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Original Article

The comparison of staples and prolene suture for wound closure in total knee arthroplasty patients: a retrospective cohort study

Total diz artroplastisi sonrası yara kapamada stapler ile prolen sütürün karşılaştırılması: Retrospektif kohort çalışması

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Abstract

Aim: The wound closure method applied after total knee replacement, plays a critical role in the success of the surgery. Various skin closure methods have been described in the literature in order to reduce infection rates, shorten the surgical time, and increase patient satisfaction. However, there is no standardized guideline on which type of suture should be used. The aim of this study was to compare the efficiency and safety of staples with prolene sutures in wound closure after total knee arthroplasty.

Materials and Methods: Eighty-five patients that underwent total knee arthroplasty between January 2021 and October 2021 were retrospectively assessed. Patients were divided into two groups according to the wound closure method. The two groups were compared in terms of wound complication rate, operative time, postoperative hospitalization duration, and Likert scale level of patient satisfaction.

Results: The majority (87.1%) of the patients were women . The mean age of the patients was 64.6±7.2 (range, 45-79). The prolene suture group had no wound complications while the staples group had five (11.9%) ($p<0.05$). These complications consisted of three superficial infections, one deep infection, and one wound dehiscence. The mean operation time was 102.6±10.7 minutes in the staples group and 106.2±10.7 minutes in the prolene suture group ($p=0.097$). There was no significant difference in terms of Likert scores between the staples group and the prolene group (4.0±1.4 vs 4.4±0.9, respectively; $p=0.248$). Postoperative hospitalization durations were similar between the groups ($p=0.296$).

Conclusion: The prolene suture provided lower wound complication rates compared to staples. There was no significant difference between the two groups in terms of surgical time, postoperative hospitalization, and patient satisfaction. Randomized prospective studies with larger patient series are needed to fully clarify this issue.

Keywords: Total Knee Replacement ; Arthroplasty ; Surgical Staples ; Prolene ; Suture ; Surgical Wound Infection

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Öz

Amaç: Amaç: Total diz artroplastisi sonrasında uygulanan yara kapama metodu, ameliyat başarısında kritik rol oynamaktadır. Literatürde enfeksiyon oranlarının azaltılması, cerrahi sürenin kısaltılması ve hasta memnuniyetinin yükseltilmesi amacıyla çeşitli cilt kapama yöntemleri tanımlanmıştır.Bununla birlikte, hangi tip sütür kullanılması gerektiğine dair standart bir kılavuz bulunmamaktadır. Bu çalışmanın amacı, total diz artroplastisi sonrası yara kapamada cerrahi stapler ile prolen sütürlerin etkinlik ve güvenlik açısından karşılaştırılmasıdır.

Gereç ve Yöntemler: Ocak 2021 ile Ekim 2021 arasında total diz artroplastisi uygulanan 85 hasta retrospektif olarak değerlendirildi. Hastalar yara kapama yöntemine göre iki gruba ayrıldı. İki grup yara komplikasyon oranları, ameliyat süreleri, ameliyat sonrası yatış süreleri ve Likert hasta memnuniyet ölçekleri açısından karşılaştırıldı.

Bulgular: Hastaların çoğunluğu (%87,1) kadındı. Hastaların yaş ortalaması 64,6±7,2 (45-79 arası) idi. Prolen grubunda hiç yara komplikasyonu görülmezken, stapler grubunda 5 (11,9%) hastada görüldü (p<0,05). Bu komplikasyonların üçü yüzeyel enfeksiyon, biri derin enfeksiyon ve biri yarada ayrılmaydı. Ortalama ameliyat süresi stapler grubunda 102,6±10,7 dakika, prolen grubunda 106,2±10,7 dakikaydı (p=0,097). Stapler grubu ile prolen grubu arasında Likert hasta memnuniyet ölçekleri açısından anlamlı farklılık yoktu (sırasıyla 4,0±1,4 ve 4,4±0,9; p=0,248). Ameliyat sonrası yatış süreleri gruplar arasında benzerdi (p=0,296)

Sonuç: Prolen sütür, stapler kullanımına kıyasla daha düşük yara komplikasyon oranları sağladı. Cerrahi süre, postoperatif hospitalizasyon ve hasta memnuniyeti açısından iki grup arasında anlamlı fark saptanmadı. Bu konunun tam olarak açıklığa kavuşabilmesi için daha geniş hasta serili randomize prospektif çalışmalara ihtiyaç vardır.

