satisfaction, after fast-track Total Knee Arthroplasty.

Method: Surgeons, physiatrists and physiotherapists from our hospital (IRCCS Orthopaedic Institute Galeazzi, Milan, Italy) with experience on fast-track pathways selected five postoperative issues including relevant prognostic factors associated to rehabilitation. An electronic research was performed in PubMed using the following keywords: “fast(-)track” AND “arthroplasty” AND issue (i.e. “pain and analgesia”). After screening for eligibility, 43 papers were included in the synthesis.

Results: A multimodal analgesic regimen based on LIA; opioid consumption; intensive and early physiotherapy when possible; standard exercise programs based on patient cluster of characteristics; discharge planning according to functional, psychological and social criteria; patient motivation; use of psychopharmacological treatment; substantial connection between institutions; are postoperative prognostic factors which play a major impact on the effectiveness of rehabilitation after fast-track TKA.

Conclusions: Social, psychological and logistical aspects, together with clinical and functional outcomes, are fundamental to improve patient education, compliance and ability to cope with rehabilitation. Future research should therefore identify recovery curves to predict, track and understand specific outcomes to specific cohorts (or clusters) of patients, in order to refer them to the most suitable rehabilitative modality and setting.

Introduction

The individual and social burden caused by knee osteoarthritis calls for clinical and logistical innovations to improve the effectiveness and efficiency of Total Knee Arthroplasty (TKA). Fast-track surgery is a multidisciplinary perioperative approach aimed at reducing surgical stress and facilitating postoperative recovery, resulting in decreased convalescence, better patient satisfaction, and reduced hospital costs [1-2]. Indeed, accelerated recovery was attributed to better coordination and collaboration between orthopaedic surgeons, physiatrists, physical therapists and patients [3].

Accelerated recovery is not alternative to safe recovery, and fast-track pathways are increasingly considered effective, spread and inclusive [4-8]. However, the postoperative portion of care is perhaps the aspect that received least attention, and room for improvement had been recently identified in many issues [2]. Which prognostic factors, among them, can improve the outcomes of rehabilitation, in terms of functional recovery and patient satisfaction after TKA, how, and for whom?

The aim of this paper is to provide an answer retrieving evidence from the latest publications in literature. Consistently with recommended guidelines on scoping reviews [9], the research includes a high range of study designs in order to inform clinical practice, healthcare policy, and research priorities.

Methods

Relevant studies were identified as follows.

i) Surgeons, physiatrists and physiotherapists from our hospital (IRCCS Orthopaedic Institute Galeazzi, Milan, Italy) identified five postoperative issues as significantly prognostic to rehabilitation: pain and analgesia, assessment of activity and physical function (as compared to patient-related outcomes), physiotherapy, delirium and cognitive dysfunction, psychology and expectations. Their expertise is given by daily experience with fast-track pathways.

ii) An electronic research was performed in PubMed looking for the following keywords: “fast(-)track” AND “arthroplasty” AND the object of the topic, either in singular or combined words (i.e. “delirium and cognitive dysfunction”, “delirium”, “cognitive dysfunction”). 164 articles were found.

iii) Inclusion criteria were English language, fast-track and year of publication from 2015 onwards (namely after the publication of the narrative review which identified room for improvement in post-acute care as introduced previously) [2]. Exclusion criteria were outpatient procedures, non-primary procedures, errata. 62 articles resulted eligible, of which 59 remained after removing doubles.

*Correspondence to: Federico Pennestri, IRCCS Galeazzi Orthopedic Institute, Via Riccardo Gaelazzi 4, 20161 Milano, Italy, E-mail: federico.pennestri@grupposandonato.it

Key words: fast-track, knee arthroplasty, rehabilitation, compliance, patient-related outcomes

Received: June 12, 2019; Accepted: June 21, 2019; Published: June 28, 2019
iv) Eligible articles were screened to identify the site of arthroplasty, resulting in 27 papers related only to knee procedures, 16 only to hip procedures, and 16 to both hip and knee procedures. The 16 papers related only to hip procedures were excluded. 43 papers were included in the synthesis (Figure 1).

Inclusion and exclusion criteria were such as not to require double review to solve disagreement. The research was completed on March, 8th 2019.

Results and discussion

Information is organized in tables. Data retrieved from reviews are reported outside, in order to introduce, confirm or discuss the findings retrieved from original studies.

Pain and analgesia

One of the major challenges to total knee arthroplasty (TKA) is optimal pain control. Effective analgesia is capital in fast-track surgery programs to allow patient's early functional outcomes [10] (Table 1).

Assessment of activity and physical function vs patient-reported outcomes

The ability to generate benefits that matter to people is what creates real value in healthcare delivery. Since objective and subjective-reported outcomes can present significant discrepancies, major joint replacement included [21], when evaluating the effectiveness of a health technology, it is fundamental to consider the wider possible range of outcomes, both in terms of perspective (subjective or objective assessment) and range of time. (Table 2).

Physiotherapy

Fast-track TKA has shortened the time available for physiotherapists to reach functional criteria before discharge, raising safety concerns related to knee stiffness, pain, and the need for manipulation under anaesthesia (MUA). Proper physical exercise is fundamental not only to return to physical function as soon as possible, but also to avoid readmissions and long-term complications.

