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Comparison of Nonabsorbable and Absorbable Suture in Total Knee Arthroplasty

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Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Background: Wound closure of KA is important for postoperative rehabilitation. At present there is still no consensus on the best wound closure technique for KA. We performed the present study to determine whether absorbable suture is better than nonabsorbable suture in total knee arthroplasty (TKA).


Material/Methods: A total of 180 patients who underwent TKA were divided into 3 groups: 80 cases of nonabsorbable suture, 50 cases of 2-0 absorbable suture, and 50 cases of 4-0 absorbable suture. The time required for closure, frequency of gauze change, length of stay in hospital, adverse events, range of motion (ROM) after 3 months postoperatively, and VAS score of wounds were calculated. Comparison was made to explore any significant differences between different groups.

Results: There were significant differences between the nonabsorbable group and the absorbable group with regards to closure time, frequency of gauze change, and hospital length of stay (LOS). Closure time was longer in the absorbable group than in the nonabsorbable group. Frequency of gauze change, hospital LOS, and adverse events were lower, and VAS was higher in the absorbable group. Closure time was longer in the 4-0 absorbable group than in the 2-0 group. There was no significant difference between the 4-0 group and 2-0 group in other variables. There was no significant difference in long-term ROM among all groups.

Conclusions: Absorbable suture in TKA reduces the incidence of fatty liquefaction, frequency of gauze change, and postoperative LOS. It improves the cosmetic appearance and overall reduces the economic cost. There was no significant effect on early and long-term functional ROM. In conclusion, absorbable suture can be used in TKA when appropriately indicated.

MeSH Keywords: **Arthroplasty, Replacement, Knee • Cosmetic Techniques • Suture Techniques**

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Background

With the recent rapid development of knee arthroplasty (KA), orthopedists are seeking approaches to improve any aspect that may affect the results of surgical interventions. Although surgical technique of knee replacement is the most important factor, various other factors like wound closure cannot be ignored. Wound closure of KA is the last step of the procedure, and robust wound closure is required for rapid postoperative rehabilitation. Poor wound closure affects wound healing and can lead to devastating complications such as infection. Presence of other comorbidities can potentially worsen the situation. As a result, wound closure is an important research focus [1].

At present, there is still no consensus on the best wound closure technique for KA: simple suture, biological glue, barbed suture, or skin staple [2–5]. The better cosmetic appearance and convenience of suture removal has made absorbable suture an attractive option and has been used in hospitals for KA wound closure. To determine the best approach for wound closure, the present study compared the characteristics of non-absorbable suture and absorbable suture in a cohort of patients who underwent KA.

Material and Methods

Patients

We enrolled 180 patients undergoing total knee arthroplasty (TKA) from April 2017 to October 2017. Exclusion criteria included patients treated with constraint condylar prosthesis, hinges, and knee revision surgery. According to the admission sequence, patients were grouped into group 1, group 2, and group 3, respectively. Nonabsorbable suture was used in group 1, 4-0 absorbable suture was used in group 2, and 2-0 absorbable suture was used in group 3. A total of 55 patients were male and 125 were female, with an average age of 65.13 years \pm 8.41 years (range, 47–90 years). Out of 180 patients, 20 were diabetic, 39 were hypertensive, and 99 had other comorbidities. All the surgeries were conducted by the same surgeon, using joint prosthesis comprising: a prosthetic joint U2PS Taiwan, Germany LINK Gemini PS and CR prosthesis, US Zimmer NexGen LPS prosthesis, United States Smith-Nephew Genesis II PS prosthesis (Table 1).

Wound closure was completed by 3 attending orthopedists with 5–6 years of experience each. There were 80 cases in which nonabsorbable suture was used, 50 cases in which 2-0 absorbable suture was used, and 50 cases in which 4-0 absorbable

Table 1. Comparison between two types of sutures.

	Total number	Types of suture	
		Nonabsorbable group	Absorbable group
Number of patients	180	80	100
Gender			
Female	126	57	69
Male	54	23	31
Age		65.7 (47–80)	64.67 (47–87)
Prosthesis			
U2PS Taiwan	64	29	35
LINK	56	25	31
Zimmer	51	21	30
Smith-Nephew	9	5	4
Comorbidity			
Diabetes	20	9	11
Hypertension	39	17	22
Other	99	46	53
BMI			
<25	41	18	23
\geq 25	139	62	77

