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Manipulation under Anaesthesia for Stiffness after Total Knee Arthroplasty: A Systematic
Review

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Introduction/ Background

Total Knee Arthroplasty (TKA) is ranked very high and it is considered to be the most successful procedures in orthopaedic surgery. This procedure restores the function in patients through alleviation of the pain, specifically the patients suffering from degenerative knee arthritis. However, knee stiffness following total knee arthroplasty, may lead to sub-optimal functional outcomes and decreased patient satisfaction. Despite of the advancement in instrumentation and prosthetic design in the field of Total knee arthroplasty, there are extensive number of studies that reported that post-operative knee stiffness occurs in almost 30% of the patients (Gadinsky et al., 2011). There are a wide range of pre-operative, intra-operative, and post-operative factors associated with the range-of-motion.

Although the standard initial non-operative treatment option for post-operative knee stiffness following TKA is physical therapy, manipulation under anesthesia is the least invasive operative procedure, with the remaining more invasive methods reserved for failed non-operative treatment, late presentation, implant malalignment, or technical concerns (Cohen et al., 2012). However, only a limited number of studies have compared improvements in range-of-motion after MUA to patients who did not develop knee stiffness after total knee arthroplasty. Moreover, objective and functional outcomes of MUA for post- total knee arthroplasty knee stiffness have also not been widely reported.

Manipulation under anesthesia (MUA) could simply be explained as a non-invasive procedure which combines the manual manipulation of the joint with the general anesthetic. In patients who are not capable of tolerating the manual procedure due to spasm, pain, and muscle contractures might benefit from the use of anaesthesia prior to the manipulation. The anaesthetics used during the manipulation might be mild sedation, or an anesthetic injection on the affected

area, or it could be any other type of anesthetic medication therapy. The process of manipulation can be performed under mild sedation or a local injection consisting of an anesthetic agent on to the affected area (Rogers et al., 2014). The process of manipulation under anesthesia can simply be accompanied by the fluoroscopically-guided intraarticular injections with corticosteroid agents in order to reduce the inflammation within the joint analgesia.

According to a study conducted by Harvie et al (2013) the primary goals of total knee arthroplasty (TKA) are to achieve pain relief and improve knee function. Postoperative range of motion is one of the many factors that may contribute to a patient's satisfaction following total knee arthroplasty. Functional range of motion of the knee is generally regarded as 0° – 90° , as this allows the patient to sit in a chair with a flexed knee and to use stairs uneventfully. Most patients are able to achieve ROM arcs to within 10° – 15° of pre-operative levels.

Unfortunately, stiffness has been found to be a relatively common complication following total knee arthroplasty, with an estimated occurrence in up to 20% of patients (Yoo et al., 2015). Having a limited range of motion below functional standards, typically characterized as the inability to obtain 90° of knee flexion by six to eight weeks postoperatively, will decrease the patient's ability to perform activities of daily living, potentially leading to dissatisfaction with their knee. Several studies (Yoo et al., 2015; Nawghare & Brooks, 2013) have investigated risk factors for developing postoperative arthrofibrosis after total knee arthroplasty, with frequently identified risk factors including obesity, age less than 65 years, smoking, and decreased pre-operative range of motion (Nawghare & Brooks, 2013). Manipulation under anesthesia (MUA) is an available intervention to improve range of motion that may have plateaued in the early total knee arthroplasty post-operative period (Thomas et al., 2011). Historically, this has led to increased knee flexion and ultimately an improvement in patient satisfaction (Yoo et al., 2015).

A potential complication not currently well characterized is whether requirement of postoperative MUA leads to a higher risk for subsequent revision total knee arthroplasty. Revision total knee arthroplasty is a significant financial burden on both patients and the health care system (Bawa et al., 2013). Additionally, revision total knee arthroplasty for postoperative stiffness is associated with inferior outcomes. Previously reported risk factors for revision total knee arthroplasty include younger age, African race, male gender, chronic pulmonary disease, alcohol abuse, obesity and depression amongst others (Yoo et al., 2015).