Once physical exercise is prescribed, little is known about how patients cope with pain, rehabilitation program or daily activities at home. Due to the high number of papers which investigated patient issues, motivation and experience in relation of physical therapy, a dedicated section is distinguished within the same table (Table 3).

Delirium and cognitive dysfunction

Major surgery in elderly patients may be followed by delirium and cognitive dysfunction, which often complicates recovery both during hospitalization and later (Table 4).

Psychology and expectations

Accelerated pathways presuppose a high degree of patient engagement, which requires in turn a high educational, physical

![Flowchart](image-url)
Pennestri F (2019) Rehabilitation after fast-track knee arthroplasty: A scoping review on evidence-based challenges

Table 1. Pain and analgesia

| Findings                                                                 | Study design       | Population                                      | Duration               | Reference |
|-------------------------------------------------------------------------|--------------------|-------------------------------------------------|------------------------|-----------|
| Local Administered Analgesia (LIA) is a safe adjuvant to Femoral Nerve Block (FNB) to reduce perioperative pain 36h after surgery, which is crucial to enable early rehabilitation LOS, patient’s satisfaction, complications and pain at 15-day follow up were not significantly affected. | Randomized Controlled Trial (RCT) | 121 selected patients undergoing TKA. | 1 month (m) after Surgery (AS) | [11] |
| The addition of perineurally or subcutaneously buprenorphine 0.3 mg to a single-shot FNB (i) reduced opioid consumption and improved sleep quality at the first post-operative night, but (ii) did not to cause any significant change in pain and early mobilization, along with (iii) an increase in the overall incidence of nausea and vomiting. | RCT                | 63 selected patients aged 50-80 undergoing TKA. | 48 hours (h) AS | [12] |
| Patients receiving sublingual sufentanil tablet system Zalviso® (SSTS) had better pain control (NRS), lower incidence of adverse events and better recovery in comparison with those who had continuous FNB, within a multimodal analgesic treatment. | Retrospective study | 95 selected patients aged > 18 undergoing TKA. | 3 days (d) AS | [13] |
| All the patients were discharged home three days after surgery. |                     |                                                 |                        |           |
| A single Adductor Canal Block (ACB) injection combined with intravenous dexamethasone is not inferior to ACB catheters in 24-hours opioid consumption. | Randomized Non-Inferiority Trial | 177 selected patients aged > 18 undergoing TKA. | 48 h AS | [14] |
| Both LIA and ABC (administered with catheter plus single-shot sciatic nerve block) allow early patient mobilization and high satisfaction. Morphine oral consumption and resting pain levels were also comparable between the treatments. LIA alone reduced peri-operative time of an average 25 minutes, thanks to its faster induction. | RCT                | 20 selected patients aged > 18 undergoing TKA. | N/A [ability to walk on the ward] | [15] |
| Adrenaline is often included in multimodal analgesic pathways to release early post-operative pain, despite its potential side-effects on tissue necrosis. Ropivacaine alone is a safer and effective alternative to release post-operative pain 48h after LIA. Readmission rates and Patient-Related Outcome Measurements (PROMs) were comparable at 3 months within both treatments. | RCT                | 50 selected patients undergoing TKA. | 3 m AS | [16] |
| Reduced Pressure Pain Threshold (PPT) on the arm and increased Pain Catastrophizing Scale (PCS) are predictive variables for moderate/severe pain 24h after surgery. | Prospective observational study (POS) | 60 patients aged 50-80 undergoing unilateral TKA. | 24 h AS | [17] |
| The relation between self-rated pre-operative pain and post-operative pain was examined in a qualitative study (Pain Catastrophizing Scale, Brief Pain Inventory). No associations were found between preoperative pain catastrophizing and pain 8w or 1y after surgery. | Prospective cohort study | 71 random patients aged ≥ 18 undergoing TKA. | 1-year (y) AS | [18] |
| The relation between self-rated pre-operative pain and post-operative pain was examined in a qualitative study (Pain Sensitivity Questionnaire, Brief Pain Inventory). Patients younger than 70 years exhibited more pain 8w after surgery, regardless to the degree of pain that was expressed before. The authors could not explain this correlation. | Prospective cohort study | 71 random patients aged ≥ 18 undergoing TKA. | 8 weeks (w) AS | [19] |
| Perioperative administration of escitalopram 10mg daily from pre-anaesthesia to post-operative day 6 did not reduce significantly the level of pain assessed by the patients 48h after surgery, in comparison with placebo. | RCT                | 120 high pain catastrophizing patients (PCS) undergoing TKA. | 6 d AS | [20] |