Anahtar kelimeler: Total Diz Replasmanı ; Artroplasti ; Cerrahi Stapler ; Prolen ; Sütür ; Cerrahi Yara Enfeksiyonu

Introduction

Total knee replacement (TKR) is an orthopaedic surgical procedure that is performed to treat symptomatic gonarthrosis. In this procedure, early rehabilitation is crucial to improve postoperative range of motion but might increase stress on the surgical wound [1]. Therefore, skin closure technique plays an important role in avoiding wound complications. The technique should provide a tension free and waterproof closure without skin edge inversion [2]. The wound should recover rapidly without infection and dehiscence [3].

Postoperative surgical site infection is a major concern today [4]. This devastating complication not only increases hospital stay duration, but also causes an increase in healthcare costs and burden on the healthcare system [4]. In addition, postoperative wound complications may cause impaired physical activity and subsequent joint stiffness [5].

Various techniques have been described for skin closure after TKR surgery [6-11]. However, none of these have been widely accepted as optimal closure method [12-14]. Of these methods, staples have been compared with different suture techniques in several studies. In majority of these studies, staples and suture have been reported as comparable in terms of complications [7,15-18]. In few studies, staples have been reported associated with lower wound complications [9,19]. On the other hand, in large meta-analyses that include orthopaedic surgeries, staples have been found to be associated with higher wound infection rates [14,20]. Therefore, more studies are needed to understand which closure method is best. Despite most knee arthroplasty surgeons use staples for wound closure, studies have shown that most of them would change their practice with evidence of one method over another [13]. Moreover, there is no standardized guideline on which type of suture should be used [21]. To our knowledge, this is the first study that compares staples with prolene sutures in TKR patients. The aim of this study was to compare the efficiency and safety of staples with prolene sutures in TKR.

Material and Methods

Following ethics committee review approval (approval number:2021/136-1), the medical records of TKR patients operated at a state hospital between January 2021 and October 2021 were retrospectively reviewed. The informed consent was obtained from participants. All patients were followed-up for three months. All patients admitted for primary unilateral TKR were eligible for inclusion in the study. Malignancy and previous knee surgery were exclusion criteria.

One of the 93 patients had malignancy and three patients had previous knee surgery. These patients were excluded. Four patients were excluded for refusing to participate and the

remaining 85 patients were included in the final analysis.

In terms of surgical site infection, the estimated risk ratio taken from a previous study was two [22]. After adding the non-response rate of 10% and with a power of 80% and 5% significance, the sample size came out to be eighty-two patients.

The type of anesthesia was spinal anesthesia for all patients. A pneumatic tourniquet was utilized in patients throughout the operation. A suction drain was placed in the knee joint before the joint capsule was closed. Deep wound closure was performed with absorbable sutures at the level of arthrotomy and in the subcutaneous layer. For subcutaneous closure, intermittent buried knots with 2-0 Vicryl were used, and the same technique was used in the two groups. During the subcutaneous closure, care was taken to ensure that the wound edges were positioned on the same plane, and that the sutures were not too close or too far from the incision in all patients. The skin closure was performed in the 45° knee flexion position and was done via either staples or a polypropylene suture using the vertical mattress technique. If staples is available, staples was utilized for all cases. In the situation that staples is absent in our facility, prolene suture was utilized. Early range of motion exercise and ambulation with a supportive device was started for the patients at postoperative first day. Standardized postoperative rehabilitation, deep vein thrombosis prophylaxis and wound care were applied for all patients. Staples and sutures were removed three weeks after surgery.

Demographic features were recorded such as age, gender, and body mass index (BMI). Preoperative ASA score, C-reactive protein and the erythrocyte sedimentation rate (ESR) values were collected from the hospital records. Outcome measures included surgical time, postoperative hospitalization duration, wound complications, and Likert scale level of patient satisfaction. The surgical time was obtained from the operative record and was defined from the time of the first incision until the wound closure was completed.

Surgical site infection was classified according to the Center for Disease Control (CDC) criteria: Superficial incisional, deep incisional and organ/space. Wound dehiscence was recorded if present within the three month follow-up period.

Data were included in a database created via the Excel 2007 programme by Microsoft (Microsoft Corporation, Radmond, Washington, USA). Statistical analysis was done using PASW statistics for Windows (version 18,USA). For the quantitative variables, the normality assumption was checked using the Kolmogorov-Smirnov test. Mean and standard deviation were calculated for parametric variables. The median and interquartile ranges were calculated for non-parametric variables. The qualitative variables were expressed as frequencies and proportions. Fisher's Exact and Chi-Square tests were used for categorical variables. A significance level of $p<0.05$ was considered in all comparisons.

Results

In the demographic analysis of the study cohort, 87.1% (n=74) of the population was female and 12.9% (n=11) was male. The mean age of the patients was 64.6±7.2 years (range: 45-79 years).