In a research study conducted by Ipach et al (2011) it was found that more than 20% of patients who have a total knee arthroplasty develop knee stiffness and consequently have a reduced range of motion of <90° of flexion¹⁻⁵. Decreased preoperative range of motion, age, genetic predisposition, diabetes mellitus, socioeconomic status, previous knee surgery, and lack of patient compliance with rehabilitation are some of the factors that have been proposed to influence this condition⁶⁻¹³. Nevertheless, if left untreated, knee stiffness can potentially be a devastating condition and can negatively affect the functional outcomes, daily living activities, and patient satisfaction.

Manipulation under anesthesia is usually considered the initial non-invasive operative step for the treatment of knee stiffness after total knee arthroplasty; however, its long-term outcomes have not been well studied (Witvrouw et al., 2013). In addition, there is no consensus regarding the optimal timing of manipulation after the index arthroplasty to achieve the highest gains in range of motion and functional outcomes. Some authors have suggested that the two to twelve-week postoperative period may be the ideal, since after this time; maturation of the scar tissue may require more invasive procedures.

However, other authors (Antoni et al., 2014) have found no differences in gains in range of motion between early (before twelve weeks) and late manipulations (after twelve weeks). In our practice, although we had observed improvements in knee flexion after manipulation under anesthesia for the treatment of knee stiffness after total knee arthroplasty, we also noticed better clinical outcomes for early manipulation under anesthesia compared with late manipulation under anesthesia.

According to the systematic reviews conducted by (Brown et al., 2015; Nawghare & Brooks, 2013), the mean gain in flexion following manipulation under anesthesia was approximately 30 (range, 22 to 42; $p < 0.01$), which was similar to our overall findings. The results of our study are also in agreement with previous reports that have found higher gains in flexion with early manipulation under anesthesia. Ghaniet al (2012) reviewed the cases of forty-six patients who had total knee arthroplasty and had undergone manipulation under anesthesia because of stiffness. At a mean follow-up of thirty-one months, the mean flexion arc (and standard deviation) had improved from 67 ± 11 to 114 ± 16 (range, 60 to 135), with a mean gain of 47. Furthermore, patients who had undergone manipulation within the first three weeks after total knee arthroplasty had significantly higher final range of motion compared with those who had undergone the procedure after three months (121 ± 11 compared with 112 ± 16 ; $p = 0.021$).

Witvrouw et al (2013) reviewed 113 manipulations in ninety patients followed for a mean of 4.6 years. They reported that the mean knee flexion had improved from 70 (range, 30 to 100) to 105 (range, 50 to 130), with a mean gain of 35. However, no significant difference in flexion gain was detected for patients who had manipulation under anesthesia before or after twelve weeks from the index procedure ($p = 0.36$). Witvrouw et al (2013) reviewed the cases of forty-eight patients who had total knee arthroplasty and had manipulation under anesthesia for knee

stiffness. At a mean follow-up of 7.5 years, the mean flexion improvement was reported to be 34. At the one-year followup evaluation, they found no difference in the mean gain in range of motion between knees that had been manipulated within twelve weeks postoperatively (mean, 8.8 weeks) and those manipulated after twelve weeks (mean, 17.8 weeks). However, they did not report long-term outcome when it was substratified by the timing of the manipulation.

In a retrospective study, Werner et al (2015) compared 102 patients who had undergone early manipulation (within twelve weeks) with ninety-three patients who had undergone late manipulation (after twelve weeks). They reported that both early and late manipulation cohorts achieved significant gains in mean flexion of 33 (from 68.4 ± 17.2 to 101.4 ± 16.15 ; $p < 0.001$) and 17 (from 81.0 ± 13.3 to 98.0 ± 18.0 ; $p < 0.001$), respectively. Similarly, in our study, we found that although early and late manipulation both resulted in significant gains in flexion arc, early manipulation resulted in approximately twice the mean flexion gains. However, none of those studies had evaluated functional outcomes.

