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Post-operative pain management methods and nursing role in the relief of pain of total knee replacement patients

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Abstract
Pain management after total knee replacement is a challenging and an integral part in the post-operative care. In order to recover fast and accomplish good outcomes pain should be managed adequately thus sufficient postoperative pain management skills provide a foundation to manage the pain. The aim of the study was to find out the various postoperative pain management methods and the nursing role in the care of total knee replacement patients. The purposes of the study were to offer research findings to increase nursing knowledge which may aid to improve successful pain management care. The study was conducted based on literature review, the data of the subjects were obtained from PubMed, EBSCO, CINALH databases considering exclusion and inclusion criteria. The selected articles were published between the year 2008 and 2015. All the chosen 12 articles were examined using content data analyzing method. The outcomes of the studies are discussed in three different themes that were pharmacological method, non-pharmacological method and nursing role. The findings of this study describe about a multimodal drug treatment and successfulness of both combinations of pharmacological and non-pharmacological method. Additionally, nurses are more responsible for assessing the pain effectively and adjust the treatment, according to a patient's individual needs as well as nurses should have a new knowledge and evidence based data to provide total knee replacement patients a pain relief and recover within a short period.

Keywords/tags: Pain management, Post-operative pain, Nursing pain assessment, Total knee replacement/Arthroplasty
Miscellaneous

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1 Introduction

Pain is unavoidable after total knee replacement surgery, making the pain bearable has therefore been a priority in healthcare settings. Studies have shown that in order to experience a quick recovery after a knee surgery, controlling pain is a major concern. (Treatment and Procedures 2014; Corke 2013.)

The main responsibilities of the nurses in pain management is to know how to assess pain by appropriate planning and implementing the adequate treatments. Moreover, the nurse needs to provide appropriate counseling and instructions for the follow-up care after discharge, such as therapeutic approaches and techniques for relieving pain by using both pharmacological and non-pharmacological methods. During the assessment of the effectiveness of those interventions, the nurse will need to monitor the adverse effects and advocate for the patient when the interventions are ineffective in relieving pain. (Lippincott 2013.)

Over the years, pain management has been the utmost challenge for healthcare practitioners and professionals and it is therefore an unavoidable subject. According to American pain management society, pain management has been considered as a fifth vital sign, which has been increased an awareness among health professionals. However, it has always been a challenge, since the pain is very individualized. (Lippincott 2013.)

The purposes of the thesis is to offer research findings to increase nursing knowledge which may aids to improve successful pain management care. The aim of the thesis is to describe the various postoperative pain management methods and nursing role in the care of total knee replacement patients. Nurses will memorize effective pain management therapies by being exposed to real situations and trained throughout their career since pain management has been one of the priorities after a surgery.

2 Total knee replacement patients

2.1 Arthritis

Arthritis is a disease which causes inflammation in the knee joints and the surfaces of the knee bones are stiff and painful. (See Figure 1.) It causes pain, swelling and stiffness. Any joint in body can be affected by the disease, however it is very common in the knee. Knee arthritis makes daily activities hard, such as climbing stairs and walking. Common types of knee arthritis are osteoarthritis and rheumatoid arthritis and posttraumatic arthritis. (Arthritis of the knee 2014.)
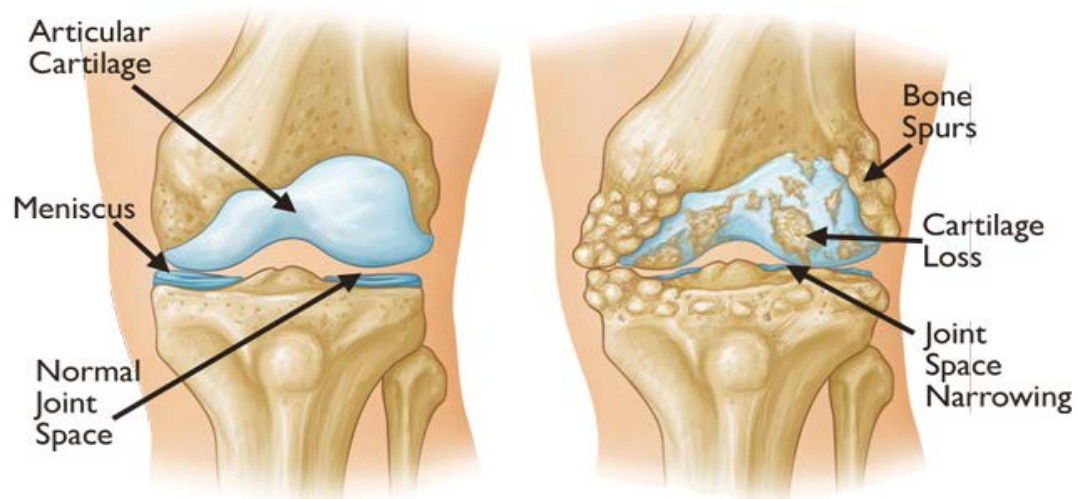
(Left) Normal joint space between the femur and the tibia. (Right) Decreased joint space due to damaged cartilage and bone spurs.

FIGURE 1. Arthritis of the knee 2014.

Osteoarthritis is most common reason for the total knee operation and a degenerative type of arthritis that occurs usually in people over 50 years. (Osteoarthritis 2015).
In osteoarthritis the cartilage of the knee joint wears away. The cartilage area becomes frayed and rough and the protective space between the bones decreases. It causes rubbing on bone and painful bone spurs. Osteoarthritis develops slowly and the pain worsens. (Arthritis of the knee 2014.) There is no cure for this degenerative joint disease, but total knee replacement can be a very helpful option in severe disability and pain of the knee. Some risk factors are obesity and smoking (Osteoarthritis 2015).

Rheumatoid arthritis is a chronic disease. It attacks to multiple joint throughout the body. Rheumatoid arthritis is symmetrical and affects the joint on both sides of the body. Knee is covered by the synovial membrane. In rheumatoid arthritis it begins to swell causing pain and stiffness. In this autoimmune disease the immune system attacks its own tissues. The immune system damages cartilages and ligaments and softens the bone. Posttraumatic arthritis is developed after the injury to the knee. Broken bone may damage the joint surface and lead to arthritis in the long period of time. Ligament injuries can cause instability and wear on the knee joint. (Arthritis of the knee 2014.)

2.2 Total Knee Replacement

Anatomy of the knee

The knee is the largest joint in the body though it can be easily injured. The structure of knee consists of bones, cartilage, ligaments, and tendons. The knee is a joint that links the thigh bone (femur) to the shin bone (tibia), tendons and the ligaments hold the bones together. The other types of bones that form the knee joint are the tibia (fibula) and the kneecap (patella). Cushions of cartilage make the knee to glide in order to function properly and act as shock absorbers meniscus is also stabilizing the joint. The slippery substance, articular cartilage, covers the back of the patella and the ends of the femur and tibia. Knee joint allows flexion, extension, slight medial rotation, and lateral rotation of the leg in the flexed position. The ligaments are on the sides and also crossing each other inside the knee and help to control back and forth movements of the knee joint. (Arthritis of the knee 2014; Knee replacement 2015.)

Total knee replacement surgery

Firstly Total Knee Replacement (TKR) has commenced in German in 1860 but the results have not been satisfied by then, the techniques were used lead to early failure. However, in 1970 TKR begins to improve to another dimension, for instance surgeries were performed using Condylar design across the world, this conception has helped to ensure stability of the knee joint. (Williams 2010.)

In the quality of the metal which was used has been also improved over time, in the recent days they use ceramics materials based prosthesis which have been improved the longevity. According to recent studies over 130,000 knee surgeries are performed in the each year in the USA (Palmer 2014.) Moreover, according to new studies, the number of total knee replacements seem to be increased in Finland, mostly the age between 30 and 59, the main reason they have indicated is knee osteoarthritis. (Paddock 2012.)

Total knee replacement (TKR) is common surgical procedure performed in the treatment of advanced knee osteoarthritis, rheumatoid arthritis, meniscus tears, joint infections as well as prolonged knee pain. Usually when all the treatments are failed to give the desired results orthopedists direct patient for TKR. Mostly TKR is recommended when the pain cause a huge impact on their life performances, among all TKR surgeries done today the common reason is knee osteoarthritis. The main target of TKR is to relieve pain, establish mobilization which enhance the quality of life and daily activities. (Parvizi 2011.)

The implantation of procedure is done in three ways; the linked prosthesis, the resurfacing implant and the conforming implant respectively. TKR procedure is usually performed in few steps first prepare the bone by removing disease affected area (damaged cartilage) of the bone, in the second step, position the removed cartilage and bone with the artificial metal implant. After metal shield created the surgeon access into patella (kneecap) making a sharp incision, then resurface the patella (kneecap) with hardened plastic material, however it does not require in every total knee replacement surgeries, then lastly ensure by inserting a plastic spacer in between metal components. The components of the knee replacement can be surgically fixed with bone cement or a cement less techniques. (Trebse 2013.)

In order to provide the patient with a functional painless and stable joint a metallic and acrylic prosthesis is often used to replace the original knee joint. The prosthesis can be fully, semi or non-constrained depending on the strength of the ligaments. If the ligaments are too weak, a fully constrained prosthesis will be chosen. (Lippincott 2013.)

3 Postoperative pain

3.1 Nurses role in pain assessment

The experiences of pain are very personal. According to official the International Association for the Study of Pain, pain is "An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage". (International association for the study of Pain 2012; Hinkle 2013.)