- These findings support reviews according to which i) regional anaesthesia and multimodal analgesia are key innovations to reduce pain, minimize narcotic consumption and achieve a faster rehabilitation [21]; ii) FNB could be counterproductive in an accelerated pathway, since it generates a significant decrease in femoral quadriceps strength (FQS) which can prevent early exercise after surgery [10].
- The question is which combination is optimal, whether in addition (LIA, better with bupivacaine) or in alternative (LIA, ultrasound ACB, sufentanil tablet system) to FNB.
- To avoid catheterization, a single ACB injection combined with intravenous dexamethasone is a safe alternative.
- LIA and ACB can allow early mobilization and high patient-satisfaction also after GA, when this treatment is necessary. The former contributes to an overall 25 min average reduction of the perioperative process.
- The psychological capacity to cope with pain is also important, since identifying high-patient responders pre-operatively can help planning individual strategies to improve recovery early after surgery. However, these findings need validation on more patients, as well as further studies on which drugs and doses can support that recovery.
Table 2. Activity, physical function, patient-related outcomes

| Findings                                                                 | Study design            | Population                  | Duration       | Reference   |
|--------------------------------------------------------------------------|-------------------------|-----------------------------|----------------|-------------|
| Patient reported improved physical function (mean 7, Knee Injury and    | Prospective cohort study| 40 selected patients aged   | From preoperative to 3 w AS | [21]        |
| Osteoarthritis Outcome Score) when objective assessed change in physical |                         | 55-80 undergoing TKA.       |                |             |
| performance (paced-walk, chair-stand, stair-climb tests) decreased.     |                         |                             |                |             |
| Barthe, MRC knee scale and VAS parameters were significantly greater, in | Retrospective observational study (ROS) | 95 selected patients aged | 2 m AS         | [22,23]     |
| fast-track patients, at 2 months after surgery.                         |                         | 40-95 who underwent TKA under the same surgeon. |                |             |
| Patients who underwent fast-track rehabilitation had reduced LOS (3d in | POS                     | 84 patients undergoing     | From 1 y before to 1 y AS | [24]        |
| comparison to 4) and comparable results in knee function (American Knee |                         | TKR with accelerated        |                |             |
| Society knee – AKSK - and functional - AKSF - scores) 1 year after surgery. |                         | rehabilitation.             |                |             |
| Mean LOS was 5 days.                                                     | Retrospective cohort study | 566 patients aged mean 69.3 who underwent TKR. | 1 y AS         | [25]        |
| Age > 70 was the most important factor influencing LOS, followed by BMI ≥ 30 and the number of comorbidities. Gender and type of arthroplasty, on the contrary, were not significant. The same factors played a significant role in determining patient-reported outcomes 1 year after surgery. | Retrospective register-based study | 66 selected patients aged 36-89 undergoing TKA. | 1 y AS     | [26]        |

- Fast-track protocol for primary TKA showed significantly lower knee pain scores and improved functional outcome in the first 7d after TKA compared to a regular protocol.
- Studies on a high number of unselected patients confirm that patient characteristics, more than LOS itself, determine patient-reported recovery in the longer run.
- Despite fast-track pathways are associated with reduced length of stay, high patient satisfaction, low revision rates and with improved health-related quality of life and functionality, early improvement in patient-reported outcomes does not correlate with objectively assessed function. Patient-reported outcomes measurements (PROs) should not be considered alone when evaluating the impact of a technology on recovery.

Table 3a. Physiotherapy.

| Finding                                                                 | Study design            | Population                  | Duration       | Reference   |
|--------------------------------------------------------------------------|-------------------------|-----------------------------|----------------|-------------|
| A ROM of ≥70° flexion combined with an extension deficit of ≤10° is suggested as an "optimal-zone" for ROM at discharge. The reason is the low occurrence of MUA (4.3%) in relation to the large amount of TKAs it represents (71%). | ROS                     | 359 patients undergoing TKA. | N/A [MUA rate after surgeries] | [27]        |
| A 15-minute walk immediately after recovery from anaesthesia did not increase pain (VAS) in comparison to a traditional non-intensive protocol, but neither did it improve functional recovery (Knee Society Score) up to 2w after surgery. | RCT                     | 31 patients aged 68 undergoing TKA. | 2 w AS         | [28]        |
| In 15% patients, free acupuncture applications reduced post-operative pain from 1 day after surgery. Women and white patients had more odds of receiving acupuncture in comparison to men and non-white patients. | POS                     | 1875 patients ≥ 18 undergoing TJR. | N/A [Self-reported pain assessment before and after acupuncture application] | [29]        |
| In motivated patients, 10 repetitions of maximum-loaded knee extension performed in one set until contraction failure increases voluntary activation of the quadriceps, along with no acute pain immediately after repetition nor at rest. | Prospective cross-sectional study | 24 selected patients aged 18-80 undergoing unilateral TKA. | Early AS (no further specified) | [30]        |
| 20 TKA/THA booklets were found 40% of them were related to accelerated pathways 55% of the hospitals to which they were related stated their patients to be mobilized on the day of surgery 100% TKR guidelines suggested the use of bed exercise for rehabilitation 35% TKR guidelines suggested functional exercise as a method for rehabilitation 55% TKR guidelines proposed strength or resistance-based exercises. Many patient information booklets do not follow ERAS principles for fast-track rehabilitation. | UK Google search       | N/A                         | N/A            | [31]        |
| In both sexes, knee and gait measures improved nonlinearly over time. It was possible to establish expected deviations from the pattern according to patient characteristics. | ROS                     | 2987 selected patients aged ≥ 50 who underwent unilateral TKA followed by postoperative outpatient physiotherapy. | 12 w AS        | [32]        |