There were 42 (49.4%) patients in staples group and 43 (50.6%) patients in prolene group. There was no statistically significant different between the groups in terms of preoperative ASA score, ESR, and CRP values ($p>0.05$). The two groups were comparable in terms of demographic features (Table 1).

Table 1. Comparison of preoperative demographic features between two types of closure methods.

Variable	Staples group (n=42)	Prolene group (n=43)	P value
Age, years	63.7 ±7.9	65.6±6.3	0.262
Gender (male:female)	6:36	5:38	0.715
Side (right:left)	18:24	23:20	0.327
Weight, kg	76.5±11.5	79.1±10.5	0.276
Height, cm	160.4±7.8	159.5±8.6	0.573
BMI, kg/m^2	29.9±5.0	31.3±5.2	0.196
ASA classification	1.6±0.5	1.7±0.5	0.760
ESR, mm/h	22.7±15.9	26.6±15.2	0.251
CRP, mg/dL	0.6±0.7	0.5±0.6	0.426

BMI: Body Mass Index, ASA:American Society of Anesthesiologists, ESR: Erythrocyte Sedimentation Rate, CRP: C Reactive Protein

Surgical time for the staples group averaged 102.6 minutes (sd=10.7) and 106.2 minutes (sd=10.7) for the prolene group ($p=0.097$). Five (11.9%) patients in the staples group and no one in the prolene group developed a complication. The association between closure method and incidence of a wound complication was statistically significant ($p=0.026$).

Complications consisted of three superficial infections, one deep infection, and one wound dehiscence. Patients were treated successfully with debridement and antibiotherapy. None of the complications required a revision arthroplasty operation.

Postoperative hospital duration was similar between groups ($p=0.296$). Likert scale levels of patient satisfaction were similar between the staples group and the prolene group (4.0±1.4 vs 4.4±0.9, respectively; $p=0.248$) (Table 2).

Table 2. Comparison of postoperative outcomes between two type of closure methods.

Characteristic	Staples group (n=42)	Prolene group (n=43)	P value
Hospital stay, days	4.4±1.3	4.2±1.4	0.296
Surgical time, hours	102.6±10.7	106.2±10.7	0.097
Likert satisfaction scale	4.0±1.4	4.4±0.9	0.248
Wound complications	5 (11.9%)	0 (0.0%)	0.026

Discussion

The most important finding of the current study was that wound closure with polipropilene sutures using the vertical mattress technique provided less wound complication rates compared to staples in TKR patients. No study could be found in literature comparing these two methods for knee arthroplasty. However, staples have been compared with different suture material and techniques. Majority of these studies reported comparative complication rates [7,15-18]. Several meta-analyses have reported lower complication rates with staples [9,19]. In the present study, different suture technique and different suture material was used. Polypropylene sutures provide permanent tensile strength preservation of tissue even in the presence of infection [23]. The vertical mattress suture technique has the advantage of good wound eversion and closure of dead space [24]. These factors may explain why prolene provided lower wound complication rates in the present study cohort.

In several studies, barbed sutures have been used for wound closure after knee arthroplasty [25,26]. The investigators reported higher infection rates compared to staples and recommended against the use of barbed sutures for superficial closure after knee arthroplasty. These results may be as a result of overtightening of the barbed suture, which may cause a possible ischemic cutaneous necrosis resulting in dehiscence and superficial infection [26]. In the present study, vertical mattress technique using polypropylene sutures was performed for all patients. No skin necrosis or wound complications were observed in the prolene group.

In the literature, staples have been found to be associated with lower surgical time [7,17]. In the present study, there was no statistically significant difference between groups; however, there was a trend towards significance (p=0.097). These results may be because of the small sample size in the present study.

In the sub-group analysis of a recent meta-analysis, the sub-group included seven studies with patients treated with TKR. The authors compared the infection rates of sutures and staples. The suture group of the meta-analysis included patients treated with subcuticular absorbable and nylon sutures. They found no significant relationship between the groups (12/239 in the suture group; 7/263 in the staples group). The cumulative risk ratio was reported as 1.38 (0.42 to 4.52) in the study [9]. In the current study, different material and different suture technique was applied in the suture group, and satisfactory results were observed with the use of polypropylene sutures using the vertical mattress technique.

This study has several limitations. First, this was a retrospective study and the retrospective design does not allow for the accuracy of prospectively obtained data. Second, the sample size was small. Third, a number of other potential confounding variables which may affect wound healing were not available including steroid use and tourniquet time.

Conclusion

In conclusion, prolene suture using vertical mattress technique provided lower complication rates compared to staples. There was no significant difference between the two groups in terms of surgical time, postoperative hospitalization, and patient satisfaction. Randomized trials with larger sample sizes are needed to confirm the results of this study.

Declaration of conflict of interest

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. There is no conflict of interest to report in this study.

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