Sensation of pain feels when the tissues are damaged. When the tissues are damaged, automatically pain receptors get activated and start sending signals to the spinal cord through peripheral nerve. In the spinal cord, neurotransmitters get activated to give information to the thalamus where the information is sorted out to send throughout the body. Then the thalamus in the brain moves those pain signals to somatosensory cortex, which senses the feeling of pain. The pain can be either short term, acute or chronic. (Hinkle 2013.) In general, there are certain things which affects how a person experiences the pain that include emotions, any personal previous painful experiences, attitudes, gender, cultural and religious beliefs. (Pain and how you sense it 2012). Acute pain occurs when the tissues are damaged due to trauma, surgery or burns, the duration of pain is short and healing does not require advance procedure. Chronic pain on the other hand need more advanced treatment to cure. (Hinkle 2013.)

Moreover, relieving patient´s anxiety and suggesting the most comfortable position for the patient are also areas of concerns for the nurses in order to help the patient calming down his pain or coping better. Nurses can observe regularly as well any autonomic signs like pallor, sweating, restlessness, tachycardia, feeling of uneasiness which are signs of pain. There are several pain management aims and results that the nurses should daily strive to reach. One of them is to relieve the pain as fast as possible and prevent of its recurrence. Another one is to measure the pain systematically after potentially painful treatments, an operation or an intake of analgesic to know how it evolve. Moreover, it is

very important to consider that the assessment tool must always be adapted to the patient profile and the patient must be encouraged to manage the pain as much as possible in autonomy during painful crisis. (Hallouët 2012.)

In order to give an effective pain care, a good pain assessment is prominent. Nurses are assessed pain using three pain measuring tools. (See Figure 2-4) there are numerical rating scale (NRS), visual analog scale (VAS) and verbal descriptor scale (VDS) respectively. The NRS measure pain from 0-10, the VAS evaluates giving patients to freely draw their pain level on the analog scale, the VDS provides 6 choices which described in words. However, when evaluating the pain nurses not only depends on pain scores but also other signs and symptoms which indicates the patient is having pain for ex: anxiety, restlessness, high heart rate can be signs of pain. (Petter 2007.)

Wong Baker Face Scale

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| No Hurt | | Hurts Little Bit | | Hurts Little More | | Hurts Even More | | Hurts Whole Lot | | Hurts Worst |

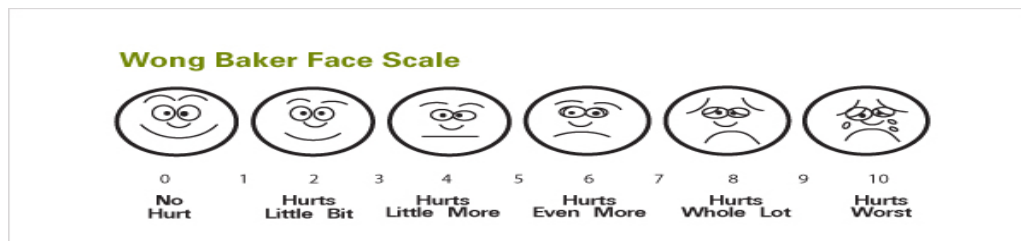**FIGURE 2. Verbal descriptive scale 2012.**

(adapted from Management of patient with a minor burn injury 2012)

Visual Analog Scale (VAS)*

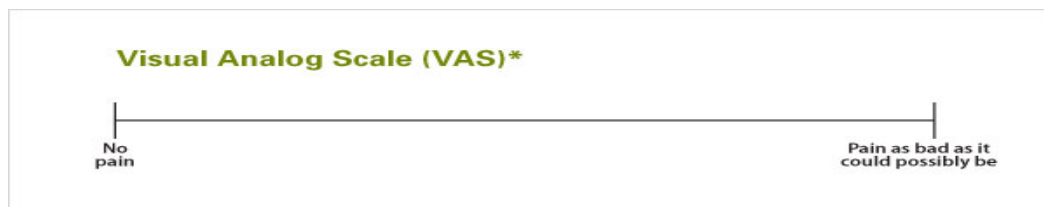No pain   Pain as bad as it could possibly be

FIGURE 3. Visual analog scale 2012.

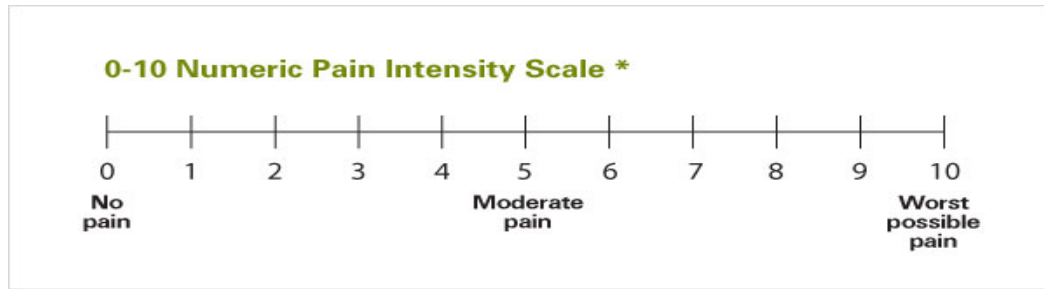(adapted from Management of patient with a minor burn injury 2012)

FIGURE 4. Numeric pain scale 2012.

(adapted from Management of patient with a minor burn injury 2012)

3.2 Pain after surgery

After surgery one of the main priorities in the postoperative care is to relieve the patient from pain when awakening from anesthesia. It is obvious that the surgical incision done during the surgery and anesthesia causes patient to feel pain, discomfort and restlessness (Petter 2007.) When pain is adequately managed, it also help patients to breathe properly and start ambulation as soon as possible. Acute pain begins from mild and develop into severe phase if pain is not managed well. The acute pain is easier to identify and nursing professionals are more willing to treat acute pain in comparison to chronic pain. After surgery, pain affects the patient overall recovery because uncontrolled pain, minimizes the self-care and early mobilization. Pain alone does not only give discomfort to the patient, but also it gives physical and psychological complications such as patient is exhausted, emotionally impaired, not able to receive enough rest, slow wound healing etc. (Petter 2007.)

On other hand neuropathic pain also appears when nerves get injured in the surgery, health care providers should look for any signs which associated with neuropathic pain such as dysaesthesia (abnormal sensation or no sensation, caused by injuring a peripheral or sensory nerve), allodynia (pain caused by stimulus), hyperalgesia (high sensitivity to pain) and provide effective treatment to relieve such symptoms. (Tomas 2009.) According to Pamela (2007), Acute Pain Management A practical Guide describes that among all the surgical patients 50% of them experiencing severe pain after surgical

procedures and 10% of patients experiencing moderate to severe pain the time of discharging, managing pain adequately and therefore being a main task after surgery. Thus, health care providers introduce new techniques and treatments to provide effective pain care to the surgical patients, patient controlled analgesia method, and intermittent intramuscular analgesia have been a few of good examples. (Pamela 2007.)

Unrelieved acute pain also contributes to gives respiratory complications, especially in elderly patients as well as patients who have a history of smoking. When pain is exist and minimizes the ability of coughing and deep breathing. It can result in lungs dysfunctions, hypoxia, pneumonia and infection. Pain also slow the normal gastrointestinal functions and increases duration of venous fluid. As a result of pain patient may get high blood pressure, tachycardia. When the sympathetic activity is overacting and high workload on the heart and increases the oxygen intake later may develop into heart failure. Pain causes the body to produce high catecholamine and other stress associated hormones in the blood, these hormones modulate immune responses which effects on healing as well as increases of infection risk. (Parsons 2010.) In addition, treating pain is not only providing satisfaction and good comfort to the patient after knee surgery, but also it ensures the early mobilization and reduces complications that might confront after surgery (Pamela 2007).

Moreover, some previous studies have proven that cultural beliefs and personal indication of pain intensity also influences when expressing their pain, therefore those other factors also should be considered instead of only basing on those numerical data because in some cultures As nursing diagnosis and intervention give a map to the surgical team to create an appropriate therapy to the patient, so nurses do important work in the pain assessment. (Petter 2007.)

In some cultures the acceptance of pain defines as a faith and leads to person own spiritual development, so the nurses should have general understanding of other culture in order to make good intervention in managing pain (Dimension of Culture 2011). The goal

of pain management vary from patient to patient, the goal is not always expecting pain score to be 1 but if a patient can function and satisfied with pain score 3, that would be the goal for that patient. (Ramsay 2000.)

3.3 Other factors influencing pain after surgery

Hematoma

Hematoma can occur in every patient and rather common after surgery, but if hematoma causes excessive pressure in the tissue, then it causes pain to the patient. If the hematoma causes significant pain to the patient then the physician would make an incision in the area where seen a hemorrhage and let the blood leaks out and then health care providers monitor patients incision area. (Greengard 2015;Juutilainen 2009; Meani 2007.)

Infections

In order to ensure patient safety, antimicrobial treatment is always being used, however as the patient is left with a foreign object in the body, an infection risk is unavoidable. In most cases, antibiotics are prescribed before and after the surgery to avoid infections. The treatments are always depending on the type of infection, the location and the pathogens, where in some cases a bacterial culture test is checked. (Greengard 2015;Juutilainen 2009; Meani 2007.)