Yeoh et al (2012) performed a separate multivariable regression analysis adjusted by various patient demographics and comorbidities which further confirmed that late manipulations compared with early manipulations had resulted in significantly lower overall mean final range of motion ($p < 0.0001$), as well as mean gains in flexion ($p < 0.001$) at the time of final follow-up (Table III). Separate adjusted regression models by various demographic data and comorbidities found no significant differences in mean gains in range of motion (21.54; 95% confidence interval [CI]: 29.07 to 6.00; $p = 0.6874$), Knee Society function (22.24 points; 95% CI: 26.57 to 2.09 points; $p = 0.3083$), and Knee Society objective scores (1.05 points; 95% CI: 23.56 to 5.66 points; $p = 0.6523$) in the comparison of women and men (as the reference group). There were

no significant differences in the rate of manipulation under anesthesia per surgeon ($p = 0.31$) or per prosthesis ($p = 0.28$).

Thus, the timing of the manipulation may be an independent factor that can affect the clinical outcomes of manipulation under anesthesia. Orthopaedic surgeons should have lower thresholds for performing early manipulations under anesthesia to treat knee stiffness following primary total knee arthroplasty to achieve the highest potential gains in flexion, highest overall range of motion, and best clinical outcomes (). Manipulation after twenty-six weeks may provide the least amount of gain in flexion and lower overall range of motion required for the majority of activities of daily living. Patients may benefit from counseling with regard to the outcomes of the procedure on the basis of the timing of the manipulation so that they will have realistic goals and expectations and not delay the procedure, to achieve a better outcome (Yeoh et al., 2012).

Methodology

Research in the field of Orthopaedics is mostly dependant over variables, numbers, procedures, evaluations, statistics, and comparison of the interventions (Fayaz et al., 2013). All of these factors guide the path of the research study towards a positivistic approach. Robson (2002) stated that positivist theory verifies the theory when it is compared to qualitative approach which generates theory. Thus, the research study will follow a positivistic approach due to the following reasons.

The scientific approach adopted in this study aims to establish the one, three and six month risk for requiring MUA after total knee arthroplasty in a national database of private payer and Medicare patients, investigate the association of patient demographics and medical comorbidities with a need for MUA within six months postoperatively and compare the risk of requiring revision total knee arthroplasty in patients who require postoperative MUA to those

who do not. All of these pose a greater risk for the patients. Thus, all of these aims are going to be tested by the collection of data looking for the incidence of a particular variable (DVT/PE). The research study will be an objective analysis that will be supported by strong evidence, and investigations previously used for the identification of the variable.

However, there are also other various paradigms that should be mentioned in this research proposal even though they were not adequate enough to be used in the research study. Another researcher paradigm is the interpretivist, under this paradigm the researcher seeks to understand the world from the perspective of the actors. Under this paradigm the researcher studies the behaviour of the human being along with their approaches towards various stimuli.

This study will be a systematic review of the various articles that will be selected for the study after assessing the relevance with the research topic i.e.: manipulation under anaesthesia for stiffness after total knee arthroplasty. For this study the research will conduct an in-depth literature search in the Medicare and Cochrane databases in order to establish the one, three and six month risk for requiring MUA after total knee arthroplasty in a national database of private payer and Medicare patients, investigate the association of patient demographics and medical comorbidities with a need for MUA within six months postoperatively and compare the risk of requiring revision total knee arthroplasty in patients who require postoperative MUA to those who do not.

Systematic reviews are scientific investigations in which the unit of analysis is the original primary studies (Smith et al., 2011). They are an essential tool to synthesize the available scientific information, increase the validity of the findings of individual studies and identify areas of uncertainty where research is needed. They are essential to the practice of evidence-based medicine and a fundamental tool in medical decision making.

The reason behind the selection of systematic review method is that it is one of the most reliable research methods which allows the researcher to make informed decision specifically in studies related to medical and nursing. Perhaps that is the reason why systematic reviews are becoming more popular, and have increased very significantly the reviews published in recent years. However, performing a quality systematic review is not a simple task. In fact, there are rules for processing and, like other designs, recommendations for the presentation of results according to quality standards that are developed by multidisciplinary international groups of experts, including authors of systematic reviews, methodologists, clinicians and editors.

