

## Review Article

# Perioperative and Postoperative Pain Management in Patients Undergoing the Method of Fast-Track Total Knee Arthroplasty

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**Abstract**

Fast-track total knee arthroplasty (FT-TKA) is a procedure that depends on early rehabilitation and mobilization, reducing hospital stay. It improves clinical and functional outcomes and demands a new analgesic program for early patient recovery and mobilization. The success of this procedure depends on proper surgical planning, education, and advising of patients. The patient is educated and becomes more responsible during recovery because of the perioperative procedure. The purpose of this article is to present recommendations for the perioperative and postoperative analgesia in Fast-Track total knee arthroplasty in order to create an analgesic protocol for the patient and improve his recovery.

**Keywords:** Fast-track total knee arthroplasty, Perioperative pain management, Postoperative pain management, Rehabilitation

**Introduction**

The term osteoarthritis (OA), according to the American College of Rheumatology, is a consolidation of circumstances characterized by cartilage disruption and joint degeneration, which ultimately lead to disability<sup>1,2</sup>. Pain is the most important symptom during daily activity, but later becomes worse especially at night<sup>3</sup>. Surgery is necessary when the patient's situation cannot become better with medication, while at the same time the radiological findings worsen<sup>4,5</sup>.

Knee arthroplasty, which is divided into total and partial, is characterized as a reliable surgical procedure performed during the late stages of osteoarthritis<sup>6,7</sup>. It is worth emphasizing that it allows patients to recover their activity, reducing pain and improving their quality of life<sup>4,7</sup>. Moreover, it is considered as one of the most common orthopedic procedures<sup>4,6</sup>. For this reason, most patients report satisfactory improvement after 3-6 months from the day of surgery and a slight improvement during the following 2 years<sup>4</sup>. At the same time, remarkable benefits are observed after the first 6 months, even at 12 or 24 months<sup>3,6</sup>.

It is well known that knee arthroplasty is the most effective way to relieve and improve the function of people suffering from serious diseases, such as osteoarthritis<sup>1,3</sup>. It is considered to be the most common joint disease worldwide, which mainly affects the elderly population<sup>3,6</sup> and the risk

of its occurrence is higher in people aged 70-74<sup>3,4</sup>. Today, the percentage of people over the age of 60 suffering from osteoarthritis in Europe is 22%, and expected to reach 27% by 2020<sup>3,4,6</sup>.

Total arthroplasty with the Fast Track surgery technique is a great tool for reducing post-operative pain. Thus, it helps in the fastest return of the functionality of the joint and in the fastest walking with the operated leg. At the same time, it returns the patient to normal rhythms in a very short period of time<sup>8</sup>.

This new technique aims at the accelerated, in all areas, rehabilitation of the patient. Rehabilitation includes the return to normal rhythms of the patient's physical, mental and physiological state. Sport fitness includes level of activities, strength of the operated limb, and range of motion.

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The state of mind is about eliminating concerns about the limb that hurt before the operation and returning the patient's self-confidence. The physiological status relates to hemodynamic status, cardiorespiratory function, as well as other systems, such as renal function, gastrointestinal and other systems, which are potentially disturbed by the stress of major surgery<sup>8,9</sup>.

The advantages of the fast-track surgery method in total knee arthroplasty are mentioned as follows<sup>4</sup>:

- Avoiding the use of strong analgesics (opioids) after surgery and avoiding their side effects.
- Avoiding the use of epidural analgesia, or nerve blocks postoperatively, which limit the possibility of rapid postoperative mobilization.
- Faster mobilization and faster recovery with normal gait
- All patients with this technique are able to walk 2 hours after total knee arthroplasty
- A short stay of a few hours (1-2) in bed without the use of a urinary catheter. Remove oxygen and IV lines after 8 hours.
- Shorter hospital stays. In classic cases the average length of stay is 6-7 days, while with the quick recovery technique it is limited to 1-2 days.
- Greater range of knee flexion-extension from the first postoperative days.
- Almost zero chance of transfusion, unlike the 2-3 bottles required in classic knee arthroplasties.
- Lower rate of complications (deep vein thrombosis, skin complications, respiratory infections, level of consciousness disorders).
- Significantly greater post-operative patient comfort.
- Significant reduction of psychological trauma after total arthroplasty, due to rapid recovery and minimal post-operative pain, compared to what is known so far.
- Overall greater patient satisfaction

This procedure offers exceptional pain administration of TKA candidates throughout the perioperative period. Patient preparation through informational materials and meetings with medical staff is critical. The patient becomes responsible in the pre-operative stage onwards, because he is informed about his own recovery steps. Short- acting anesthesia and exceptional pain guidance ensuring rapid recovery, are real challenges throughout the perioperative period<sup>1,2</sup>. Therefore pain management needs to move forward in fast track surgery as it entails treating pain not only at rest but also during early activities such as walking, knee flexion and extension, and stair climbing. At the same time, multimodal bleeding control is important to avoid anemia and limit hemarthrosis<sup>2,3</sup>.