- Significant reductions in MUA and LOS can be simultaneously achieved through a standard degree of flexion and extension at discharge.
- Earlier and more intensive physiotherapy can enhance recovery, but the best combination of intensity and duration has not been determined. Nearly half patient information booklets do not follow accelerated principles and are non-procedure specific.
- A high variance in modalities and frequency prevents physiotherapeutic rehabilitation and TKR in general to express their potential.
- Patient characteristics are the fundamental predictor of LOS and postoperative rehabilitation and determine preventable deviations from the standard pattern. These deviations are helpful to optimize standard treatments according to specific cohorts of patients.
- Acupuncture can support earlier physical therapy by reducing pain from the first day after surgery, despite its effectiveness varies according to sex and ethnicity.
Delirium and cognitive dysfunction.

Table 3b. Patient issues, motivation and experience in relation to physical therapy.

| Findings                                                                 | Study design                      | Population                                      | Duration       | Reference |
|-------------------------------------------------------------------------|-----------------------------------|------------------------------------------------|----------------|-----------|
| Leg oedema was the major issue after discharge (90.7%), followed by     | Qualitative cross-sectional study  | 86 patients aged ≥ 18 undergoing TKA, home and   | 3 w after       | [33]      |
| pain (81.4%), sleeping disorders (47.7%), appetite disturbance (38.4%)  |                                    | referred to physiotherapy in the community.     | discharge (AD)  |           |
| and bowel dysfunction (34.9%). In case rehabilitation was organized by   |                                    |                                                |                |           |
| municipal care services, patients were left alone with regard to issues   |                                    |                                                |                |           |
| related to pain. 69.8% patients did not entirely comply with recommended |                                    |                                                |                |           |
| exercises.                                                              |                                    |                                                |                |           |
| The use of a sphygmomanometer device is cheap and feasible technique in  | Qualitative study (QS)            | 24 selected patients undergoing TKA, UKA.       | From Post-Operative Day (POD) 1 to discharge | [34]      |
| postoperative independent knee extension training.                      |                                    |                                                |                |           |
| An android-based knee training device could be an effective support to   | Qualitative case report            | 50 healthy volunteers aged 18-40.               | Single session  | [35]      |
| patient rehabilitation in addition to regular physiotherapy. The       |                                    |                                                |                |           |
| absence of technical issues and a high volunteer satisfaction          |                                    |                                                |                |           |
| suggest the high potential to reduce the lack of compliance.            |                                    |                                                |                |           |
| Understanding information, dealing with pain, feeling unconfident and   | QS                                 | 8 selected patients aged 42-82 undergoing unilateral THA/TKA. | From preoperative outpatient visit 1 to discharge. | [36]      |
| being unready for discharge are the main worries in patients undergoing |                                    |                                                |                |           |
| LOS >3 days.                                                             |                                    |                                                |                |           |
| The fast-track pathway seemed to enable patients to take an active role  | Qualitative focus group study      | 13 patients aged 46-79 undergoing TKA which were discharged. | 2 w AS         | [37]      |
| in own self-care. The patient's coping capacity was strengthened by     |                                    |                                                |                |           |
| education, knowledge and predictability. Four main areas related to     |                                    |                                                |                |           |
| coping emerged after discharge:                                         |                                    |                                                |                |           |
| The majority of patients expressed that it was good to come home and    |                                    |                                                |                |           |
| take responsibility for their own rehabilitation.                       |                                    |                                                |                |           |
| The possibility to be assisted in case of pain, even just with a phone   |                                    |                                                |                |           |
| call, was considered an important prerequisite for feeling secure after  |                                    |                                                |                |           |
| returning home.                                                         |                                    |                                                |                |           |
| The patients seemed empowered by sharing experiences with others.       |                                    |                                                |                |           |
| Postoperative pain was prevalent in many patients after discharge, but  |                                    |                                                |                |           |
| the patients seemed prepared by information provided.                   |                                    |                                                |                |           |
| 28 patients were positive regarding short LOS. Pain gradually decreased  | Qualitative focus group study      | 13 patients aged 46-79 undergoing TKA which were discharged. | 2 w AS         | [37]      |
| and quality of life and function gradually improved during the 6w.      |                                    |                                                |                |           |
| Mean hours of weekly physiotherapy were 0.6 for w1 and 0.9 during the   |                                    |                                                |                |           |
| w6, with high variance of treatment modalities due to the lack of       |                                    |                                                |                |           |
| standardized treatment protocols.                                        |                                    |                                                |                |           |
| The intensity of physiotherapy was surprisingly low. The quality of life |                                    |                                                |                |           |
| 6w after discharge was similar to that before the surgery.              |                                    |                                                |                |           |

- Patients' lack of compliance to home physical therapy is often a problem, due to misunderstandings or inadequate pain management.
- In order to improve compliance, several devices are being tested. However, their effectiveness and accessibility must be test on more patients in number and characteristics.
- The potential side effects of reduced or fragmented institutionalization, among which inaccurate pain management stands first, are the major worries expressed by patients when they are discharged. Preoperative patient education and/or postoperative pain support (even just a telephone consultation) are then supposed to be highly cost-effective innovations in rehabilitation.
- When rehabilitations is not provided by the same institution in which they underwent surgery, patients fear being abandoned or inadequately assisted. At this purpose, more studies are needed to evaluate the pros and cons of continued or interrupted institutionalization, both clinically and economically, on a broader and longer-sighted point of view.