For this study the researcher will use publicly available databases, MEDLINE and PubMed, in order to retrieve the data on manipulation under anaesthesia for stiffness after total knee arthroplasty. The researcher will conduct an in-depth analysis in the databases and will select the studies in which the patients had undergone unilateral primary TKA. This will allow the researcher to gain a more in-depth knowledge regarding the research topic. The reasons behind the selection of both these databases are the amount of records present in them. Access to a wide range of studies will enable the researcher to select the studies that fulfil the inclusion and the exclusion criteria set by the researcher.

Aims of the Study

The aim of the present study is three-fold: 1) to establish the one, three and six month risk for requiring MUA after total knee arthroplasty in a national database of private payer and Medicare patients, 2) to investigate the association of patient demographics and medical comorbidities with a need for MUA within six months postoperatively and 3) compare the risk of requiring revision total knee arthroplasty in patients who require postoperative MUA to those who do not.

Methods

Review Questions

Any structured clinical question (whether of etiology, diagnosis, treatment, prevention or prognosis) consists of the four components. These are the four basic components of most clinical investigations, according to the acronym PICO, Patient, Intervention, Comparison and Outcome or result:

- Patients: selection criteria, i.e. inclusion (clinical diagnosis, although it may be tempered by the stadium box) and exclusion (e.g. severity criteria);
- Intervention: type of intervention, therapeutic, diagnostic, potentially harmful exposure or prognostic characteristic of interest for the experimental groups, with possible specification of the time and mode of administration and duration, if applicable;
- Comparison: in many studies a group subjected to intervention with a control group, used for comparison is compared. This group should detail the same characteristics aforementioned intervention, but referred to the control group. In particular type of comparison (placebo, active treatment in treatment studies, other diagnostic tests or the reference standard in diagnostic studies etc.);

- Outcome or result: the event or that the trial intervention is proposed to treat, ameliorate, delay or prevent disease; or definitive diagnosis in the case of a diagnostic test; or illness which is alleged consequence of exposure; or the final outcome of a forecast study

The specific research question for this study is Does manipulation under anaesthesia after total knee arthroplasty is responsible for for stiffness.

- Population: The population of the study are patients who have total knee arthroplasty and are less than 65 years;
- Intervention: Any intervention including assessment and therapeutic intervention;
- Comparison: This systematic review will not emphasise on this issue;
- Outcome: To determine all of the patients' manipulation under anesthesia at different intervals

Inclusion / Exclusion Criteria

The inclusion / exclusion criteria are utilized to channel the pursuit. Subsequent to utilizing legitimate keywords with proper Boolean operators and also manual inquiry on web search tools will give countless studies on the given point (Tan et al., 2012). To minimize this number, the researcher needs to apply some particular criteria so the quantity of studies get to be lessened and all the resultant studies are extremely important to the subject.

The selected studies will be consisting of the patients who are under 65 years. Since a wide range of authors has conducted studies on this topic, the researcher expects to find an extensive number of studies in the defined databases in which the patients have received Total knee arthroplasty.

The following table gives the specific Inclusion / Exclusion criteria used in this systematic review:

Inclusion	Exclusion
The studies discuss the patients who are under 65 years of age and have received Total knee arthroplasty	Studies talking about patients who are 65 or more than 65 years of age
Studies available in English language	Studies available in other languages
Published studies only	Studies which are not published
Studies conducted and published between 2000 to 2015	Studies conducted and published prior to 2000

Search Strategy

The literature search can be performed essentially in different sorts of sources. There are diverse groupings of the sorts of archives that will be handled in the literature search:

- Primary: Original, straightforwardly transmit data (unique papers, proposals);
- Secondary: They give depictions of the essential reports (indexes, databases, orderly audits, outlines);
- Tertiary: They orchestrate essential and auxiliary reports (catalogues) (Higgins & Green, 2008)

The databases are a resource of secondary recoverable homogeneous information through Internet. Records containing references or finish, sorted out in fields that cover all parts of the data (title, creator, rundown, and so forth.). For this research study the research will utilize two libraries for searching data which are PubMed, and MediLine. These libraries will be used by the researcher in order to find the relevant articles pertaining to the topic of the study.