## Methods

This article is a systematic review on these topics. The search for these sources has been carried out through Web of Knowledge, PubMed, PsycINFO and ScienceDirect.

## Inclusion Criteria

The articles that resulted from the above search should have been published in international peer-reviewed scientific journals or in full text from international scientific conferences and focus on the purpose and objectives of the present research. The predefined criteria for the selection of published research relevant to the subject of the review were as follows:

- The articles must be written in English language
- The publication date of the articles should extend from 2005 to 2017

## Exclusion Criteria

- Articles that have been published in the form of diploma and degree theses.
- Articles not also translated into English.
- Articles that were not valid, were older than 2005, were excluded from the results of this work
- Articles whose topic is not related to the sub-research framework of the present study.
- Meta-analysis articles and case studies were excluded.

## Results

Forty-three articles were selected. Peripheral or epidural anesthesia is very important in perioperative pain management. The correct choice of anesthesia methods has been proven the most effective in order to control post-operative pain in fast-track surgery, faster patient recovery, minimization of hospital stays and reduction of post-operative complications. General and spinal anesthesia, as well as peripheral nerve block are the most common techniques throughout the total fast-track surgery. The succession of this procedure depends on the combination of different specialists who create an exclusive analgesic program for the patient.

## Literature Review

### *The Perioperative and Postoperative Pain Management in Fast-Track Recovery in Total Knee Arthroplasty*

The surgical pain is characterized by a nociceptive component due to activation of peripheral nociceptors, an inflammatory component due to the release of proinflammatory mediators, which in turn lowers the activation threshold of nociceptors<sup>1</sup>, and finally a neuropathic component common levels due to nerve damage<sup>2</sup>.

The cause of this is that peripheral and central sensitization and hyperalgesia mechanisms are activated. Local and systemic inflammatory responses provoke peripheral sensitization. On the contrary, central sensitization is caused by nociceptive input from the surgical field to the spinal cord 3-6 hours after surgery, resulting in the release of excitatory neurotransmitters<sup>3</sup>.

Before surgery, the postoperative pain is influenced

by the period and power of pain. This is associated with abnormalities in somatosensory perception and an imbalance between excitatory and inhibitory endogenous pain processes<sup>6</sup>. As to the perioperative pain management, it should be said that to rapidly achieve surgical goals, multimodal pain management<sup>4</sup> that combines drug therapy with local invasive analgesia (LIA)<sup>7</sup> is needed. The analgesic regimen followed in the hospital reflects oral administration of acetaminophen 15 mg/kg and etoricoxib 90 mg before operation, which selectively inhibit COX-2, do not affect platelet aggregation, and do not cause intestinal side effects<sup>5</sup>, which are very beneficial drugs for analgesia before surgery<sup>10</sup>.

Moreover, anti-inflammatory effects, etoricoxib also induces analgesia with the addition of PGE2 synthesis, thereby lowering the activation threshold of peripheral neurons. In our preemptive analgesia regimen, we also administer oral oxycodone/naloxone 10/5 mg, an extended-release combined opioid agonist/antagonist that has demonstrated pain relief during arthroplasty efficacy<sup>11</sup>. Naloxone limits the gastrointestinal side effects of oxycodone, such as constipation, nausea, and vomiting. Dexamethasone 0.1–0.2 mg/kg is also given during anesthesia to prevent nausea and vomiting and to reduce joint edema<sup>8,12</sup>.

During the postoperative period (days 0 and 1), it is recommended to give to the patient intravenous acetaminophen 15 mg/kg every 8 hours, ketorolac 30 mg every 12 hours, and oral oxycodone/naloxone every 12 hours 10/5 mg. From day 2 until discharge (usually day 3), oral therapy is a combination of paracetamol, oxycodone/naloxone, and diclofenac 150 mg once daily. The purpose of this mixture of analgesia is to manage different medicines in submaximal doses, minimize the side effects of each drug, and maximize effectiveness through synergistic effects<sup>9</sup>.

The introduction of analgesics as an alternative to morphine has resulted in a substantial reduction in many side effects such as cognitive side effects, respiratory depression, postoperative nausea and vomiting, and urinary retention. In order to identify patients who may be prone to side effects after oxycodone/naloxone at an early stage, patients are given this combination a few days before surgery and, if poorly tolerated, given a weak opioid (such as tramadol 1 mg/kg IV twice a day).