Table 4. Delirium and cognitive dysfunction.

| Findings                                                                 | Study design                      | Population                                      | Duration       | Reference |
|-------------------------------------------------------------------------|-----------------------------------|------------------------------------------------|----------------|-----------|
| Among the 789 patients who had LOS >4 days, 0.7% were delayed because   | Prospective risk-assessment study | 6331 patients aged ≥ 70 years undergoing unilateral THA/TKA. | N/A [PD or not] | [39]      |
| of Postoperative Delirium (PD). Mean age was 80.7 and median LOS 10 days,|                                    |                                                |                |           |
| without differences in gender and site of arthroplasty. Early          |                                    |                                                |                |           |
| mobilization, lower opioid consumption and return to routine (both in   |                                    |                                                |                |           |
| physiological terms of restored circadian rhythms and in psycho-social  |                                    |                                                |                |           |
| terms of recovering in place) contributed to a significant reduction in  |                                    |                                                |                |           |
| its incidence.                                                          |                                    |                                                |                |           |
| Opioid consumption, together with sleep disturbances, pain and          |                                    |                                                |                |           |
| neuroinflammation, is indeed a prognostic factor to PD and rehabilitation|                                    |                                                |                |           |
| Lower opioid consumption is confirmed to be effective in reducing the   |                                    |                                                |                |           |
| incidence of POD, calling for more studies on the combination of        |                                    |                                                |                |           |
| optimized opioid-sparing analgesia, reduction of inflammatory-           |                                    |                                                |                |           |
| immunological responses, early mobilization and discharge.             |                                    |                                                |                |           |
| Logistical and psycho-social factors such as recovering in place also   |                                    |                                                |                |           |
| contribute to a better recover after surgery, so that preoperative      |                                    |                                                |                |           |
| discharge-planning according to patient characteristics and living      |                                    |                                                |                |           |
| living is highly recommended. More information about this will follow in |                                    |                                                |                |           |
| sections 8 and 9.                                                       |                                    |                                                |                |           |
Table 5. Psychology and expectations

| Findings                                                                 | Study design | Population                                      | Duration          | Reference |
|--------------------------------------------------------------------------|--------------|-------------------------------------------------|-------------------|-----------|
| Understanding information, dealing with pain, feeling unconfident and being unready for discharge are the main worries in patients undergoing LOS > 3 days. | QS           | 8 selected patients aged 42-82 undergoing unilateral THA/TKA. | From preoperative outpatient visit 1 to discharge. | [40]      |
| Patients appreciated only 1 or 2 days in hospital. However, they were not sufficiently involved in the discharge planning. There was a feeling of uncertainty and being left on their own after discharge. | QS           | 8 patients                                      | 12 w AD           | [41]      |
| Dealing with transition between hospital and home, pain, self-medication and self-rehabilitation were the main worries. | QS           | 445 patients undergoing THR/TKR.                | 2 w AD            | [42]      |
| For TKR, median satisfaction score was 8.5 out of 10. No association was found between overall satisfaction following THR or TKR and sex, comorbidity, or LOS. | QS           | 2183 patients undergoing THA/TKA                 | N/A [Preoperative questionnaire administration] | [43]      |
| THR patients had shorter mean LOS than TKR patients, even though the median LOS was 2 days for both groups. THR patients were more satisfied than TKR patients in the first weeks after discharge. | POS          | 943 patients undergoing THA/TKA who received psychopharmacological treatment. | 90 d AS           | [4]       |
| Psychiatric conditions were evaluated preoperatively (SCL-90-R). Patients undergoing THA/TKA are not more burdened by psychiatric symptoms than a healthy control group with the exceptions of symptoms relating to somatization. | Prospective comparative study | 8373 unselected patients undergoing THA/TKA. | 90 d AS           | [44]      |
| Patients with a preoperative registered psychiatric diagnosis (PsD) had no increase in LOS > 4, 30- and 90d readmissions in comparison to those who received psychopharmacological treatment, without a psychiatric diagnosis. Both groups had increased risk of LOS > 4 in comparison with a healthy population. | Prospective comparative study | 1001 patients affected by Psychiatric Disorders undergoing THA/TKA. | 90 d AS           | [45]      |
| Pharmacologically treated psychiatric disorder is among the medical risky conditions which can be preventable before surgery. | POS          | 118 selected patients aged ≥ 18 undergoing TKA. | From 2w before hospitalization to postoperative clinic visit. | [46]      |

POS

- Not all patients can bear the mental and physical demand of an accelerated pathway. Accurate pre-operative assessment is fundamental before admission.
- Psychiatric disorders may not be, in themselves, a reason to exclude patients from accelerated pathways, while psycho-pharmacological treatment could be, due to drugs side-effects.
- Along with hypersensitivity and catastrophizing (which we addressed in section 2), anxiety is a particularly widespread phenomenon affecting patients before arthroplasty, despite we believe it to be physiological and non-harmful until it does not affect the outcomes of surgery (which has to be demonstrated).
- However, patients generally appreciate a shorter LOS, provided accurate support and education.
- Dealing with transition between hospital and home, pain, self-medication and self-rehabilitation are fundamental concerns which emerge during recovery and remain up to 12m after surgery, regardless to sex, comorbidity or LOS.

