Modern Total Knee Arthroplasty (TKA): With Or Without a Tourniquet?

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ABSTRACT

BACKGROUND: Since arthritis of the knee is one of the most common pathologies in industrialized nations, there has been a growing interest in fast-track total knee arthroplasty (TKA). However, while one of the main concerns is the role of a tourniquet, the available data are inconclusive.

AIM: This study sought to assess the link between postoperative outcomes and use of a tourniquet in TKA. Our goal was to determine whether it is justified to forego tourniquet use as indicated by the fast-track concept.

METHODS: The participants (n = 108) in this retrospective, non-randomized study were assigned into two groups after they satisfied the inclusion criteria: primary gonarthrosis or secondary gonarthrosis without previous arthroscopy. TKA was performed without (Group I, n = 55) or with (Group II, n = 53) a tourniquet. The postoperative outcome was evaluated in terms of postoperative pain, based on a numeric rating scale (NRS) and the need for pain medication, and postoperative function, based on range of motion (ROM) and walking tests.
RESULTS: Overall, no significant correlations were observed between tourniquet use and postoperative pain according to the NRS. Group I required less oxycodone, but more non-opioids. There was no significant difference in the improvement in pre- to postoperative ROM with regard to tourniquet use. The final walking distance was significantly longer in Group I.

CONCLUSIONS: These results suggest that there is no strongly significant link between the postoperative outcome and the use of a tourniquet. However, further studies will be needed to determine whether a tourniquet may have some other impact on TKA.

INTRODUCTION

Arthrosis is a widespread disease of advanced age. According to the current 12-month prevalence survey by the Robert Koch Institute in Germany, about 48.1% of women and 31.2% of men over the age of 65 are affected. A study on adult health in Germany (DGES1) revealed that the knee is affected in more than 50% of cases. Moreover, arthrosis, as a musculoskeletal disease, is one of the main global causes of a reduced quality of life.

The high prevalence and strong impact on quality of life have led to an increasing need for therapy. After failure of conservative therapy, endoprosthetic knee joint replacement is the gold standard for advanced gonarthrosis with persistent complaints. According to an initial survey conducted by BÄRMER Germany in 2009, however, 18.3% of patients were dissatisfied with the results of TKA.

Fast-track total knee arthroplasty (TKA) seeks to reduce morbidity and improve rehabilitation. The fast-track concept involves four changes in perioperative management in TKA: the lack of a tourniquet, the use of tranexamic acid, tailored pain therapy, and the absence of drainage. Each of the latter three components has been shown to confer a significant benefit.

The need for a tourniquet is controversial. The greatest advantage of a tourniquet is the significant reduction in intraoperative blood loss. Furthermore, a tourniquet shortens the operation time. Pfitzner et al. found that the thickness of the tibial cement mantle was increased with the use of a tourniquet. Although this leads to increased implant stability, it has not yet been conclusively clarified whether this also extends the service life of the endoprosthesis. Tourniquet use also has several disadvantages. Induced ischemia leads to tissue damage in the muscles, with indications of potential muscle atrophy. Another disadvantage is the increased rate of complications (both thrombotic and non-thrombotic).

Tourniquet use has been associated with greater postoperative pain, and Dennis et al. showed that quadriceps strength was significantly lower with a tourniquet. To date, there have been few studies on TKA methods with a focus on early functional results. Moreover, only a few studies have considered tourniquet use as a main criterion. This study was performed to develop a generally valid statement on tourniquet use through a holistic view of early rehabilitation. There are two alternative hypotheses:

- alternative hypothesis 1 (H1): Fast-track knee arthroplasty without tourniquet use reduces postoperative pain.

MATERIALS AND METHODS

This study examined retrospective data from 108 patients in whom an arthroscopically modified knee joint was replaced by a total endoprosthesis using the fast-track concept. Surgery was performed in the endoprosthesis center of maximum care, OCM/SANA-Clinic Munich, Germany.