The local invasive analgesia (LIA) is the cornerstone of multimodal pain management during joint replacement surgery. The LIA produces an intra-articular sensory block, allowing slow appearance of nociceptive input and simultaneous initiation of multimodal drug medicine. During LIA, large doses of long-acting local anesthetic are invaded into the junction and in the surgery during wound closure<sup>8</sup> to ensure early patient mobilization, rapid recovery, reduced opioid use (morphine can be discontinued), and shorter length of hospital stay<sup>13</sup>.

Ropivacaine 2% (less cardiotoxic compared to bupivacaine) can be administered in volumes up to 200

mL with adjuvants such as ketorolac, epinephrine or morphine<sup>14-15</sup>. This elevated dose has been shown to be secure and free of side effects, as mean serum concentrations are very small (1.30–2.5 µg/mL) and thus well allowed<sup>16</sup>. LIA is an easy and secure method and processes exceptional anesthesia during the first 6 to 12 hours<sup>17</sup>. Adjuvants such as ketorolac<sup>15</sup>, magnesium<sup>18</sup>, and epinephrine can be considered to upgrade the condition and length of time of anesthesia. Nevertheless, these medicines are not packaged sterile, so it is necessary to be used with great care in the surgical field, while using a 0.2-micron antimicrobial filter.

Since there is currently no advantage of drug mixtures (cocktails) over single anesthesia in LIA, we do not wish to add any other drugs to the anesthetic, which are available in sterile surgical blisters. It is necessary to infiltrate 4–5 ml at several periarticular sites, especially when the wound is closed. In fact, the drug must penetrate the medial tibial periosteum, the junction of the medial meniscal capsule, the patellar tendon, and the maintained intrapatellar tissue.

In the femoral region, the medicine must penetrate throughout the length of the osteotomy, the suprapatellar synovial cavity, the posterior capsule near its medial and lateral femoral insertions, the quadriceps tendon, and the incised medial subcutaneous tissue (as the lateral side will be denervated) through the incision). Epinephrine should not be used during subcutaneous infiltration to abstain the possibility of decreased oxygen perfusion to the wound due to vasoconstriction. In the US, the duration of LIA was extended to 48–72 hours with liposomal L-bupivacaine.

This medicine is not obtainable outside the US, and recent studies have shown little or no benefit over standard LIA. Not long ago, some reports have shown the probability of enhancing the effects of LIA by saphenous nerve blockade, which can be done during LIA surgery<sup>9</sup>. The saphenous nerve in the adductor canal can be reached with a long epidural needle. The protection and benefit profile of the method is still under examination.

About the anesthesia, the femoral nerve blocks, either as a single injection or as a continuous infusion, are considered the gold standard for joint replacement pain relief. It is an easy method that can also be accomplished at the bed and supplies exceptional pain relief, reducing postoperative opioid use. However, this method is not correct to be used in a rapid surgery as it results in a 49% reduction in quadriceps muscle strength with high local anesthesia concentrations<sup>19</sup> or with low local anesthesia concentrations %, e.g. 0.1, induces -0.2% ropivacaine<sup>20</sup>. This reduction in contractility is incompatible when the patient is mobilized too soon.

Alternatively, ultrasound-guided block of the adductor canal can be achieved; it is an easy method with great success rate and produces exceptional postoperative anesthesia with insignificant reduction in quadriceps contractility (8%)<sup>19</sup>. The vase of cryotherapy could also be mentioned which involves applying cold to the skin surrounding the injured soft tissue. It is very important in the postoperative phase of

fast-track surgery.

This is a secure and non-invasive method. Advanced cryotherapy reduces swelling, pain and inflammation. In addition to vasoconstriction, cold leads to decreased neurotransmission and subsequent anesthesia and decreased prostaglandin synthesis, which are crucial in the pain progress<sup>21</sup>. Compression helps reduce the incidence of joint edema by pressing more and decreasing fluid leakage into the interstitial space<sup>22</sup>.

As to the analgesic therapy, it is mentioned that many pharmacological rather than medicine therapy is obtainable. Magnesium sulfate, a molecule with anesthetic, analgesic, and muscle relaxant effects, can be applied as an adjuvant to decrease postoperative opioid waste<sup>23</sup>. It is an NMDA receptor antagonist that controls calcium influx into cells which requires a bolus of 40 to 50 mg/kg over the next 24 hours and a continuous infusion of 10 to 15 mg/kg/h to increase effectiveness; this procedure decreases VNS and opioid use. However, there is no reduction in the incidence of side effects<sup>24</sup>.