Search for relevant articles on PubMed will be done in June 2015. The keywords given above will be utilized by the researcher in order to find out relevant data associated with the

research study. In order to check the relevancy of the articles with the researcher study the researcher will apply the inclusion and exclusion criteria given below to determine the articles that best suits the research study. The research will use to databases MediLine and PubMed. The reason behind the selection of MediLine database is it vast research database, the researcher will have access to the studies consisting of detailed patient records through this database, which would prove to be highly beneficial for this literature review. On the other hand, the PubMed is regarded as the gold standard for data on medical literature. It will allow the researcher to gather a wide range of data on the researcher topic. The search on both the libraries will be conducted using the similar keywords that have been given above.

A standout amongst the most habitually utilized databases as a part of Health Sciences is Medline (Higgins & Green, 2008), which has been utilized by the specialist to discover studies for this examination study. MEDLINE is a database created by the National Library Medicine (NLM) in the US that contains bibliographic references and more than 4,000 modified works from biomedical diaries distributed in the United States and 70 different nations. It is including the International Nursing Index (International Nursing Index) that records around 270 worldwide nursing diaries. Medline has around 11 million records on biomedical writing subsequent to 1966. It contains the fields of drug, nursing, dentistry and veterinary pharmaceutical (Higgins & Green, 2008). The overhauling of the database is month to month and contains a thesaurus (word reference controlled terms) called MeSH (Medical Subject Headings), a tree framework that gives a reliable approach to hunt down data, utilizing distinctive phrasing for the same perspective.

In the wake of selecting databases, keywords will be chosen will be chosen. Keywords are the real ideas or variables of the issue or issue of examination. These words will be the way

to begin the pursuit. In the vast majority of the databases, keywords might be utilized as just words in addition to expresses. At the point when distinguish significant studies, the scientist can check for different terms that can be utilized as keywords. Elective terms (equivalent words) for ideas or variables can likewise be utilized as keywords. Most databases have a thesaurus that can be utilized to distinguish key inquiry words (Littell et al, 2008).

In this specific study the keywords, for example, Manipulation under Anaesthesia, Total Knee Arthroplasty and Manipulation under Anaesthesia for Stiffness after surgery are utilized with Boolean operators of "And" and "Or" to locate the extreme number of studies. In every database, the pursuit is performed by a different quest for every keyword. Most databases permit to demonstrate quickly what part of the database records is expected quest for the term (in the titles of the articles, diary names, catchphrases, headers formal issues or full messages of articles).

Most databases give synopses of the articles in which it refers to the term, giving some data about its substance, so the specialist can judge whether the term is valuable in connection to its chose point. In the event that he finds any vital reference, ought to spare it in a document. Alternately, the quantity of references (or "discoveries") that were found ought to be noted (Littell et al, 2008). At times, the quantity of discoveries might be too high for them to be analyzed completely. Contingent upon the hunt technique and blend of keywords, results will be pretty much exact and will get pretty much results. At the point when records coordinate the pursuit subjects, it permits recognizing what their descriptors and consequently utilizing as a part of new hunt down more exact data.

The process behind the selection of relevant literature for this research study will consist of the analysis and selection of the data through conducting screening of the titles of the articles,

analysis and selection of the data through reading the abstracts of the articles, analysis and selection by reading the full texts of the articles. All the studies will be searched, identified, and extracted by the researcher. This would ensure that the data collected for the study is highly authentic, and at the same time it will also ensure that all the search criteria are met by the researcher while determining the literature for the study.

For this study the research will ensure that the risk of bias is assessed properly, through utilizing the criteria developed by Ferreira et al (2010). These criteria described the representativeness of the sample (measured by 2 items), the response rate, the accuracy of the data, evidence of power calculation and the instrument used. Thus, following these criteria each of the selected study will be assigned a score as risk of their bias, expressing the number of criteria met on a 6-point scale, higher scores being representing low risk of bias (Ferreira et al., 2010).