The antibiotic treatments are continued until the infection is cleared, in order to check whether the patient is resistance or whether the patient is receiving an appropriate antibiotic therapy. The patient's C - reactive protein level (tells if inflammation is present) should be monitored in this context. In most skin infections, staphylococcus, clindamycin (Cleocin), Cotrimoxazole antibiotics are good starting points for treating skin infections. (Greengard 2015; Juutilainen 2009.)

Studies show that patients with rheumatoid arthritis and diabetes are a high risk group of developing infections after surgery. However, if a patient have an infection other part of the body, such as in the mouth, kidneys or prostate, it may lead to develop infections. Therefore, it is very important to review patient medical history in advance to the surgery, if they are entitled to have any infections then it should be treated before the surgery. (Greengard 2015; Juutilainen 2009.)

4 Pain management methods

4.1 Counselling and education

Counseling and patient education is an essential part of candidates who undergo total knee replacement surgery. Complication that occur during the surgery can be minimized by advising and preparing patients in advance to the surgery. According to Jones (2012) offering education about the surgery and how pain is managed, what complication may occurred before the surgery proves to shorten the hospital stay after the surgery which aids patients to recover within a short period. The fear of pain also causes anxiety and distress to the patient therefore nurse explains to the patient about pain care pathway and the cause of pain which may help to prepare their mind to face for the pain. (Jones 2012.)

Nurses' main responsibility is to listen to the patient and provide comfort without being ambiguous. The patient expresses pain differently according to the level of tolerance depending on its chronicity, suddenness, meaning of severity, the loss of hope that it generates, the culture of the person or the previous experience. (Dagorne 2012; Jones 2012.)

The nurses advise preoperatively on many main topic, including mobilization and managing pain after surgery and after discharge. Two to three months usually before the surgery, an exercise program guide will be available for the patient for the postoperative

period. After two or three days patients usually goes home after discharge, however, the duration can be longer. Moreover, if many obstacles exist at home, a temporary home would be needed. The need of four to six weeks off work is needed depending on the type of work. Some position and exercise are limited, like kneeling or running a high impact sport in order to prevent from occurring pain and complications. Nurses make sure that the patient have enough knowledge of the usage of medication at home and moreover the patient are advised to not take certain pain medication while driving. (Sietsema 2009.)

4.2 Pharmacological methods

NSAID

The non-steroidal inflammatory drugs prescribed for acute pain phase, are mostly used in anti-inflammatory diseases, after surgery using these drugs help to reduce the inflammation and swelling. NSAIDs (Non-steroidal anti-inflammatory drugs) can be given by p.o, i.m and iv. The types of NSAIDs include ketoprofen, ibuprofen, naproxen etc. In some cases, NSAIDS are combined with opioids to enhance a better effectiveness and recommended following postoperative day one. The daily dosage of NSAIDS is 600mg x 3. However, in giving these drugs nurses should monitor patients who are undergoing through asthma or renal failures, in that case paracetamol is safer with patients who have asthma or renal failure. (Salmivaara 2013.) Nurses should monitor possible side effects such as headache, dizziness, nausea, vomiting, and gastric ulcer. NSAIDs is not given to the patient who have hypersensitivity to these drugs. To add more, renal failure and bronchospasm may develop after using NSAIDs, therefore, long term usage should be restricted and renal function should be checked during the treatment. While using these drugs, nurses should monitor patients, cardiovascular functions, renal functions, allergies as well as any signs of bronchospasm. (Priff 2005.)

Opioids

Opioids medication works by reacting with u-types receptors and directly acting on the spinal and peripheral nerve system. These medications either block the pain transmission in the spinal cord by stimulating or blocking the pain signals. Opioids are given p.o, i.m and i.v. Opioids are mostly used in managing of short term pain for example after surgery. The potentiality of the opioids are being divided (Table 1) into three categories as follows. (Galbraith 2004; Mustajoki 2013.)

TABLE 1. Opioids

OPIODS STRENGHS	DRUGS NAMES
STRONG	Oxycodone, Morphine, Fentanyl, Pethidine
MODERATE	Buprenorphine
WEAK	Codein (Combined with other drugs), Tramadol

Though opioids gives good results in managing the post-operative pain, it also gives some adverse side effects. These side effects include: respiratory dysfunctions so the respiratory rate can be dropped significantly. After taking opioids patients may feel drowsiness and tiredness. One third of patients who are receiving opioids medication has complained vomiting and nausea. Long term usage of opioids can cause constipation and addiction together with tolerance difficulties. In some patients who are undergoing with moderate to severe pain, mostly opioids are given combined with paracetamol to get effective results. (Galbraith 2004; Mustajoki 2013.) In the treatment of opioids nurses should observe patient cardiovascular functions and respiratory functions as well as pain level. Indeed, pain scores should be evaluated before and after administering the medication to check whether the opioids helping patient to relieve pain. Nurses also make sure that patient get pain medication before pain become into severe phase. (Priff 2005.)

Patient controlled analgesia (PCA)

In the management of pain (PCA) patient controlled analgesia is also used. Especially, in patients who are orientated and able to use it by her/himself according to the instructions. However, people who are drug addicted, overweight, having a kidney or liver failure or chronic obstructive pulmonary disease (COPD) not always recommended to use PCA device. During the usage of PCA device patient pain level should be monitored by nurses. Apart from that the breath rate, signs of vomiting, any reactions, blood pressure and pulse changes should be checked. The PCA device gives medication both intravenously and subcutaneously at a constant speed, through this device patient also can receive pain shots as they need by pushing a button. The program is set together with nurses to avoid getting excessive amount of medication. (Mustajoki 2013; Nurminen 2012.) Patient controlled analgesia is a safe method to relieve pain but it should be used with nursing observation to get effective results. Most importantly, nurses should inform the patients about possible side effects so that the patient is aware about it and may not panic. (Pamela 2007.)

4.3 Non Pharmacological methods

Non-pharmacological methods are divided into two categories, the physical and cognitive-behavioral approaches. Among physical approaches there are the transcutaneous electrical nerve stimulation (TENS), the use of hot and cold, massages and moderate exercises. While the cognitive-behavioral approaches include elements that can change perceptions of pain and improve the strategies of coping, such as relaxation, music therapy, distraction, guided mental imagery, hypnosis and Biofeedback (Briggs 2002; Horgas 2003.)

Transcutaneous electrical nerve stimulation

The transcutaneous electrical nerve stimulation (TENS) is a physical method based on the gate theory in order to relieve pain. It acts on the wanted site by emitting electrical stimulation frequency and variable amplitudes promotes a reduction in nociceptive

perception. Indeed, this method reduces the threshold and perception of pain feelings. The physiological mechanisms of TENS is not yet clear. (Breit 2004.)

In their study, Breit and Wall (2004) evaluated the usefulness of TENS in relieving postoperative pain after total knee replacement. The results they have obtained, have not suggested any significant benefit of the TENS among the tested populations. However, many other studies have found positive results in patients who received repeated and regular episodes of TENS after Total knee replacement. Indeed it significantly decreased pain sensations, increased knee flexion and reduced hospital stay. (Breit 2004.)

Guided imagery

Guided imagery is often used to treat chronic pain patients. This method requires the patient to concentrate on visual images, sounds, music and words. These materials are used in order to create empowerment and relaxation. It was demonstrated to be an effective therapy due to a rise in endorphins rate. It is a safe adjuvant method that allow reduce of pain, anxiety and drug use. Unfortunately, the main reasons associated with its under-utilization are lack of knowledge and discomfort experienced by health professionals. (Antall 2004.)

Cold treatment

Generally, ice packed therapies are used to minimize swelling, bleeding and inflammation after surgery. Studies claim that it is a safe and easy method. Moreover, abnormal bleeding and swelling cause pressure and pain after knee surgery, therefore, minimizing it aids to relieve pain. Ice packs are applied on the pain area 20-30 minutes depending on the severity of pain. (Halperm 2003.)

5 Study purpose, aims and research questions

The aim of the thesis is to describe various postoperative pain management methods and nursing role in the care of total knee replacement patients. The purpose of the thesis is to offer research findings to increase nursing knowledge which may aids to improve successful pain management care

<u>Research questions</u>

What are the methods used to relieve post-operative pain in total knee replacement patients?

What is the nursing role in relieving post-operative pain in total knee replacement patients?

6 Methodology and implementation

6.1 Literature review

A research literature review is a critical analysis which is based on relevant research and non-research. It is a clear and reproducible method of recognizing, analyzing and synthesizing the scientific researches and studies conducted by other researchers, scholars or practitioners. Literature review provides a general overview of what has been achieved, what has been discovered, what theories and hypotheses exist, what system of methods have already been laid down and their utility. (Fink 2005; Ramdhani 2014.)

A research literature review include seven tasks. The first task is to select the research questions which will guide the whole review. The second task is the selection of articles database, books, web sites and other sources to help answering the research questions.

The third task is the selection of words and concepts in a logical order to get the right sources that will answer the research question. The fourth task is the screening criteria which consist of determining inclusion and exclusion criteria to retrieve the most relevant articles. The fifth task is to apply the criteria. The sixth task is to check if the data is valid and reliable. Finally, the seventh task is the synthetization of the results, meaning that the review´s findings are described and summarized. (Fink 2005, 5.)