Another NMDA receptor antagonist which stops neurotransmission is ketamine; low doses (0.15-0.3 mg/kg bolus and 0.1 mg/kg/h for 24 hours) decrease using opioid as well as the appearance of nausea and incidence of vomiting; it appears to have excellent hemodynamic stability without side effects such as hallucinations and diplopia<sup>25</sup>.

A non-invasive and secure method that can treat a variety of accompanying symptoms is acupuncture. In spite of the fact that the evidence is urgent, many studies have supported that it decreases pain symptoms and opioid use; regardless, few surgeons have added acupuncture for total knee replacement<sup>26-27</sup>.

Based on the above, it should be said that the perioperative and the postoperative pain are the most important causes of delayed recovery after total knee arthroplasty. There are many nerve endings in our body, which during the operation are injured and irritated, causing pain, which starts even from the time of surgery<sup>28,29</sup>. The perioperative and the postoperative pain, after the anesthesia wears off, the stimulation of these endings causes pain, which is imprinted on the brain, so that even small stimuli cause the activation of a cascade of chemical processes that result in the release of intense pain. The aim is to stop these processes at the time of surgery so that the pain is not imprinted in the patient's memory<sup>30</sup>.

The philosophy of fast-track recovery begins with the correct surgical technique, which is tissue-friendly. During the arthroplasty a skin incision as small as possible and less soft tissue injury is performed. It continues with the use of appropriate analgesic mixtures, which we inject in collaboration with our anesthesia team. The injection is made in specific points of the knee during the operation, with which we manage to block the pain at its origin. These mixtures also have a hemostatic effect, greatly limiting postoperative blood loss. The combination of analgesia and bleeding

limitation is the basis of the new technique of rapid recovery after total arthroplasty, which results in many benefits for the patient<sup>31</sup>.

### ***The Perioperative and Postoperative Pain Management in Fast-Track Recovery in Total Knee Arthroplasty and Pharmaceutical Provision***

The adequate pain control after knee arthroplasty in fast-track surgery operations can be a challenge, both for the attending physicians and physical therapists, and for the patients themselves<sup>32</sup>. Pain management is often achieved through the use of opioids (narcotic drugs) which can have dangerous side effects such as severe addiction<sup>33</sup>. However, in addition to controlling postoperative pain in fast-track surgery, the perioperative pain is also considered very important<sup>33,34</sup>. Peripheral or epidural anesthesia of the patient is usually used for its management<sup>34</sup>.

The correct choice of anesthesia methods has been proven to lead to lower levels of post-operative pain in fast-track surgery, faster patient recovery, minimization of hospital stays and reduction of post-operative complications<sup>34</sup>. By extension, all this can turn out to be profitable for the medical system of each country, as its operating costs would be reduced<sup>35</sup>. On the other hand, it is worth emphasizing that the wrong choice of anesthetic method can lead to the appearance of chronic pain after surgery, which is observed in 1/3 of the cases<sup>35,36</sup>.

The most commonly used methods of anesthesia throughout knee arthroplasty in fast-track surgery are general and spinal anesthesia, as well as peripheral nerve block (injection of cortisone and local anesthetic around a peripheral nerve) or the combination of these<sup>37,38</sup>. In recent years, many studies have favored local anesthesia over general anesthesia for several reasons. The first method has been found to cause fewer cardiovascular and pulmonary complications, reduce mortality and blood loss, while at the same time showing lower blood transfusion rates and chances of infections<sup>39</sup>. In conclusion, these factors allow for faster recovery and a reduction in hospitalization time, resulting in savings for both the patient and the clinic<sup>40</sup>.

In contrast, the peripheral nerve block is a local anesthetic method used to control intraoperative pain<sup>35,38</sup>. This has been noted to reduce postoperative opioid consumption and minimize cardiac, pulmonary, and thromboembolic risk<sup>36</sup>. However, the side effects of the present method include fluid retention, inability to control the bladder, the high probability of perirenal hematoma or nerve infection<sup>38</sup>. In many hospitals in Greece for example, general anesthesia is still preferred over local anesthesia due to lack of expertise of anesthesiologists and due to limited time<sup>41</sup>. Nevertheless, several findings show that the combination of general and local anesthesia can reduce blood loss levels<sup>9</sup>.

For the management of postoperative pain in fast-track surgery, the medication followed includes the administration of drugs and non-drugs. The combination of non-steroidal



anti-inflammatory drugs and local anesthesia has shown that it can reduce levels of postoperative pain<sup>32</sup>. However, in order to determine an optimal pain treatment, adequate training of the medical staff is required, as well as their multidisciplinary cooperation, which is often absent in Greek hospitals<sup>34</sup>.