Conclusions

Which postoperative factors can improve the outcomes of rehabilitation after TKA, in terms of functional recovery and patient satisfaction, how, and for whom? A multimodal analgesic regimen based on LIA; opioid consumption; intensive and early physiotherapy when possible; standard exercise programs based on patient cluster of characteristics and relative recovery curves; post-acute care and discharge planning according to functional, psychological and social criteria; patient motivation; use of psychopharmacological treatment (regardless to a PsD); formal and substantial connection between the institution in which the patient is operated and the institution in which he is rehabilitated; are postoperative prognostic factors which play a major impact on the effectiveness of rehabilitation after fast-track TKA.

Outcomes themselves, however, must be cautiously considered, for many subjective psychosocial variables may positively or negatively bias an objective evaluation. Since the purpose of JA is to improve function and quality of life when conservative treatment of osteoarticular pain is not effective [47], this is not a reason to neglect the former (i.e. patient-related outcomes), but rather to establish an equally rigorous set of indicators.

On these grounds, clinical and functional outcomes are not the only factors that have to be considered. Social, psychological, cognitive and logistical aspects are fundamental to turn theoretical benefits (efficacy) into real (effectiveness), in order to improve patient education, compliance and ability to cope with rehabilitation. These arrangements are better to be defined since before the surgery.
Future research should therefore identify recovery curves to predict, track and understand specific outcomes to specific cohorts (or clusters) of patients, in order to refer them to the most suitable rehabilitative modality (i.e. intensity and frequency) and setting (i.e. outpatient, domiciliary, day-hospital). Despite early and tailored exercise are known to benefit the recovery of patients, we need more specific evidence about how long and how intensive should be the intervention after surgery and discharge.

Out of the 43 papers included in the synthesis, 22 were Observational Studies (either POS or ROS), 9 were Qualitative Studies, 7 were RCTs, 4 were Reviews and 1 was a Google Search. The degree of evidence can therefore be affected by the high variability in the methodological approaches adopted between the studies, which can be a limitation of the present study. However, this is consistent with the goal of a scoping review, which is to summarize and update evidence in support of more detailed research and clinical trial.