Study Selection

The search for studies is comprehensive and unbiased is one of the key differences between systematic reviews and traditional reviews. While electronic databases such as MEDLINE are powerful tools for locating studies can only identify between 30 and 80% of all studies that have been published. On the one hand, this database does not include all of the published medical literature and, secondly, some studies never get published. References of studies written in language English are not underrepresented in MEDLINE, so if the database is used to identify studies the review may be potentially affected by publication bias, which arises when what is published does not It is representative of what is investigated.

From another perspective, publication bias may be due to the tendency among authors, reviewers and journal editors to allow management and the statistical significance of the research

findings to influence the decisions to send and accept for publication the results of research, selecting priority studies with positive results. Although initially it was thought that medical journals could be fundamentally responsible for this type of bias, and that would tend to publish only studies with significant results, today, and from interviews conducted directly with researchers, it is known that primarily responsible are the authors to consider that if no significant results, the studies are not interesting for publication (Torgerson, 2003). In publication bias involved several factors: in addition to the work with statistically significant results are more likely to be published than those not shed differences, once accepted are published more quickly.

To avoid these biases and to ensure that, as far as possible, all relevant data to be included in a review is necessary to use several sources of information to identify studies. It should also take into account the possibility of bias references (a tendency to preferentially cite studies that support the point of view) and help by using multiple search strategies. Possible sources of information for locating studies include: a) computerized bibliographic databases for studies published in journals indexed (MEDLINE, PubMed, Cochrane Library etc.); b) review articles and meta-analyses; c) original articles (preliminary or full publications) in primary publications; d) secondary publications: summaries of articles published in other journals as original (Evidence Based Medicine etc.); e) conference proceedings; f) doctoral theses (publication record of powers); g) textbooks on the subject; h) personal contacts with experts, scientific societies, working groups, etc.; i) funding agencies (FIS, CICYT, foundations, etc.); j) clinical trials registry (Ministry of Health, Cochrane Collaboration, case records, etc.); k) pharmaceutical industry, and l) manuals from bibliographies of original articles searches. Below are reviewed in more detail the most relevant for localization studies sources (Torgerson, 2003).

The criteria for selection of studies are dictated by the goals of the review, i.e. the unmistakable inquiry for exploration. Another viewpoint that decides the determination of things is methodological quality and on the off chance that they meet the criteria looked for exploratory quality. In a first stage the viewpoints that the researcher considers might be: the title, authors, abstract and the outcomes (Torgerson, 2003).

Concerning title, the researcher can check whether it is valuable and significant to the research subject, the authors' validity or involvement in the field will be distinguished and the summary ought to break down whether it is right and if the outcomes are appropriate to the subject of study. The second stage will continue to the critical reading of records. Critical reading programme is a method that offers the chance to expand the adequacy of the perusing, gaining aptitudes important to bar as fast as experimental articles and trashy acknowledge those sufficiently other logical quality to offer the analyst in choice some assistance with making. In this manner, the papers must be assessed in three ranges:

1. Can we believe the outcomes? At the end of the day: would they say they are legitimate? That is to say, arraign the methodological legitimacy of the article. The criteria of legitimacy things are distinctive for various inquiries;
2. What are the outcomes? For instance, would it be able to be contrasted with the trial intercession with control an extraordinary impact and so on? Furthermore, how they do it?
3. Are these outcomes pertinent or appropriate in my surroundings? (Torgerson, 2003)

Quality Assessment

A key aspect of any systematic review is to evaluate the methodological quality of included studies in order to identify possible sources of bias. Linked to the analysis of methodological quality with which it was designed and conducted the study, it is the analysis of how the findings are reported. It is difficult to distinguish between the two aspects of quality as both are closely related. For either analysis tools there are two very popular today. On the one hand, the STARD initiative for the publication of studies of diagnostic accuracy is aimed at magazine editors and authors of articles and aims to improve the quality of publications and to allow readers to assess the potential biases of the study and judge their generalization (Bossuyt et al., 2003). This initiative is the area of research on what the diagnosis was CONSORT research in treatment. On the other hand, is the QUADAS questionnaire, designed specifically for evaluating the quality of the primary studies included in systematic reviews of diagnostic. The questionnaire contains a number of items, including the design and analysis of the study covering the spectrum from patients included into the presence of the most common biases(Bossuyt et al., 2003).