At the opposite extreme, according to the American Society of Anesthesiologists (ASA), the most effective method for pain control after a knee arthroplasty is balanced (multimodal) analgesia<sup>35</sup>. Paracetamol or acetaminophen has recently been used as an analgesic for pain management after surgical procedures<sup>34,35</sup>. Additionally, according to the findings of Kehlet (2013) intravenous acetaminophen is effective in reducing postoperative pain and opioid-narcotic medication consumption, but also in enhancing patient satisfaction<sup>34</sup>.

### ***The Complications of Fast-Track Surgery in Total Knee Arthroplasty***

The serious complications in fast-track total-knee arthroplasty surgery are rare. The postoperative mortality ranges from 0.2% in the first 30 days to 40% at 90 days after surgery. For the first year, a rate of 1.5% is reported, which is comparable to that of the general population. Prosthesis infections account for less than 1% of complications. Revision rates are also low. It is estimated that 0.7% of total knee arthroplasty requires revision in the first year 2.7%, in 3 years 3.9%, in 5 years and 4.9% in the decade<sup>31</sup>.

The early complications include deep vein thrombosis, superficial and deep wound infection, peripheral nerve injury, and pulmonary embolism. Late complications include aseptic loosening of the prosthesis, osteolysis, difficulty kneeling, numbness in the scar area, and a metallic sound when moving the joint. Limitation of knee range of motion is another reported complication that can cause significant limitation of motion. When knee flexion is less than 75°, mobilization under anesthesia is deemed necessary. Kievit et al., (2014) report that patients with a range of motion of less than 60 degrees are more likely to experience complications and suggest that patients should be discharged with at least this range of motion secured<sup>32</sup>.

Total knee arthroplasty (like hip arthroplasty) is considered one of the most successful surgical procedures, especially when evaluated by criteria related to the prosthesis itself (such as its radiographic imaging and lifespan), as well as by criteria based on the surgeon's own assessment of the outcome of the total arthroplasty. Many studies have confirmed significant or even dramatic improvement in joint pain and functionality postoperatively. This improvement is captured by self-report questionnaires-as expressed by patients themselves through quality-of-life assessment tools and functional assessment scales.

Similar conclusions were reached by other researchers<sup>9,13</sup>. However, it is noted that in the fast-track total-knee arthroplasty surgery, the improvement in pain and

functionality is observed several weeks later compared to total-hip arthroplasty. For this reason, it is recommended that the final evaluation be carried out after a year, when an even greater improvement can be observed. Indeed, the maximum improvement in terms of physical functionality is observed in patients with THA in the first 6 months postoperatively, while in patients with total-knee arthroplasty between 6 and 12 months postoperatively.

The main long-term problems reported by patients are persistent pain and functional disturbances. Indeed, pain persistence is reported in the literature in 7% to 20% of all total knee arthroplasty patients<sup>15-17</sup>.

A review of 11 total knee arthroplasty reports involving patient populations undergoing total knee arthroplasty secondary to osteoarthritis found that a significant proportion of patients who had undergone total knee arthroplasty reported significant pain in the operated joint during the first few years. Specifically, the percentage of patients who reported an adverse outcome in terms of pelvic pain were between 10-34% after total knee arthroplasty<sup>13</sup>.

Liddle et al., (2015), investigated the presence of postoperative pain in 632 total knee arthroplasty patients using the WOMAC pain scale, pain detect Questionnaire and short-form McGill pain<sup>31</sup>. The researchers concluded that the presence of persistent pain postoperatively was important, although in most cases it was mild, intermittent pain and clearly milder than preoperative. However, 15% of total knee arthroplasty patients reported very severe pain up to 3-4 years postoperatively. It seems that the psychological burden may be responsible for these intense symptoms, as a statistically significant correlation has been found between pain and major depression<sup>18</sup>.

## **Discussion**

According to the findings of the literature review, there are two types of knee arthroplasty depending on the extent of destruction of the articular surfaces<sup>31</sup>. These are noncompartmental or partial knee arthroplasty and total knee arthroplasty<sup>32</sup>. The first occurs when one joint compartment has a normal joint space, while the other presents severe arthritis with "bone-on-bone" degeneration (disappearance of the joint space)<sup>33</sup>. The second is carried out in cases where there is an advanced stage of arthritis<sup>34</sup>.

Although more than 90% of patients show high satisfaction and positive results from knee arthroplasty operations<sup>35</sup>, a small percentage appears to show a high degree of dissatisfaction stemming from high postoperative pain, stiffness and inability to perform daily activities<sup>36</sup>. However, the results of knee arthroplasty appeared to vary according to patient demographic characteristics, such as gender, age and body mass<sup>38</sup>.