6.2 Literature search

Literature search find answers to specific research questions by briefing evidence based articles and studies that has been already done before. To avoid any bias, this study provided a see through support by adding inclusion and exclusion criteria (Table 2). Thus the criteria helps researcher to find more reliable findings and later based on those findings it also helps researcher to make reliable conclusions. (Boland 2014; Webb 2008.)

The aim of the literature search may be to review the existing critical theories, to identify the current research finding and methods on a specific topic and to be able to compare the studies (Liverpool Hope University 2012). In doing a literature search, there are a few elements that should be considered that include good research questions that are clear and explained well. Indeed a relevant methodology describes what should be included in the research, carrying out a proper search concerning those eligible criteria and then synthesizing the findings concerning validity and reliability. (The University of British Columbia 2015.)

In general, the literature review is tracing the knowledge on the field by gathering the relevant sources, evaluating it and emphasizing the relevant information for the future (Literature Reviews 2014). After the articles are chosen, they will be represented and explained (See Appendix 1). The table below will show the inclusion and exclusion criteria (Bettany-Saltikov 2012).

TABLE 2. Inclusion and Exclusion criteria

INCLUSION	EXCLUSION
Articles only in English	Different languages
Articles published 2008-2015. The order of research from most recent years to 2008	Different dates
Articles with full text	Not full text
Articles about pain management in the postoperative process of total knee replacement	No articles about pain management in the postoperative process of total knee replacement
Articles that answer our research question (pain)	Articles what have not focused on pain relief and management
Only evidence based articles and from trusted academic journals	Non evidence based articles
When searching "All my search terms"	Terms not related to the topic

In this thesis the data was collected from articles, journals and obtained by conducting a search on the school database. The aim is to find relevant articles that research the various postoperative pain management methods and nursing role in the care of pain of total knee replacement patients. The collected data is screened, extracted and analyzed from database such as EBSCO, CINALH and PubMed. The total number of articles selected from the databases were 12 (Table 3.) During the first search the key words used were "Knee replacement" or "Arthroplasty of knee" plus "AND" plus "Pain management methods". Furthermore, during the second search the key words used were "Knee replacement" or "Arthroplasty of knee" plus "AND" plus "Nursing pain management". Finally during the third search the key words used were "Knee replacement" or "Arthroplasty of knee" plus "AND" plus "Post-operative pain". Once the articles were found following the search, the articles' title and abstract were examined carefully and

only the ones responding to the research questions were kept and then the inclusion criteria helped exclude the rest.

TABLE 3. Collection of articles

Stages of search	Implementation	Number of articles	Databases from
Stage 1	Identifying the relevant articles through databases by using word "Knee replacement / Arthroplasty", "pain management methods" and "Nursing pain management"	159	EBSCO PUBMED
Stage 2	Scrutinizing articles related to the thesis purpose statement and research question by reading the title and abstract	87	
Stage 3	Applying all inclusion and exclusion	33	CINALH
Stage 4	Choosing the most relevant articles	12	

6.3 Data analysis

The content analysis method is applied to analysis qualitative data and it provides systematic approach. It can be consist of visual information, written information and verbal information. The aim of using the content analysis method is to sum up a large amount of raw data while keeping the connection between research aims and findings. (Thomas 2003.) The outcome of the content analysis is dependent variable which means what researchers are exactly searching for and eventually answering research questions. (Elo 2014; Slack 2006.) Content analysis can be either inductive or deductive. In this research selected 12 articles were examined based on the inductive content analysis method.

The inductive content approach is a systematic way of analyzing data which is conducted by particular aims and objectives. The inductive content analysis method includes three sections which are preparing, organizing and reporting. In the preparatory stage,

researcher reads transcripts and through articles deeply several times and get the main idea of the article and emerge themes. In, the organizing stage, form subcategories different ideas selected by comparing and briefing every article. In the reporting phases based on these subcategories, create main categories by organizing similar subcategories together, which answer research questions of the subject area. (Thomas 2003.)

The contents analyzing method is basically used in nursing studies especially in gerontology, mental health and public health related studies. Content analyzing method allows researcher to brief most important factors of certain studies by forming categories through word distillation. The inductive content analysis carried out concerning coding, categorizing abstracting of the data. In the step of coding studies are read several times and mark the main headings and underline important studies, it can be either certain words or phrases. Then in the next step those coding are arranged into high categories putting similar categories together. The main target of creating categories is to provide clear description which helps to give a clear knowledge of the study. (Elo 2007.)

Considering the inductive content analysis method all previously chosen articles were read several times until the researcher gains primary understanding of the articles while writing down key notes and only gathered up information that is relevant and suitable to the study topic and other irrelevant data was deducted. In the inductive analysis, coding is done by reading texts carefully and considering different ideas that are integral in the text. (Thomas 2003.)

The process of data analysis of the chosen articles consisted of firstly, writing down the text which is answering the research question; secondly color coding the words or sentences which have similar ideas or meaning plus putting them in different columns of a table and finally, when all different ideas are found then all the subcategories are ready. (Thomas 2003.) The following (Table 4) explains the process step by step.

TABLE 4. Analyzing step by steps

Step 1	The chosen articles are analyzed: by reading the articles many times and writing down the main ideas and making sure that it answers the research question.
Step 2	Creating subcategories: by putting in different colors the various ideas selected and then forming subcategories.
Step 3	Creating main categories: by choosing to put some subcategories in either the pharmacological or non-pharmacological categories.
Step 4	The results: finally the formation of the two categories ensure that the research question is answered. (David 2003; Elo 2007)

After analyzing all the articles, the relevant information were formed into subcategories and texts relevant to those subcategories are put together and similar ideas were marked in color which avoided the repetition of similar theories Generally, in the most content analysis shows more than three categories and inductive method gives efficient and easy structure to analysis data. (Thomas, 2003.) As shown in the (Figure 5) subcategories were organized by using a diagram, and three main categories were formed. The data analysis focused on three main themes, so called the main categories, which is pharmacological and non-pharmacological methods for post-operative pain together with the nursing role in the management of post-operative pain which answer the research questions.
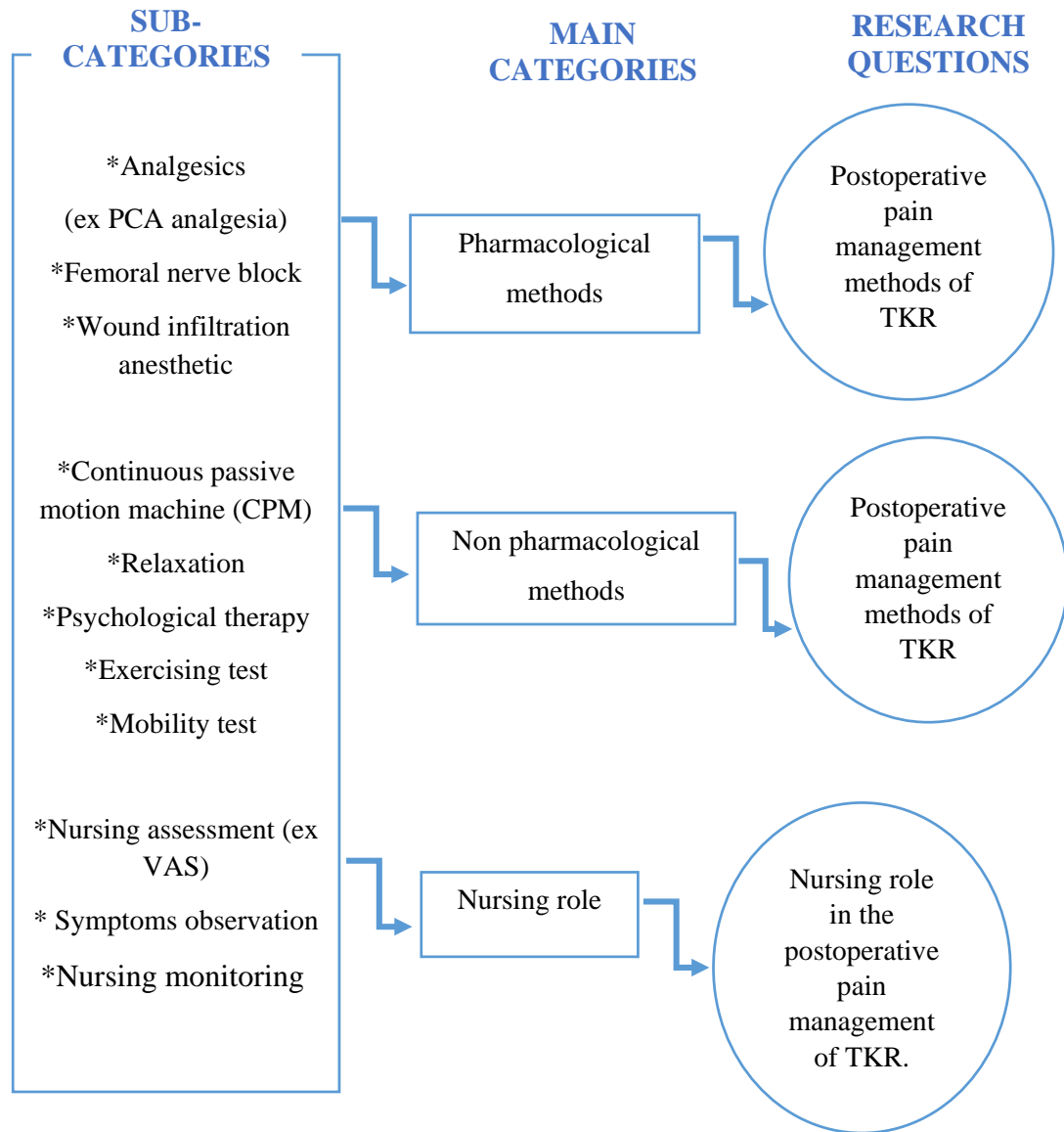
SUB-CATEGORIES **MAIN CATEGORIES** **RESEARCH QUESTIONS**

*Analgesics

(ex PCA analgesia)

*Femoral nerve block

*Wound infiltration anesthetic

Pharmacological methods

Postoperative pain management methods of TKR

*Continuous passive motion machine (CPM)

*Relaxation

*Psychological therapy

*Exercising test

*Mobility test

Non pharmacological methods

Postoperative pain management methods of TKR

*Nursing assessment (ex VAS)

* Symptoms observation

*Nursing monitoring

Nursing role

Nursing role in the postoperative pain management of TKR.