According to the main criterion (tourniquet use), the patients were divided into two groups. Group I (55 patients) underwent TKA without a tourniquet. After the fast-track concept was established with a learning phase of 12 months, the data were sourced consecutively and standardized. The operations took place between December 2016 and March 2017.

Group II (53 patients) underwent TKA with a tourniquet between July 2015 and November 2015. The data were acquired retrospectively by a targeted search query.

Patients with primary gonarthrosis or secondary gonarthrosis without previous arthroscopy were included in the study. The exclusion criteria were as follows: secondary gonarthrosis with previous arthroscopy, rheumatoid arthritis, severe malpositions, or post-traumatic gonarthrosis.

Fast-track TKA was indicated by the diagnosis in connection with the patient’s level of suffering. The diagnosis was total arthrosis of the knee, varusgonarthrosis, or valgusgonarthrosis.

The groups were compared with regard to age, sex, height, weight and calculated body mass index (BMI).

The influence of a tourniquet was analyzed in terms of postoperative pain (H1) and range of motion and functionality of the knee joint (H2). The overall clinical impression at discharge was also considered.

Postoperative pain was recorded using a numeric rating scale (NRS) from 1 (no pain) to 10 (maximum pain). Pain was initially evaluated at fixed times (15, 60 and 120 minutes) after arrival in the recovery room. Postoperative pain was then re-evaluated twice a day (morning and evening) for the entire
hospital stay. Pain was recorded by the nursing staff using the NRS.

Pain medication was standardized by the local infiltration anesthesia (LIA) scheme, which was used in both groups (Table I). In the case of persistent pain, another medication was added. We adhered to the guidelines of the WHO stage scheme. The need for additional pain medication was documented in the medical record.

The preoperative range of motion (ROM) of the knee joint was determined using the neutral-zero method. From the first postoperative day onwards, physiotherapists documented the range of motion during daily therapy. The final evaluation of the functionality of the knee joint included an examination of the possible walking distance and the gait.

On the day of discharge, the surgeon performed a final clinical examination, and noted possible irritation and swelling of the operating area, and the presence of intraarticular effusion and hematoma.

After acquisition, patient data were stored anonymously in an Excel spreadsheet (version 14.1.0; Microsoft Inc., Redmond, WA). The statistical evaluation was carried out using SPSS statistics software (version 22; IBM Corp., Armonk, NY). The results were visualized by diagrams produced with RStudio (version 1.1.463; RStudio Inc., Boston, MA). A probability p value of less than .05 was considered significant.

**RESULTS**

The data from 108 patients were analyzed: 53 without a tourniquet (Group I) and 55 with a tourniquet (Group II).

The demographic characteristics of the two groups were similar, except that Group I had a significantly higher mean BMI.

To test alternative hypothesis H1, pain recorded using the NRS and the need for pain medication were compared between the two groups. In the mornings of postoperative days 4 and 5, pain on the NRS in Group I was significantly lower than that in Group II. The mean pain in Group I was again significantly lower than that in Group II in the evening of postoperative day 6. There were also some differences between the groups in the need for pain medication during the postoperative course. On one hand, Group I required significantly less oxycodone than Group II (Fig. 1). However, Group I required more non-opioid medications than Group II. This difference was statistically significant on the day of surgery and on postoperative days 2-6.
To illustrate the influence of the surgical method on the range of motion (ROM), the difference between pre- and postoperative ROM was compared between the groups. With a probability error of p = .263, this difference was not statistically significant. During the postoperative course (Fig. 2), significant differences were observed on days 1-5 (p < .050). On day 1, the ROM of Group I was greater than that of Group II. Thereafter, the ROM increased significantly more in Group II than in Group I. As a result, the ROM in Group II was significantly greater than that in Group I on postoperative days 2-5. No statistically significant difference was observed on the sixth postoperative day. With regard to the functionality of the knee joint, significantly more patients in Group I (vs. Group II) had unlimited mobility at the day of discharge (p < .001).