In order to increase the positive results and to be fully compatible with the new data in the field of medicine, total knee arthroplasty techniques have been modified and modernized in recent years. Currently, in various European

countries and the USA, the techniques of electronic navigation in the patient's joints, total knee replacement with the help of robotics, Minimally Invasive Surgical Technique (MIS), "press-fit" implantation technology and 3D printing of prostheses are applied<sup>36,38</sup>.

At the same time, modern rehabilitation methods have been discovered, such as neuromuscular electrical stimulation (NMES) and the control of the course of the knee through smartphone technology<sup>38</sup>. According to various empirical findings, the above innovative technique of the fast-track total-knee arthroplasty surgery has numerous benefits for the patient, since they offer reliable placement and alignment of the prostheses, improved performance, better quality of life and enhancement of the degree of acceptance and survival of the implants<sup>39</sup>.

In order to achieve the aforementioned, the role of the physiotherapist during the post-operative phase of the patient is also strong. It is worth noting that he / she records the actions of the patient, helps and controls him/her from the first day until the final stages of his / her review<sup>39</sup>. The physiotherapist also provides great support in order to fully restore and return the patient to his daily activities, which were difficult to perform due to disability<sup>40</sup>. In conclusion, through knee arthroplasty procedures, patients are given an extension to fulfill their purposes enhance the quality or change their lifestyle with the goal of a pleasant and safe future<sup>41</sup>.

Although some of the new fast-track total-knee arthroplasty surgery applied in Greece present satisfactory results, however, further actions must be taken with the aim of strengthening this method<sup>39</sup>. More in detail, it is proposed to provide continuous and quality training, both of the medical staff and of the physical therapists in the new knee arthroplasty and rehabilitation techniques that exist<sup>40</sup>.

Furthermore, the selection of implants is suggested to be done carefully, and where possible to use 3D printing with the aim of an excellent result, as well as the detailed information of the patients about the advantages and disadvantages of each technique<sup>41</sup>. At the same time, it would be good to provide greater awareness and more psychological support on the part of physiotherapists to patients. Finally, it is proposed to offer more and better information to the Greek public regarding the achievements of new technologies in knee arthroplasties, with the aim of reducing the fear and prejudices related to surgery that utilizes prosthetic material<sup>39,40</sup>.

As to the pharmaceutical treatment of the perioperative and the post-operative pain management in the fast-track total-knee arthroplasty surgery, this primarily aims at reducing pain and, by extension, improving the functionality and quality of life of patients with knee OA.

The medicines widely recommended for the perioperative and the post-operative pain management in the fast-track total-knee arthroplasty surgery are those of paracetamol and Non-Steroidal Anti-Inflammatory Drugs (NSAIDs).

Paracetamol, which has an analgesic effect according to guidelines, is recommended for mild to moderate pain. NSAIDs can be applied topically or taken orally. The latter should be taken on the recommendation of the doctor, who will determine which preparation is suitable, the dose of the medicine, as well as the duration of taking it. The use of NSAIDs should be limited to short-term use and the lowest possible dose, due to the serious side effects that have been recorded in the gastrointestinal and cardiovascular systems<sup>41</sup>.

The NSAIDs are also applied locally to the affected areas and come in various forms, such as cream, gel, patch. Another type of drugs are opioids, which are prescribed in cases of failure of previous pharmaceutical methods. However, it should be mentioned that prescribing those should be done with special care by doctors, due to side effects and the risk of addiction they present<sup>39,40</sup>.

Other medicinal methods that contribute to the improvement of the perioperative and the post-operative pain management in the fast-track total-knee arthroplasty surgery, are the injectable intra-articular infusions of corticoids, hyaluronic acid and autologous activated platelets (platelet-rich plasma, PRP) in the affected joints<sup>39,41</sup>. Finally, dietary supplements such as chondroitin and glucosamine have a controversial effect in the treatment of the perioperative and the post-operative pain management in the fast-track total-knee arthroplasty surgery<sup>42,43</sup>.

## Conclusion

According to what is mentioned above, the fast-track surgery in orthopedics is an exceptional method involving an early activity of the patient after surgery. Therefore, it is necessary for the patient to have a complete analgesia which will support his/her early recovery with no side effects. Patients must be informed and educated about the perioperative process which will help him/her with the physical therapy.

It is necessary to establish a complete analgesic program in which the local infiltration analgesia must be adopted and developed. Lots of therapies involve unsuccessful analgesic programmes. The fast-track surgery involves a combination of different specialists (orthopedic surgeon, anesthetist, physiatrist, physical therapist, internist) in order to create a perfect analgesic protocol for each patient during the entire perioperative period.