The use that can be given to the results of this analysis of quality is a topic of debate. It is proposed from a simple description of this quality in order to assess the extent of the evidence available to the most drastic proposal to exclude from the analysis of lower quality studies. In what seems to be some consensus on quality discourage summarize in a single numerical score and the difficulty of explicitly incorporate the weighting of quality of primary studies when analysing the data. A common alternative is to conduct sensitivity analysis comparing the results obtained including and excluding selected studies according to their quality or certain features of the design.

Data Extraction

The essential point of data extraction is to gather however much studies as could be expected and to review them legitimately. This appraisal depends on the reason or the essential inquiry of the deliberate survey on which the entire structure of examination is set up. This might choose the significance of the selected studies. It is prompted that this data ought to be recorded in a different database (Newell & Burnard, 2006).

One of the significant difficulties of directing orderly review is to discover most extreme number of important studies. This should be possible by receiving a far reaching and powerful looking technique which can minimize all the recovery inclinations. In this way, it is essential to fuse manual looking likewise into the search study.

Data Synthesis

In this study the researcher will calculate the odds ratios, and the confidence intervals (CIs) of the patients within the selected studies in order to make a comparison between the cohorts. Finally, the researcher will perform chi square test in order to determine the statistical significance of the univariate analysis, with $P < 0.05$ considered significant (Newell & Burnard, 2006). All statistical analysis will be completed in SPSS version 21. This will ensure that the results generated by the study are accurate and reveal the correct outcomes of the selected studies.

Ethical Considerations

The major aim of the Research Ethics Committee (REC) is the protection of the safety, rights and dignity of the participants of the research study. Since, this study is a systematic review there will be no live participants involved in the study; this research study mainly involved the articles that have been selected for this study. This research study involves reviews

of the articles consisting of the case studies of the patients who have received manipulation under anaesthesia for stiffness after total knee arthroplasty. Thus, the study will only use the information of the patients such as their name in order to avoid any sort of duplication, and confusion. The researcher will ensure that the confidentiality and anonymity of the patients involved in the selected studies are maintained throughout the study, and more importantly during the process of dissemination.

The research study does not consist of contact number of any of the patients, and utilization of devices or instruments(Newell &Burnard, 2006). Thus, there will be no need for informed consent. Another main principle of Ethic is Non-Malificence, which is completely satisfied as this study does not involve any live participant there will be no physical harm to anyone. Next is the Beneficence, which is a criteria that this study will fulfil as it is aiming to do good through investigating the association of patient demographics and medical comorbidities with a need for MUA within six months postoperatively and comparing the risks of requiring revision total knee arthroplasty in patients who require postoperative MUA to those who do not.

Dissemination

The findings that will be achieved from this study will prove to be beneficial for the orthopaedic surgeons, chiropractors, and doctors. The initial dissemination of the findings of the study will be given through a power point presentation within the departmental meeting, which would include the Orthopaedic nursing staff, House Officers, Consultants, and Registrars. In the next phase the findings of the study will be presented Lecture Hall in order to reach the various other colleagues working within the department, who frequently gather in the Lecture Hall for continuous professional development. Along, with that the researcher will also present the

findings of the study in-front of the departmental and Trust audit meeting, in order to reach the trust and the audit managers of the department.

The research will also present the findings of the study in various other seminars and meetings in order to create and awareness among the people allowing the research to learn and get the feedback from the other experienced professionals working within the field. Another medium of dissemination that can be utilized by the researcher in the future is poster presentation. The researcher can print a poster representing the overall research process, and findings of the study and present that at the national and international Orthopaedic Conferences. After all of these processes are done, the researcher will publish the article in journals such as the Research and Injury of Foot and ankle International in order to reach the vast part of the population such as the students, and general public and provide them the essential information regarding the manipulation under anaesthesia for stiffness after total knee arthroplasty.

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