References
1. Andersen S, Holm HB, Jorgensen M, Grumov K, Kjaergaard-Andersen P, et al. (2017) Time-driven Activity-based Cost of Fast-Track Total Hip and Knee Arthroplasty. J Arthroplasty 32: 1747-1755. [Crossref]
2. Avasnak EK, Luna IE, Kehlet H (2015) Challenges in postdischarge function and recovery: the case of fast-track hip and knee arthroplasty. Br J Anaesth 115: 861-866. [Crossref]
3. Castorina S, Guglielmino C, Castrogiovanni P, Szychlinska MA, Ioppolo F, et al. (2018) Clinical evidence of traditional vs fast track recovery methodologies after total knee arthroplasty for osteoarthritis knee treatment. A retrospective observational study. Muscles Ligaments Tenons 7: 504-513. [Crossref]
4. Gylvin SH, Jorgensen CC, Fink-Jensen A, Gislason GH, Kehlet H (2017) Lundbeck Foundation Centre for Fast-Track Hip and Knee Replacement Collaborative Group (2017) The Role of Psychiatric Diagnoses for Outcome After Hip and Knee Arthroplasty. J Arthroplasty 32: 3661-3615. [Crossref]
5. Pitter FT, Jorgensen CC, Lindberg-Larsen M, Kehlet H, (2016) Postoperative Morbidity and Discharge Destinations After Fast-Track Hip and Knee Arthroplasty in Patients Older Than 85 Years. Anesth Analg 122: 1807-1815. [Crossref]
6. Jorgensen CC, Kehlet H, Lundbeck Foundation Centre for Fast-Track Hip and Knee Replacement Collaborative Group (2013) Outcomes in smokers and alcohol users after fast-track hip and knee arthroplasty. Acta Anaesthesiol Scand 57: 631-638. [Crossref]
7. Jorgensen CC, Kehlet H, Lundbeck Foundation Centre for Fast-Track Hip and Knee Replacement Collaborative Group (2013) Role of patient characteristics for fast-track hip and knee arthroplasty. Br J Anaesth 110: 972-980. [Crossref]
8. Jorgensen CC, Madsbad S, Kehlet H, Lundbeck Foundation Centre for Fast-Track Hip and Knee Replacement Collaborative Group (2015) Postoperative morbidity and mortality in type-2 diabetes after fast-track primary total hip and knee arthroplasty. Anesth Analg 120: 230-238. [Crossref]
9. Colgouhoun HL, Levac D, O’Brien KK, Straus S, Tricco AC, et al. (2014) Scoping reviews: time for clarity in definition, methods, and reporting. J Clin Epidemiol 67: 1291-1294. [Crossref]
10. Caparrini C, Miniati I, Ponti M, Baldini A (2017) Perioperative pain management in fast-track knee arthroplasty. Acta Biomed 88: 139-144. [Crossref]
11. Barastegui D, Robert I, Palau E, Haddad S, Reverte-Vinaixa M, et al. (2017) Can local infiltration analgesia increase satisfaction in postoperative short-term pain control in total knee arthroplasty? J Orthop Surg (Hong Kong) 25: 2309499017690461. [Crossref]
12. Van Beek R, Zonneveldt HJ, Van Der Ploeg T, Steens J, Lirk P, et al. (2017) In patients undergoing fast track total knee arthroplasty, addition of buprenorphine to a femoral nerve block has no clinical advantage: A prospective, double-blinded, randomized, placebo controlled trial. Medicine (Baltimore) 96: e7393. [Crossref]
13. Scardino M, D’Amato T, Martorelli F, Fencichio G, Simili V, et al. (2018) Sublingual sufentanil tablet system Zalviso for postoperative analgesia after knee replacements in fast track surgery: a pilot observational study. J Euthet Orthop 5: 8. [Crossref]
14. Lee S, Roohan N, Vaghadia H, Savkia AN, Tang R (2018) A Randomized Non-Inferiority Trial of Adductor Canal Block for Analgesia After Total Knee Arthroplasty: Single Injection Versus Catheter Technique. J Arthroplasty 33: 1045-1051. [Crossref]
15. Kastelik J, Fuchs M, Krämer M, Trauzeddel RF, Ertem M, et al. (2019) Local infiltration anaesthesia versus sciatric nerve and adductor canal block for fast-track knee arthroplasty: A randomised controlled clinical trial. Eur J Anaesthesiol 36: 255-263. [Crossref]
16. Schotanus MGM, Bemelmans YFL, van der Kay PHM , Jansen J, Kort NP (2017) No advantage of adrenaline in the local infiltration analgesia mixture during total knee arthroplasty. Knee Surg Sports Traumatol Arthros 9: 2778-2283. [Crossref]
17. Luna IE, Kehlet H, Petersen MA, Avasnak EK (2017) Clinical, nociceptive and psychological profiling to predict acute pain after total knee arthroplasty. Acta Anaesthesiol Scand 61: 676-687. [Crossref]
18. Høvik LH, Winther SB, Foss OA, Giglio KH (2016) Preoperative pain catastrophizing and postoperative pain after total knee arthroplasty: a prospective cohort study with one year follow-up. BMC Musculoskeletal Disorder 17: 214. [Crossref]
19. Valeberg BT, Høvik LH, Giglio KH (2016) Relationship between self-reported pain sensitivity and pain after total knee arthroplasty: a prospective study of 71 patients 8 weeks after a standardized fast-track program. J Pain Res 9: 625-629. [Crossref]
20. Lunn TH, Frokjaer VG, Hansen TB, Kristensen PW, Lind T, et al. (2015) Analgesic effort of perioperative oxycodone in high pain catastrophizing patients after total knee arthroplasty: a randomized, double-blind, placebo-controlled trial. Anaesthesiology 122: 884-894. [Crossref]
21. Turnbull ZA, Sastow D, Giambonne GP, Tedore T (2017) Anesthesia for the patient undergoing total knee replacement: current status and future prospects. Local Reg Anesth 10: 1-7. [Crossref]
22. Kehlet H (2018) Postoperative pain, analgesia, and recovery-bedfellows that cannot be ignored. Pain 159 Suppl 1: S11-S115. [Crossref]
23. Luna IE, Kehlet H, Peterson B, Wede HR, Hoesvgaard SJ, et al. (2017) Early patient-reported outcomes versus objective function after total hip and knee arthroplasty: a prospective cohort study. Bone Joint J-99-B: 1167-1175. [Crossref]
24. Maempfel JF, Wahlmsley PJ (2015) Enhanced recovery programmes can reduce length of stay after total knee replacement without sacrificing functional outcome at one year. Ann R Coll Surg Engl 97: 563-567. [Crossref]
25. Brock TM, Baker PN, Rushton S, Bardgett G, Deeban D (2017) Length of stay and its impact upon functional outcomes following lower limb arthroplasty. Knee Surg Sports Traumatol Arthrosc 25: 2676-2681. [Crossref]
26. Winther SB, Foss OA, Wik TS, Davis SP, Engdal M, et al. (2015) 1-year follow-up of 920 hip and knee arthroplasty patients after implementing fast-track. Acta Orthop 86: 78-85. [Crossref]
27. Wied C, Thomsen MG, Kallimose T, Myhrmann L, Jenss LS, et al. (2015) The risk of manipulation under anaesthesia due to unsatisfactory knee flexion after fast-track total knee arthroplasty. Knee 22: 419-423. [Crossref]
28. Zietek P, Zietek J, Szczypior K, Safranow K (2015) Effect of adding one 15-minute-walk on the day of surgery to fast-track rehabilitation after total knee arthroplasty: a randomized, single-blind study. Eur J Phys Rehabil Med 51: 245-252. [Crossref]
29. Crespin DJ, Griffin KH, Johnson JR, Miller C, Finch MD, et al. (2015) Acupuncture provides short-term pain relief for patients in a total joint replacement program. Pain Med 16: 1195-1205. [Crossref]
30. Mikkelsen EK, Jakobsen TL, Holgaard-Larsen A, Andersen LL, Bandholm T (2016) Strength Training to Contracture Failure Increases Voluntary Activation of the Quadriceps Muscle Shortly After Total Knee Arthroplasty: A Cross-sectional study. Am J Phys Med Rehabil 95: 194-203. [Crossref]
31. Wainwright TW, Burgess LC (2018) To what extent do current total hip and knee replacement patient information resources adhere to enhanced recovery after surgery principles? Physiotherapy 104: 327-337. [Crossref]
32. Pua YH, Seah FJ, Poon CL, Tan JW, AlanClark R, et al. (2018) Age- and sex-based recovery curves to track functional outcomes in older adults with total knee arthroplasty. Age Ageing 47: 144-148. [Crossref]
33. Szöts K, Pedersen PU, Hordam B, Thomson T, Konradsen H (2015) Physical health problems experienced in the early postoperative recovery period following total knee replacements. Int J Orthop Trauma Nurs 19: 36-44. [Crossref]
34. Horstmann H, Coluc C, Lobenhoffer P, Krettek C, Weber-Spickchen TS (2017) Evaluation of the acceptability of a sphygmomanometer device in knee extension training following surgical procedures of the knee. Int J Orthop Trauma Nurs 25: 42-47. [Crossref]
35. Weber-Spickschen TS, Colcue C, Hanke A, Clausen JD, James PA, et al. (2017) Fun During Knee Rehabilitation: Feasibility and Acceptability Testing of a New Android-Based Training Device. *Open Med Inform J* 11: 29-36. [Crossref]