## References

1. Andersen LØ, Kristensen BB, Husted H, Otte KS. Subacute pain and function after fast-track hip and knee arthroplasty. *Anesthesia* 2009; 64:508–13.
2. Rasmussen GL, et al. Etoricoxib Provides Analgesic Efficacy to Patients After Knee or Hip Replacement Surgery: A Randomized, Double-Blind, Placebo-Controlled Study. *Anesth Analg* 2005; 110:4–1111.
3. Lavand'homme P, Thienpont E. Pain after total knee arthroplasty - A narrative review focusing on the stratification of patients at risk for

- persistent pain. *Knee Suppl to Bone Jt J* 2015; 97:45–8.
4. Røslund T, Gregersen LS, Eskehave TN, Kersting UG. Pain sensitization and degenerative changes are associated with aberrant plantar loading in patients with painful knee osteoarthritis. *Scand J Rheumatol* 2015; 44:61–9.
  5. Kehlet H, Andersen LØ. Local infiltration analgesia in joint replacement: the evidence and recommendations for clinical practice. *Acta Anaesthesiol Scand* 2011; 55:778–84.
  6. Andersen KV, Nikolajsen L, Haraldsted V, Odgaard A, Søballe K. Local infiltration analgesia for total knee arthroplasty: should ketorolac be added? *Br J Anaesth* 2013; 111:242–8.
  7. Røslund T, Gregersen LS, Eskehave TN, Kersting UG. Pain sensitization and degenerative changes are associated with aberrant plantar loading in patients with painful knee osteoarthritis. *Scand J Rheumatol* 2015; 44:61–9.
  8. Bondok RS, El-hady AMA. Intra-articular magnesium is effective for postoperative analgesia in arthroscopic knee surgery. *Br J Anaesth* 2006; 97:389–92.
  9. Vendittoli P-A, Makinen P. A Multimodal Analgesia Protocol for Total Knee Arthroplasty. *Journal Bone Jt Surg* 2006; 88:282–9
  10. Spreng UJ, Dahl V, Hjal A, Fagerland MW, Ræder J. High-volume local infiltration analgesia combined with intravenous or local ketorolac 1 morphine compared with epidural analgesia after total knee arthroplasty. *Br J Anaesth* 2010; 105:675–82.
  11. Murphy J, et al. Analgesic efficacy of continuous intravenous magnesium infusion as an adjuvant to morphine for postoperative analgesia: a systematic review and meta-analysis. *MEJ Anesth* 2013; 22:11–20.
  12. Toftdahl K, et al. Comparison of peri- and intraarticular analgesia with femoral nerve block after total knee arthroplasty A randomized clinical trial. *Acta Orthop* 2007; 78:172–9.
  13. Lierz P, Losch H, Felleiter P. Evaluation of a single preoperative dose of etoricoxib for postoperative pain relief in therapeutic knee arthroscopy. *Acta Orthop*. 2012; 83:642–7.
  14. Reuben S, Buvanendran A. Preventing the Development of Chronic Pain After Orthopedic Surgery with Preventive Multimodal Analgesic Techniques. *Journal Bone Jt Surg* 2007; 89:1343–58
  15. El Bitar YF, Illingworth KD, Scaife SL, et al. Hospital length of stay following primary total knee arthroplasty: data from the Nationwide Inpatient Sample Database. *J Arthroplasty* 2015; 105:1200–1203.
  16. Jørgensen CC, Kehlet H. Role of patient characteristics for fast-track hip and knee arthroplasty. *Br J Anaesth* 2013; 110:972–980.
  17. Buvanendran A, Kroin JS, Valle CJ, Della Moric M, Tuman KJ. Cerebrospinal Fluid Neurotransmitter Changes During the Perioperative Period in Patients Undergoing Total Knee Replacement: A Randomized Trial. *Anesth Analg* 2012; 114:434–41.
  18. Waldron NH, Jones CA, Gan TJ, Allen TK, Habib AS. Impact of perioperative dexamethasone on postoperative analgesia and side-effects: systematic review and. *Br J Anaesth*. 2013; 110:191–200.
  19. Paauwe JJ, Thomassen BJ, Weterings J, Rossum E, Van & Aulsems ME. Femoral nerve block using ropivacaine 0.025%, 0.05% and 0.1 %: effects on the rehabilitation programme following total knee arthroplasty: a pilot study. *Anaesthesia* 2008; 63:948–53.
  20. Murphy J, et al. Analgesic efficacy of continuous intravenous magnesium infusion as an adjuvant to morphine for postoperative analgesia: a systematic review and meta-analysis. *MEJ Anesth* 2013; 22:11–20.