FIGURE 5. Results of the literature search

6.4 Results

Pharmacological methods

According to McCartney´s research (2014) the use of acetaminophen combined with a short course of NSAIDs. Careful titration of opioid analgesics can also be helpful, as can

other adjuvants such as the antidepressants or antiepileptic medications used especially for patients with neuropathic pain. Topical agents may provide benefit and are associated with fewer systemic side effects than oral administration. (McCartney 2014.)

Mac Cartney´s article (2014) introduces the multimodal pain management method to treat post-operative pain in elder TKA patients. Furthermore the article describes that administrating analgesics before the surgery has minimized the post- operative pain and use of analgesics after surgery, it also indicates that in managing post-operative pain controlling pain before surgery is not enough but also managing opioids related side effects are important thus gabapentin and regional anesthesia has contributed to minimize side effects associated with opioid usage. (McCartney 2014.)

Furthermore, epidural and spinal anesthesia also helped to reduce perioperative morbidity and mortality especially in elderly people who are already entitle to have serious risk factors. Instead of administrating a single drug with higher dosages giving multiple drugs increase the effectiveness of the drug treatment for ex: neuraxial and peripheral anesthesia also reduces the opioid related side effects. On the other hand ketamin also has proven to manage acute pain after total knee replacement surgery, especially ketamine is given to the patients who are opioid-tolerant and when other drug are failing to give desired results. (McCartney 2014.)

Furthermore, this study indicates that opioids drugs are safer to use as a short term treatment with older TKA patients, but yet no guarantee whether it is safer to use as a long term treatment. Commonly given opioids include morphine, oxycodone and hydromorphone and daily dose is two or three times in the day and small dosage is safe and effective with elderly patients. More common side effects of opioids include nausea, sedative feeling, vomiting, tolerance and constipation, these side effects occur in the beginning of the treatment and constipation is treated with laxatives. Acetaminophen is usually given to the patients who have liver diseases and effective dosage is 4g per day, Acetaminophen is also given combined with NSAIDs. (McCartney 2014.)

NSAIDs used as a short-term treatment, mostly used in musculoskeletal pain. However, NSAIDs can cause toxicity and gastrointestinal side effects and therefore mostly combined with Omaprazole drugs which reduces those side effects. Apart from that patients who entitle to have risk factors such as hypertension, hyperlipidemia, smoking, and diabetes as well as cerebrovascular and ischemic heart diseases, these drugs should be used with a caution. (McCartney 2014.)

In order to treat neuropathic pain TCAs and anticonvulsant is given, as TCAs amitriptyline and nortriptyline proven to reduce pain by 25%. The TCA drugs also cause some side effects such as sedation, dry mouth, however, nortriptyline causes less side effects compared to amitriptyl and safer to use in elderly TKA patients. As anticonvulsant drugs gabapentin is mostly used drugs, but yet sedation and dizziness inevitable side effects when using these drugs in higher dosage, not only that bus also renal functions should be monitored during the treatment. Topical NSAIDs is proven to treat pain related to osteoarthritis, but the success of the results has not been evaluated. (McCartney 2014.)

In Chan article (2014) describes that femoral nerve block gives better results and less side effects compared to patient controlled analgesics (PCA). Furthermore effectiveness of analgesia is greater continuous use of femoral block rather than giving only one dose. In comparison to PCA (patient controlled analgesics) any kind of femoral block lessens the pain during activities and at rest. On the other hand patient who uses femoral blocks uses less analgesics. (Chan 2014.)

Fetherston´s article (2011) studies contributes to improve postoperative pain management to another level by introducing the use of femoral nerve catheter (FNC) and benefits of it. Significantly, patients who use FNC receives less narcotics, drugs in the postoperative period and with small dosage of fentanyl give better results, however, it does not influence on the score but the pain level shows high in patients who use only PCA. This study also reveals that gender also effects on assessing functioning ability after the surgery; the women who undergo for a knee surgery wait till the knee is considerably damaged while men undergo for a surgery before the disease get into serious stage. As a

consequence of that patient gets high pain scores and decrease disability after the surgery. (Fetherston 2011.)

Therefore, it is important that patients receive painkillers on time so that, it is effective and direct patient to knee surgery before the knee is highly deteriorated (Fetherston 2011). According to the Yu-Min article (2008), administrating celecoxib before the operation in combination of opioids seems to decrease pain at rest postoperatively and reduce intake of morphine, as well as there is no any bleeding risk has shown during the surgery. In general, NSAIDs have proven to lessen the morphine usage between 30-50%. Particularly in this study, it shows 40% which indicates that the effect of it certain. (Yu-Min 2008) In Wylde´s article (2011), the use of local anesthetic wound infiltration is another techniques that has proven to minimize the postoperative pain scores up 12 months.

Non-pharmacological methods

McCartney´s (2014) study indicates that when the acute pain is not adequately managed it leads to chronic pain which is then required advanced methods to treat. To treat chronic pain different psychological techniques are used because patient who undergo depression more prone to get into chronic pain stage, evidences suggest that treating depression also decrease pain. Apart from that cognitive behavioral therapy (CBT), practice of meditation, biofeedback techniques a few of non-pharmacological method that are used to give good outcomes. In the treatment of chronic pain acupuncture, massage, transcutaneous electrical nerve stimulation therapeutic treatments have been beneficial. (McCartney 2014.) Patient education is also a fundamental factor to consider which prepares patients before the surgery so that they are aware what would occur during and after the surgery. Chen´s (2013) study results explain that patients who receive education before the surgery had shown low pain scores and prior intervention, booklet and other sources that were given was increased functional ability and muscle strength of the knee. (Chen 2013.)

The biofeedback is a monitoring tool which used to control compelled activities that occurred in the body frequently such as pulse rate, temperature, blood circulation, muscle pressure. The researcher Wang (2014) indicates that the biofeedback treatment reduces pain by making patient relaxed and relieving stress related symptoms as well as it decreases usage of analgesia. Compared to other treatments this study emphasizes that biofeedback is an unharmed method to use while using CPM continuous passive motion therapy because CPM alone causes pain thus biofeedback treatment helping by relieving pain. Moreover, the researcher suggests that biofeedback therapy should apply together with CPM as a pain treatment after the knee operation. (Wang 2014.)

As stated in the Liu (2012) that adolescents and females have identified as a risk group of getting acute pain instantly after the surgery, particularly patients who undergo through total knee arthroplasty. In addition, home opioid usage and depression is highly risky to suffer from severe pain. Likewise Liu´s (2012) claims that some related studies had represented that 53% of patients have suffered from chronic pain a year after total knee surgery, the intensity of acute pain has a significant influence in developing into chronic pain. Additionally, in managing pain patient satisfaction and comfortability is a priority, to achieve that working co-operatively with patients and organizing enough nursing staff are essential factors. Importantly, opioid consumption and opioid related symptoms seem to reduce by administering regional and multimodal analgesia techniques. Multimodal techniques usually are used to limit opioid usage and analgesics induced side effects. (Girish 2015.) Thus, non-steroid anti-inflammatory drugs NSAIDS, gabapentinoids, ketamine seems to reduce intake of opioid especially in patients who are high risk of getting analgesia (Liu 2012).

Bandholm (2014) describes how the strength training affects pain. Pain remains low when a patient at rest and during daily basic activities but the pain seem to increase as the quantity of weight put on the knee during strength training and during contraction activities. Moreover, research indicates that knee contractions are implemented, many times so the repetition of contraction activity may have caused extra pain to the knee, but

loads activity has failed completely therefore the results of the studies are difficult to apply to the clinical settings. (Bandholm 2014.)

Holm (2010) provides information that fast track recovery shows successful results in restoring mobilization after surgery, 90% of the patients who participate in the study, improve their mobility within 3 days and pain level does not increase. Most importantly, most of the patients able to move independently in the following day after surgery and the pain score remain moderate. As the patients are able to move themselves independently, patients start physiotherapy treatments earlier and as a result of that recovering time is shorter. (Holm 2010.)

Nursing role

In Walker's article, (2012) it is observable that nurses have this very important responsibility of regularly doing pain assessment and documenting it. In the pharmacological approach it is very common to see that patient-controlled analgesia or epidural opiates are used for the first 24–48 hours to relieve the post-operative pain and nurses monitor it. Furthermore, patients coming back from the operating room and until discharge receive a stepdown approach of paracetamol plus conventional nonsteroidal anti-inflammatory drugs and strong or weak opioids as required. (Lucas 2008.)