36. Specht K, Kjaersgaard-Andersen P, et al. (2016) Patient experience in fast-track hip and knee arthroplasty—a qualitative study. *J Clin Nurs* 25: 836-845. [Crossref]

37. Høvik LH, Aglen B, Husby VS (2018) Patient experience with early discharge after total knee arthroplasty: a focus group study. *Scand J Caring Sci* 32: 833-842. [Crossref]

38. Van Egmond JC, Verburg H, Mathijsen NM (2015) The first 6 weeks of recovery after total knee arthroplasty with fast track. *Acta Orthop* 86: 708-713. [Crossref]

39. Petersen PB, Jørgensen CC, Kehlet H (2017) Delirium after fast-track hip and knee arthroplasty – a cohort study of 6331 elderly patients. *Acta Anaesthesiol Scand* 61: 767-772. [Crossref]

40. Sjavcian AKH, Leegaard M (2017) Hip and knee arthroplasty - patient’s experiences of pain and rehabilitation after discharge from hospital. *Int J Orthop Trauma Nurs* 27: 28-35. [Crossref]

41. Specht K, Agerskov H, Kjaersgaard-Andersen P, Jester R, Pedersen BD (2018) Patient’s experiences during the first 12 weeks after discharge in fast-track hip and knee arthroplasty – a qualitative study. *Int J Orthop Trauma Nurs* 31: 13-19. [Crossref]

42. Specht K, Kjaersgaard-Andersen P, et al. (2015) High patient satisfaction in 445 patients who underwent fast-track hip or knee replacement. *Acta Orthop* 86: 702-707. [Crossref]

43. Gylvin SH, Fink-Jensen A, Kehlet H, Jørgensen CC, Laursen MB, et al. (2018) Prospective psychometric characterization of hip and knee arthroplasty patients. *Nord J Psychiatry* 72: 39-44.

44. Jørgensen CC, Petersen MA, Kehlet H, et al. (2016) Preoperative prediction of potentially preventable morbidity after fast-track hip and knee arthroplasty: a detailed descriptive cohort study. *BMJ Open* 6: e009813.

45. Jørgensen CC, Knoop J, Nordentoft M, Kehlet H; Lundbeck Foundation Centre for Fast-track Hip and Knee Replacement Collaborative Group (2015) Psychiatric Disorders and Psychopharmacologic Treatment as Risk Factors in Elective Fast-track Total Hip and Knee Arthroplasty. *Anesthesiology* 123: 1281-1291. [Crossref]

46. Zietek P, Zarzycka B, Zietek I, Stepien-Slodkowska M, Sienko-Awierianow E, et al. (2017) The Impact of Caregivers’ Anxiety on Patients’ Anxiety before Fast-Track Knee Arthroplasty. *Acta Chir Orthop Traumatol Cech* 84: 292-298. [Crossref]

47. Huynh C, Puyraimond-Zemmour D, Maillefert JF, Conaghan PG, Davis AM, et al. (2018) Factors associated with the orthopaedic surgeon’s decision to recommend total joint replacement in hip and knee osteoarthritis: an international cross-sectional study of 1905 patients. *Osteoarthritis Cartilage* 26: 1311-1318. [Crossref]