  21. Woolf CJ. Central sensitization: Implications for the diagnosis and treatment of pain. *Pain* 2011; 152:S2–S15.
  22. Koh IJ, Chang CB. Preemptive Low-dose Dexamethasone Reduces Postoperative Emesis and Pain After TKA: A Randomized Controlled Study. *Clin Orthop Relat Res* 2013; 471:3010–20.
  23. Stålmán A, Berglund L, Dugner E, Arner P, Fell L. Temperature-sensitive Release of Prostaglandin E2 and Diminished Energy Requirements in Synovial Tissue with Postoperative Cryotherapy. *J Bone Jt Surg* 2011; 93:1961–8.
  24. Shan L, Shan B, Suzuki A, et al. Intermediate and long-term quality of life after total knee replacement: a systematic review and meta-analysis. *J Bone Jt Surg Am* 2015; 97:156–168.
  25. Stringer BW, Singhania AK, Sudhakar JE, Brink RB. Serum and Wound Drain Ropivacaine Concentrations After Wound Infiltration in Joint Arthroplasty. *J Arthroplasty* 2007; 22:884–92.
  26. Coluzzi M, Mattia C. Pharmacological profile and clinical data in chronic pain management. *Minerva Anesthesiol* 2005; 71:451–60.
  27. Albrecht E, Kirkham KR, Liu SS, Brull R. Peri-operative intravenous administration of magnesium sulphate and postoperative pain: a meta-analysis. *Anaesthesia* 2013; 68:79–90.
  28. Jouguelet-lacoste J, et al. The Use Intravenous Infusion or Single Dose of Low-Dose Ketamine for Postoperative Original Article Analgesia: A Review of the Current Literature. *Pain Med* 2015; 16:383–403.
  29. Jung J, Cho J, Chung S. Acupuncture for postoperative pain following total knee arthroplasty: a systematic review protocol. *BMJ Open* 2015; 5:1–5.
  30. Lu Z, Dong H, Wang Q, Xiong L. Perioperative acupuncture modulation: more than anaesthesia. *Br J Anaesth* 2015; 115:183–93.
  31. Liddle AD, Pandit H, Judge A, Murray DW. Patient-reported outcomes after total and unicompartmental knee arthroplasty: a study of 14,076 matched patients from the National Joint Registry for England and Wales. *Bone Jt J* 2015; 97-B:793–801.
  32. Kievit AJ, van Geenen RCI, Kuijer PPFM, et al. Total knee arthroplasty and the unforeseen impact on return to work: a cross-sectional multicenter survey. *J Arthroplasty* 2014; 29:1163–1168.
  33. Maradit Kremers H, Larson DR, Crowson CS, et al. Prevalence of Total Hip and Knee Replacement in the United States. *J Bone Jt Surg* 2015; 97:1386–1397.
  34. Kehlet H. Fast-track hip and knee arthroplasty. *Lancet* 2013; 381:1600–1602.
  35. Chughtai M, et al. Nonpharmacologic Pain Management and Muscle Strengthening following Total Knee Arthroplasty. *J Knee Surg* 2015; 11:55–60.
  36. Winther SB, Foss OA, Wik TS, et al. 1-year follow-up of 920 hip and knee arthroplasty patients after implementing fast-track. *Acta Orthop* 2015; 86:78–85.
  37. Sutton JC, Antoniou J, Epure LM, et al. Hospital discharge within 2 days following total hip or knee arthroplasty does not increase major-complication and readmission rates. *J Bone Jt Surg Am* 2016; 98:1419–1428.
  38. Pamilo KJ, Torkki P, Peltola M, et al. Fast-tracking for total knee replacement reduces use of institutional care without compromising quality. *Acta Orthop* 2017.
  39. Kim DH, et al. Adductor Canal Block versus Femoral Nerve Block for Total Knee Arthroplasty - A Prospective, Randomized, Controlled Trial. *Anesthesiology* 2014; 120:540–565.
  40. Husted H, Otte KS, Kristensen BB, et al. Readmissions after fast-track hip and knee arthroplasty. *Arch Orthop Trauma Surg*. 2010; 130:1185–1191.
  41. El Bitar YF, Illingworth KD, Scaife SL, et al. Hospital length of stay following primary total knee arthroplasty: data from the Nationwide Inpatient Sample Database. *J Arthroplasty* 2015; 105:1200–1203.
  42. Pitter FT, Jørgensen CC, Lindberg-Larsen M, et al. Postoperative morbidity and discharge destinations after fast-track hip and knee arthroplasty in patients older than 85 years. *Anesth Analg* 2016; 122:1807–1815.
  43. Stringer BW, Singhania AK, Sudhakar JE, Brink RB. Serum and Wound Drain Ropivacaine Concentrations After Wound Infiltration in Joint Arthroplasty. *J Arthroplasty* 2007; 22:884–92.