Moreover, nurses are responsible for monitoring patient controlled analgesia meaning that they check if it is the right medicine, the medication administration run well, the dose administration is correct, the number of doses required are noted, checking the effects of the analgesia if it is an effective pain relief or not and finally checking how it affect the patient's level of consciousness, too sedated and unresponsive or alert and orientated. The nurse do the same for epidurals and blocks use. (Walker 2012.) It is very important as well that nurses are aware of the benefits and side-effects of the different types of analgesia used and strive to avoid misconceptions, for instances the patients undergoing an acute pain postoperatively are of higher risk of opioid dependency (Lucas 2008).

According to Walker, (2012) effective pain relief help the patients to mobilize earlier and with greater ease. Furthermore, in Lucas´ s article (2008), the nurses have to be encouraging the patients in performing exercises daily for recovery. Nurses are also responsible for explaining and ensuring that the patients understand first that the rehabilitation time can take months and second that some short-term restrictions on activity are needed for reaching a good rehabilitation state. In some cases drains are inserted close to the patients' wound incision to prevent hematoma formation and pain, so nurses have to monitor its effectiveness. (Lucas 2008.)

Due to an effective pain relief, the post-operative complications risks, such as respiratory infection and deep vein thrombosis, are reduced. However, if the pain is not be in control and prolonged, there would be higher complications risks, morbidity rates, greater healthcare expenses and length of hospital stay. (Walker 2012.) Talking about infections, the nurses have this important mission to detect early and late infection, which can be seen with physical signs for instances as redness, swelling, and pain. Indeed if an infection takes place and cannot be removed then the patient could reach the point of losing its prosthesis meaning that the patient would need to go through a revision implant replacement, when the infection is gone, and would cause extra pain and not wanted. (Lucas 2008.)

In McCartney´s (2014) research, it is visible that patients, undergoing an arthroplasty of the knee, have preoperative anxiety and have then an important opioid drug use and those having preoperative depression have an important non-steroidal inflammatory drug use, helping the nurses to be aware of that phenomena and anticipate it as an important target care. (McCartney 2014.)

The Visual Analog Scale (VAS from no pain 0 to 10 extremely painful) is described and very useful in all the research collected because it regularly gives and update knowledge of the pain sensitivity at different and significant time or hospitalization stage. The VAS test can be used for instances after standing up, walking distance, stair climbing,

continuous passive motion machine with different loads, knee extension test, at rest, before or after a drugs intake or non-pharmacological treatments, and after the discharge. The results helped to know how the pain evolve and if the treatments are helpful to decrease, control or not the pain. In this situation the nurses communicate the pain scores to one another, to the doctor or other health professionals involved in the treatment. (Bandholm 2014; Chan 2014; Chen 2013; Holm 2010; Huang 2008; Liu 2012.)

According the articles, nurses are challenged by the actual and/or potential problems due to many factors possible such as for instances the operation itself, comorbidities influences, or the discharge arrangements. Indeed nurses have to learn well how is the operation done, how to screen and assess preoperatively so that the current and future possible problems are already identified and how to anticipate the possible upcoming complications. (Walker 2012.)

7 Discussion

7.1 Discussion of the results

To begin with total knee replacement surgery is recommended to the patients when pain become troublesome due to osteoarthritis, arthritis or rheumatoid arthritis. The main target of TKA surgery is to relieve pain and restore mobilization. Obviously TKR is a painful procedure and managing pain adequately in the postoperative stage seem to improve pain score. According to Parker (2011) 500,000 knee replacements are carried out by year 2006 and these numbers are increasing rapidly. Furthermore, Parker (2011) describes that 1.5 million of surgeries are estimated to be done in 2015. As the number increase nurses have more chances of treating post-operative pain, therefore nurses' needs adequate evidence based knowledge and information to perform a good pain management care for TKA patients. Having enough knowledge and techniques to perform strong pain assessment, better understanding about multimodal pain care method and its advantages will improve nursing care of managing pain.

There are several treatments methods available to give a good pain management care to the patients that include pharmacological and non-pharmacological. However, those methods are not sufficient if nurses are not involved, nurses hold a tremendous responsibility in the treatment of pain. The aim of the thesis is to describe various postoperative pain management methods and nursing role in the care of total knee replacement patients.

To establish that researcher answered to two research questions, they were "what are the methods used to relieve postoperative pain in total knee replacement patients and what is nursing role in relieving pain in total knee replacement patients" based on literature review method. Thus this study concluded the information that was collected from 12 articles. The aim of this study was well achieved and all the research questions were covered coherently, this study brings also information about what are pain management methods used all around the world and what nurses' responsibility behind this and what they do. The purposes of the thesis is to offer research findings to increase nursing knowledge which may aids to improve successful pain management care.

In the data collection, it was surprising to see that not many of articles were written about nursing methods and their role, most articles were discussing about pharmacological methods and both combination of pharmacological and non-pharmacological method. Among article that were selected, five of the articles were written about pharmacological methods and five of the articles were discussing about both pharmacological and non-pharmacological methods and two of them were written only about nursing role to some extent.

The postoperative pain management is a process which is also associated with preoperative care and it is also necessary to plan how to manage the pain before going to the surgery. In the pharmacological treatment multiple drugs are used depending on the patients' needs and adequacy. The preemptive analgesia approach seems a better option to start pain management routine. The meaning of preemptive analgesia is administration

of pain medications early enough in certain cases even before the surgery, it claims to reduce post-operative pain and hospital days. (Parker 2011.) As preemptive drugs NSAIDs, opioids, peripheral nerve block, and general anesthesia are used, however, pre-emptive drugs should be given in oral form approximately an hour before the surgery (Korean Knee Society 2012).

The NSAIDs drug group has indicated as a safe drug group, it can be applied in every patients, which not only relieve pain, but also reduce inflammation by directing acting on the wound. Most importantly, it does not give opioid like effect. However NSAIDs should be administered early enough to get effective results for ex: before patients waking up after the operation, as well as these drugs are more effective combined with other drugs such as opioids. However, NSAIDs has a risk of getting gastrointestinal complications. (McCartney 2014.) Nurses should also be aware of the side effects of medications and how to treat them. Nonetheless, depending on one drug is not sufficient, the treatment should focus on multiple drugs because treating drug related side effects also part of post-operative pain management.

On the other hand opioids, drugs offer a long effect, however, opioids should be given with a special care because its side effects, tolerance and complications. The dose of opioids should be begun with a small amount and it is safer if it is used as a short action. Neuropathic pain also seems to be a problem in TKA patients yet there are not special indications in the studies that what patients have a high risk of getting neuropathic pain or any claims that every patient experience neuropathic pain. However, TCA drugs relieve neuropathic pain by 25%. Though these drugs give certain side effects safer to apply with elderly patients. (McCartney 2014.) Gabapentin also another drug which is recommended before and after surgery, gabapentin reduces analgesia usage if it is given prior to the surgery as well as patients sensitiveness to the pain however it successfulness yet to be proven with more studies (Mishra 2013).

Acute pain is obvious in vast majority of patients who undergo through TKA thus it is important to treat acute pain before it develops into the chronic stage because chronic pain is challenging to treat and it also prolongs the patient recovery process. (McCartney

2014). Femoral nerve block also another method which gives greater results than PCA (Fetherston 2011). but it should use continuously and nurses should observe patient's condition and any changes because it is associated with side effects such as weakening of front thigh muscles, this may results in falling. (Korean Knee Society 2012). Especially analgesia should be given before waking up from the surgery, when patients are on activities such as walking and practicing to mobilize after surgery and when patients is sleeping in order to get an effective relief from analgesia (Parker 2011).

PCA based analgesia indicated as a secure method to control pain. The most important things about PCA is that it gives an authority to the patients to control their own pain level with the help of nurses. The PCA machine makes even safer, according to how it is made, patients will not be overdosed because the machine does not allow to get extra medicine even if they desired to get. Patients can always request pain medications and care when they need and nurses work actively to fulfill their needs, but sometimes it is possible that nurses are not able to provide medication as quickly as they need due to preparation delays and less nursing staff. (Chang 2013.)

It was interesting to find out non-pharmacological method that is used to treat postoperative pain and the effectiveness of it because non-pharmacological approach is often considered safer compared to medication. Non-pharmacological methods such as cold therapy, relaxation, and music reported to supply a good contribution in managing pain, these are cost free method that nurses are able to offer to improve patient comfort which eventually contributes to reduce pain. (Parker 2011.)

Pharmacological methods are targeted to treat patient's somatic and visceral pain and non-pharmacological methods are focused to treat pain considering patients cognitive functions, emotional conditions, behaviors and social cultural background. Thus, non-pharmacology treatments offer several benefits to the patients such as aid to minimize stress level and anxiety, lessen the intake of painkillers by reducing amount of side effects, increase functional ability, and enhance patient ability of controlling their emotional feelings while increasing their own strengths to control the pain. Furthermore,

pharmacological treatments can be both invasive and non-invasive. Biofeedback, meditation, transcutaneous nerve stimulation, music, cold methods are few examples for non-invasive treatments. (Demir 2012.)

The non-pharmacological treatments described in five articles. According to those findings, in combination of treatment is more required rather than using one method. The study, which is carried out in Taiwan claimed that biofeedback therapy treating pain through relaxation in total knee replacement patients without giving any side effects. (Wang 2014.) Apart from that cold therapy, cognitive behavioral therapy, relaxation, meditation, transcutaneous electrical nerve stimulation, continuous passive motion therapy, acupuncture, massage also contributes to relieve pain, to some extent, nevertheless not commonly used and many studies have not claimed the effect of them. (McCartney 2014.)