At the day of discharge, the clinical status of the operated extremity was assessed on the basis of five criteria. A significant difference was noted for each criterion. Patients in Group I had a less irritable and less swollen operating area, as well as a lower prevalence of hematoma, than patients in Group II. On the other hand, intraarticular effusion occurred more frequently in Group I than in Group II.

There were only a few significant differences between patients grouped according to tourniquet use with regard to postoperative pain as rated by the NRS. Furthermore, patients in Group I (no tourniquet) required significantly less oxycodone, but more non-opioids. Finally, tourniquet use did not offer a significant improvement of pre- to postoperative ROM. During the postoperative course, an inexplicable significant decrease in ROM was observed in Group I, which suggests that some other factor may influence postoperative ROM.

Since this study can be considered a retrospective case–control study, it only provides a level of evidence III. With regard to practice recommendations, our study achieves Grade C, which means that surgeons should be flexible in their decision-making regarding appropriate practice. Therefore, at best, this study can suggest options, but not recommendations. To provide a strong recommendation (Grade A), a high-quality prospective cohort study with adequate power, or a systematic review of such studies, is needed. However, our results are consistent with a meta-analysis and prospective randomized controlled trials.

Alternative hypothesis H1 (“Fast-track knee arthroplasty without tourniquet use reduces postoperative pain.”) cannot be confirmed by our results. Although Pfitzner et al. reported that postoperative pain was strongly significantly lower for TKA without a tourniquet, we only observed some intermittent significant differences. According to the WHO definition of pain, pain can be seen as subjective, and hence is influenced by many factors (e.g., ethnicity, past experiences, education, social environment), including self-efficacy. Levett and Grimmett reported that high self-efficacy is associated with favorable outcomes. The General Self-Efficacy Scale (GSE) proposed by Jerusalem and Schwarzer has been established as a useful tool to screen self-efficacy. Our study, like others, was limited because it did not consider self-efficacy as a psychological factor that could influence postoperative outcomes. Future studies may wish to consider whether it is worth screening for self-efficacy preoperatively so...
that the surgeon is in a position to modify the patient’s therapy to improve the postoperative outcome. Moreover, the need for pain medication in Group I appeared to be inconsistent. A standardized pain medication as in the LIA scheme can address the problem that pain medication must always be tailored to the individual patient. In particular, the patient’s preferences and tolerances as well as contraindications have to be considered. However, the overall mean NRS (Group I, 1.1 ± 0.1; Group II, 1.3 ± 0.05) was relatively low. Thus, the pain medication used here was considered to be suitable.

Alternative hypothesis H2 (“Fast-track knee arthroplasty improves early postoperative function of the knee joint.”) also cannot be confirmed, although Zhang et al. reported a significantly higher ROM in non-tourniquet patients in their meta-analysis.7 In our study, an inexplicable significant decrease in ROM occurred from postoperative day 1 to 2 in Group I. Under the premise that pain might reduce ROM, on postoperative day 2, Group I reported more pain than Group II, albeit not significantly more. However, Group I required a significantly lower dose of oxycodone, but a significantly greater need for non-opioid pain medication than Group II, so that sufficient analgesia can be assumed.

A limitation of this study is that drainage was not considered. The modern fast-track TKA concept does not recommend the use of drainage for several reasons. For example, Husted et al. claimed that the total blood loss seems to be higher with drainage.17 To date, there has been no well-founded examination of the correlation between postoperative ROM and the use of drainage. This is a challenge for future research.

CONCLUSION

Our analysis suggests that there is no strongly significant link between use of a tourniquet and the postoperative outcome. Contrary to our expectations, we could not confirm alternative hypotheses H1 and H2 due to the lack of decisive significant differences.

It is still not clear whether a tourniquet may have some other impact on the outcome of TKA. Further studies will need to be identified to the conditions under which postoperative ROM improves. A possible next step would be to examine the role of drainage. In addition, future research will have to investigate the extent to which psychological factors, such as the patient’s self-efficacy, influence the postoperative outcome of TKA. Well-designed prospective trials or meta-analyses may ultimately clarify the utility of tourniquet use.

The authors declare that there are no conflicts of interest.

REFERENCES