The acupuncture method is derived from Chinese traditional medicine, it is an invasive procedure performed using needles and targets to induce body to use own natural painkillers. Thus, the number of needles are replaced on the surface of skin in certain acupuncture points in the body. Recently, some scientific and clinical trials describe safety and success of treating chronic musculoskeletal disorders using acupuncture yet the sample sizes are not enough to provide efficacy of the treatments. (Kawakita 2014; (Demir 2012.)

Cognitive behavioral therapy is linked with a multimodal approach it is not only aid to manage the pain but also CBT aids to improve patient's self-confidence, this treatment is given by doctors, nurses and other health care providers. To include, cold therapy easily available and safely used method in health care settings to manage the pain. In addition to findings describe about usage of cold therapy for relieving post operative pain after knee replacement. Cold treatment is given by applying ice packs on the painful area, the cold packs should be kept in the area 15-20 minutes to get desired results. Studies claim that applying cold packs in the surgical wound area reduce pain and edema within 24 hours.(Demir 2012.)

On other hand TENS used to treat acute and chronic pain after surgery. TENS deliver low voltage electric stimulation to the skin to relieve pain. This method can be used instead of analgesia which effects on nerve fibers and prevent spreading of pain. As a result of that medication consumption and pain score can be minimized. (Demir 2012.)

Additionally, fast track also widely used method which has proven to give quick outcomes. It decreases hospital days, intake of pain medication by decreasing pain, when the pain is absent the patient is able to move and begin to mobilize (Holm 2010). Fast track method leads to consume less opioids and increase cognitive functional capacity, this fast tract program aims patients to recover within 1-3 days with no pain (Kehlet 2010).

On the other hand patient education is necessary, the education is offered before and after the surgery, not only for the patients also for the patients' families and their guardians. (Korean Knee Society 2012). By providing prior knowledge about what to expect, what complications may occur, how pain is managed, individual risk factors may prepare patients physically and mentally because preventing pain is important than chasing it (Chen 2013). After surgery nurses should educate patients to report when they feel pain, when to request pain medication as well as prior knowledge before discharging about analgesia usages their side effects and interactions with other medications (Parker 2011).

Besides, nurses should be cautious that every patient respond to treatments differently. Another important phenomena is that identifying risk factors before going to the surgery help nurses, other health care providers and patients to create an individual treatment plan. Additionally, patients who receive treatment for depression, previous use of analgesia have somewhat contribution to increase postoperative pain. (Liu 2012.) Even though some of the non-pharmacological treatments are not widely available in every health care setting and in every country, however, some articles describe methods that are already implemented in the health care settings and the results were already approved to

use in clinical settings which means those methods are relevant and effective to relieve pain.

Nursing care is necessary and it helps patients to recover faster while managing the pain adequately, nursing evidence based care is important phenomena which offers patient safety and quick recovery from TKA. (Parker 2011.) Despite the articles selected were relevant to the study, research question concerning the role of nurses in the care of postoperative pain. Some articles could have brought more specific knowledge of good nursing skills or particular pain management method with more information to represent a complete version on the topic, however, such articles were unfortunately not found during the searching process. According the study findings performing an effective pain assessment, planning and monitoring the effects of painkillers and other treatments are included in the nursing care. Depending on the type of analgesics and method used nurses observe its effects and adjust the treatments as necessary. (Walker 2012.)

Nurses strive to upgrade their knowledge of drugs. Indeed nurses should have information about the benefits and side-effects of medications. Indeed, it is good that they know also the different types of methods that can be implemented and the correct techniques of implementing them. Moreover, nurses are in charge of achieving a step down approach of multimodal drugs and monitor its effect. (Lucas 2008.)

Nurses are assessing and documenting pain during the postoperative period, using often the Visual Analog Scale tool, numerical rating scale and verbal descriptor scale (Petter 2007). The assessment of the pain is done according to each patient condition and their pain level, thus pain management plan is done considering patient's instant pain and the degree of pain while engaging in activities and when at rest. (Parker 2011.)

Despite pain scores, nurses should be able to know other signs and symptoms that indicates that the patient is having pain for ex: anxiety, restlessness, high heart rate, pallor, sweating and sleeplessness (Hallouët 2012). According to Walker, (2012) effective

pain relief help the patients to mobilize earlier and with greater ease as well as effective pain reduces complications risks. Nurses need to know how the operation is done and how it impacts the patient on the pain level.(Walker 2012.)

Additionally, some of the patients may concern of using opioids and other painkillers because they doubt of getting addicted as well as anxious about the side effects they may get, nurses should differentiate between body dependence and addiction so that the patients are not suspicious of using painkillers and be anxious with no purpose.
In particular, these findings claim that the combination of treatment together with an effective nursing care and assessment can manage post-operative pain adequately. However, as other areas in the health care, pain management is also improving and new techniques are introduced. This study provides resourceful information that can be used by nursing student, nurses, and other health care providers to increase their knowledge about post-operative pain management.

7.2 Limitations

In the article selection process, 12 articles were selected according to the inclusion and exclusion criteria. The articles were only published in the English language, in an electronic format and only available in full text. Moreover, the articles had to be dated between 2015-2008, be only evidence-based articles and extract from trusted academic journals from CINAHL, PUBMED and EBSCO. Thus, including those inclusion and exclusion criteria contributed to the limitation of this study; for instance, the date criteria limited the access to many other articles that could have been interesting.

In the searching process, by specifying "find all the terms" and searching first only in the year 2015, followed then by the year 2014 back to 2008 may have removed some good articles as well. Moreover, the fact that only 12 articles were analyzed made effective connection of the data difficult, meaning that the results in terms of quality and quantity were not that representative of the reality. (University of Southern California. 2015.) In addition, the lack of relevant articles contributed as well to the limitation of this study by

omitting some of the articles which may have directly answered the research questions of this study. Indeed, some articles were available in the initial search and were not available in the following search anymore, as they had be paid for.

7.3 Ethical considerations

According to the center for bioethics of the University of Minnesota, the researchers should focus with respecting the main principles of ethics to ensure the safeness of the research. Indeed, when conducting a research, the researchers should refer each policies and procedures accordingly to avoid lack of trust of the research. In addition, the Finnish Advisory Board on Research Integrity (TENK) has introduced a full guidelines and policies which aims to guide a researcher to conduct a research with responsibility. (A guide to research ethics 2003; Finnish Advisory Board on Research Integrity 2012.)

The most relevant ethical principles to our research study include: honesty, objectivity, integrity, responsibility of publication, and confidentiality. Honesty consist of reporting truthfully the research process, the used methods and results throughout the study. Objectivity aims to avoid bias in the phase of research, in the design or data collection, in the data analysis process as well as in the publication. Bias is a systematic error which means that a finding deviates from a 'true' finding. (Bias 2013; Resnik 2011.)

Integrity simply means the adherence of ethical principles and guidelines when conducting a research. Throughout this research have followed the rules and regulations by reporting information precisely and avoiding any errors. Responsibility is important to evaluate the accuracy of the research information meaning that in this research any duplications were not made. Confidentiality means personal information or opinions collected would have not be revealed. In our study none of them were collected. (Resnik 2011.)

Fabrication refers to a research has been chosen to be followed but has not been used correctly thus the report information or results are considered to be false or being

invented. Plagiarism refers to copying a text or visual of someone else´s material as one´s own material thus the referencing is incorrect. Misappropriation is referring of presenting a copy of a person´s results, ideas, and words as your own. (Finnish Advisory Board on Research Integrity 2012.)

7.4 Validity and reliability

Validity defines as to what extent the results of the studies are accurate and free from any errors. There are two types of validity, the results of the study relies on both internal and external validity. Thus, the external validity measures what claims to measure in the research and external validity concerns to what extent the results of the studies can apply to the outside of the world meaning generalization of the study outcomes. (Khorsan 2014.)

The articles of the studies were collected using most believable library based databases that includes CINAHL, EBSCO and PubMed and in the selection process articles were limited to, research questions and only peer-reviewed articles were opted in order to assure quality and trustworthiness of the research. In order to assure validity, research quality also an important criterion. Literature reviews contribute to create a quality research by summarizing and organizing evidenced based sources. (Moule 2009.) The quality of the research also based on to what extent the information of the articles is written in the research, the research should be explicit and well detailed so that it can be reproduced (Bronson 2012).

This study is performed according to literature review and focused on its principles throughout the study thus methodology is clearly stated in a way that any review is able to understand as well as precisely indicating keywords and research materials make it possible to duplicate. Research bias can occur in any research, but those biases challenge the reliability of a research however, systematic reviews are the best methods to restrict those bias and guarantees reliability. (Holly 2012.)

8 Conclusion

This study and the search for articles provided informative resources about the current health treatments and methods of alleviating postoperative pain with knee arthroplasty patients. Indeed these findings gave insights into the topic, enable nurses, nursing students and other health care providers to become more knowledgeable of the matter.

Nurses play a major part in treating postoperative pain. The decision nurses make and the orientation of the care plan affects patients' pain scores, outcomes of the recovery and the length of hospital stay. Thus, whether the treatments are pharmacological or/and non-pharmacological, the nurses ought to observe constantly their usefulness, and also share this with the doctor and the health care team in order to discuss their relevance.

Despite the fact that many post-operative pain care methods are available, not all methods apply to every patient, so it is important that nurses know the effects of those various treatments in order to anticipate or find out early enough what is the most relevant care method which gives less side effects and complications to each individual patient. Nurses indeed strive to advocate for the best of the patients. In addition, a constant communication, counselling and education to the patient together with regular pain assessment and documentation is a key for an effective and comprehensive post-operative care which reduces pain scores, shortens the length of hospital stay and improves the recovery scores.

To conclude, a valuable recommendation for the future researchers would therefore be, for instance, to do research on this topic and produce a booklet which includes as much information as possible about postoperative pain methods and care to act as a guide to the nurses and students.

GLOSSARY OF TERMS

AROM: Active Range Of Motion test

ARTHROPLASTY: It is the same as is the fact that a person´s knee is replaced by a metallic knee (implant) to improve the knee health

COPD: Chronic obstructive pulmonary disease

CPM: Continuous Passive Motion

FNB: Femoral Nerve Block

FNC: Femoral Nerve Catheter

IV: Intravenous

IM: Intramuscular

NAS: Numerical Analog Scale

NSADS: Non-steroidal anti-inflammatory drugs

PCA: Patient controlled Analgesia

PO: Per os (through mouth)

TCA: Tricyclic antidepressants

TENS: Transcutaneous electrical nerve stimulation

TKR: Total Knee Replacement is the same as arthroplasty

TUG: Time Up and Go test VAS: Visual Analog Scale

VNRS: Verbal Numerical Rating Score

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APPENDICES

APPENDIX 1. Chosen articles

DATABASE and DATE of search	TITLE, AUTHORS AND YEARS OF PUBLICATION	AIMS	SIGNIFICANT RESULTS TO THE THESIS
PUBMED 08/07/15	The effect of educational intervention on the pain and rehabilitation performance of patients who undergo a TKR. CHEN, 2014	In this study, 92 patients were recruited, 42 were receiving a health education intervention (the experimental group) and 50 a basic care.	The study showed that the experimental group had less post-operative pain, better scores in stair climbing; muscle power and straight leg raises. This health education intervention could benefit health centers which strive to manage and care the best way possible for knee replacement patients.
CINALH 08/07/15	Post-operative pain management after total knee arthroplasty in elderly patients, Mac Cartney and Nelligan, 2015	The study has shown that poor acute pain control has led to develop chronic pain at the post-discharge time. Improvement in early pain control is a focus.	The use of acetaminophen combined with short course NSAIDs, titration of opioids analgesics, topical agents can be helpful. As well when neuropathic pain is present, antidepressants and antiepileptic medications can be used. Moreover psychological therapies as well help the patients who have had failed treatment and reached depression due to chronic pain.
PUBMED 08/07/15	Biofeedback relaxation for pain associated with	This study was about Continuous Passive Motion (CPM).	This full study showed that muscle relaxation help relieve pain and is a non-invasive,

	continuous passive motion in Taiwanese patient. Wang 2015	Patients have 2 sessions of muscle relaxation of 30 min twice a day during 1-5 days concurrent CPM. Half group of the 66 patients participating to the study were using the CPM machine.	inexpensive, non-pharmacological intervention. CPM may reduce blood and edema build up in and around the joint.
PUBMED 08/07/15	Predictors for moderate to severe acute postoperative pain after total hip and knee replacement. Liu, 2012	Recommendation of preoperative selection of patients according to high risk factors due to (gender, age, Body Max Index...) so that the high risk patients may be better taken in charge. 897 patients were participating to a study consisting of observing during the first postoperative day the patient's pain experience at rest and with activity from no pain to severe pain.	The study gives an overview about how caregivers need to focus more on each health cases, for instance: caregiver's team ratio should be increased for patients who are suffering from severe pain and associated with more risk factors. Moreover the importance of appropriate nursing education and referrals for experts' caregivers may improve the pain and decreased its longevity.
PUBMED 09/07/15	Femoral block for acute post-operative pain after knee arthroplasty. Chan, 2014	A study carried out among 2700 participants. The femoral block as compared to the usual methods of pain	The femoral block was found to be a more efficient analgesia compared to PCA because of less side effects for instance vomiting and nausea. They discovered that the femoral

		control: Patient controlled Analgesia (PCA), ie Opioid, epidural, analgesia by local infiltration and oral infiltration.	block was better to use continuously that just using it once.
PUBMED 24/05/15	Relationships between post-operative pain management and short term functional mobility in total knee arthroplasty patients with a femoral nerve catheter: A preliminary study. Fetherston, Catherine M 2011	In this study, the aim was to research about the connection between postoperative pain management and mobility in a short time period. The study group was receiving an IV narcotic PCA and a continuous infusion of local anesthetic through a femoral nerve catheter (FNC) and the other group received an IV narcotic PCA alone.	The intervention group had less pain (VAS Visual Analog Scale) and more quick result in standing up (TUG Time Up and Go test for standing from bed) however the movements were really difficult (AROM Active Range Of Motion test) so further investigation is required (meaning a future evaluation of the quadriceps and careful dosage of local anesthetic accordingly).
EBSCO 22/05/15	The role of pain for early rehabilitation in fast track total knee arthroplasty. Holm Bente 2010	In this study a mobility fast track program aims the patients to recover better and faster after total knee replacement surgery. The measurements were: the	In the first postoperative day the pain was moderate (5 VAS), 90% of the patients could walk independently. In the day two everyone was able to walk and the pain was moderate (4 VAS). The day of discharge pain level was under 3 VAS and every patients

		independence in transfer and ambulation (cumulated ambulation score), pain intensity (verbal analog scale, the range of motion of a knee, mobilization (timed up and go), walking distance.	could walk 70m easily with crutches. Among candidates 7% of them unable to walk in the first postoperative day because the pain was still intense and some of them felt nausea, dizziness and exhaustion.
EBSCO 22/05/15	The effect of local anesthetic wound infiltration on chronic pain after lower limb joint replacement: a protocol for a double-blind randomized controlled trial. Wylde, Gooberman-Hil, Horwood, Beswick, Noble, Brookes, Smith, Pyke Dieppe, Blom. 2011	The study aims to prove that intraoperative local anesthetic wound infiltration together with standard anesthesia regimen can reduce the severity of joint pain at 12-months after total knee replacement. (long term effects) The results observed in this article were from previous studies and unfortunately not from the research itself.	The results of the previous studies provided however the information that the use of multimodal analgesia for instance a combination of nonsteroidal anti-inflammatory drugs, systemic opioids, and local anesthetic wound infiltration were successful meaning that pain control was effective and post-operative recovery improved.
EBSCO 22/05/15	Perioperative celecoxib administration for	The perioperative celecoxib administration	During the first 48 and 72 hours postoperatively, the study group results

	pain management after total knee arthroplasty- A randomized, controlled study. Yu-Min Huang, Wang CM, Wang CT, Lin WP, Horng LC, Jiang CC, 2008	together with Pain Controlled Analgesic (PCA) aims to improve pain control. The study group received a single 400 mg dose of celecoxib, one hour before surgery, and 200 mg of celecoxib every 12 hours for five days, along with patient-PCA morphine. The other group received only PCA morphine for postoperative pain management.	demonstrated that they had less pain during the resting period and less opioids consumption than the other group. Moreover, the active range of movement in the first three days after the total knee arthroplasty were improved. However the nausea and vomiting were no different and the risks of bleeding did not decrease or increase.

EBSCO 22/05/15	Knee Pain during strength training shortly following fast-track total knee arthroplasty: a cross-sectional study. Bandholm T, Thorborg K. Lunn TH, Kehlet H, Jakobsen TL , 2014	This study has a training system that aims to recover better and faster, 30 participants were involved in the study, the experiment has done through a protocol, to rate the pain 0-10 scale has based. In order to evaluate whether the symptoms changes knee flexion range of motion and knee circumference have marked after every loads experiments.	The results indicates that during the knee extension training knee pain has elevated as load increased, as well as muscular fatigue has went up furthermore, it says that the knee pain might have increased due to repetition of contraction training however postoperative symptoms have not changed after the training.
EBSCO 05/09/15	Total hip and total knee replacement: postoperative nursing management. LUCAS, B. 2008.	A British Journal of Nursing that aims to describe and sum up all common care or so called nursing management that nurses have to do with either total hip or total knee replacement patients postoperatively.	Nurses monitor controlled analgesia or epidural opiates use during the first postoperative 24–48 hours and assess the effect on pain. Stepdown intake of paracetamol plus non-steroidal anti-inflammatory drugs plus the opioids if needed are used and monitored as well. Nurses have to know the benefits and side effects of each analgesia

			(dependency observation). To decrease extra pain and complications, nurses prevent by caring for instance on the formation of hematoma and of wound infection. Nurses empower for exercising and educate on the restrictions.
EBSCO 05/09/15	Care of patients undergoing joint replacement. Walker, J. 2012.	A journal called Nursing Older People aims to describe and sum up the pathobiology of arthrosis, the nature of the surgery and its procedure, the pre and postoperative care, and the complications of total knee replacement patients.	Nurses have to daily assess the pain. The recommendations for good nursing skills is to have good knowledge on how is the operation done, how to screen and assess preoperatively so that the current and future possible problems are already identified and how to anticipate the possible upcoming complications.