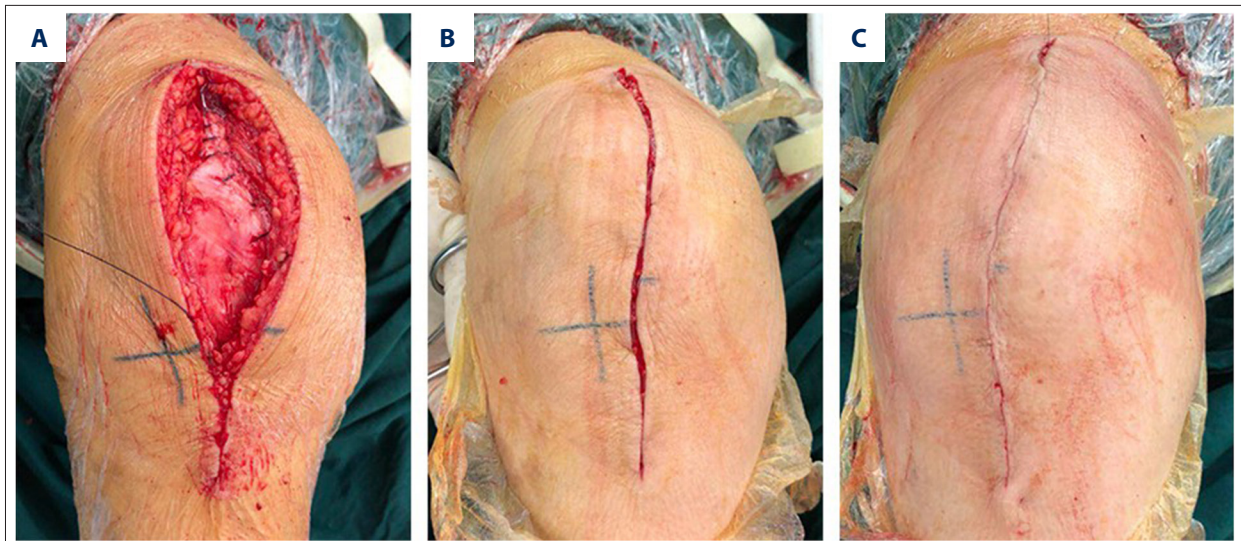


Figure 1. Three layers were sutured. (A) Showed the tendon layer was closed using nonabsorbable suture. (B) Showed the subcutaneous layer was closed using nonabsorbable suture. (C) Showed the skin layer was closed by absorbable suture.

suture was used. The nonabsorbable suture was ETHICON MERSILK® 2-0/T, the 2-0 absorbable wire type was ETHICON Coated VICRYL 2-0 with CT-1 needle, and the 4-0 absorbable wire type was ETHICON Coated VICRYL 2-0 with FS-2 needle. The non-absorbable suture was made of band nonabsorbable wires. The component of absorbable thread was Polyglactin, which was synthesized from 90% glycolide and 10% L-lactide.

Methods

All patient care, handling, and surgical techniques followed protocols approved by the Hong Hui Hospital Ethics Committee.

Medial patellar approach was used in all cases, with an antero-medial incision 15–20 cm long. Soft tissue in the joint was dissected and osteophytes were cleared. After completion of the osteotomy, a test model was used to check lower-limb lines, soft-tissue balance, flexion and extension activities, stability during valgus, and the correct patellar gliding path. The patella was not replaced and only edge osteophytes were cleared. Pulsed water was used to rinse and remove bone fragments and soft-tissue debris. The prosthesis was implanted and fixed using cement. After the cement solidified, the wound was washed and a drainage tube was placed.

The tendon layer of the joint capsule, subcutaneous layer, and the skin layer were closed (Figure 1). The knee was flexed to 45° at the time of closure. The knee was then flexed to more than 90° to check that the closure was competent, and then the rest of the incision was closed. For subcutaneous closure, we included enough tissue to avoid tearing, and care was taken so that the suture was not too close to or too far from the incision. After closing the subcutaneous layer, the competency

was tested again. We used 4-0 nonabsorbable suture, 4-0 absorbable suture, and 2-0 absorbable suture in the different groups. We used the running subcuticular technique for the absorbable suture group and vertical mattress stitching for the nonabsorbable suture group. The differences between these 2 methods are shown in a diagram in Figure 2. The start-point and the end-point of skin closure received special attention when placing sutures.

Treatment after operation

Postoperatively, routine care was taken to control pain, swelling, and infection. Oral rivaroxaban or subcutaneous injection of low molecular weight heparin was given at 12 h postoperatively. A bariatric pressure pump was used on both lower extremities. Patients were encouraged to actively perform ankle movements to improve blood circulation. Passive knee flexion and extension exercises were started on POD1. The bandages were loosened to massage the back of the knee without exposing the wound. After removal of the drainage tube, CPM-assisted exercise was started on POD2. On the 3rd or 4th postoperative day, patients were instructed to walk with the help of a walking aid. Patients were discharged from the hospital 5–16 days postoperatively.

Parameters

The influence of different types of suturing techniques on duration of surgery was observed. Incision closure time and the total operation time were recorded. Gauzes were changed according to wound exudation. The number of gauzes changed and postoperative LOS were recorded. Subjective performance was recorded when patients were discharged from the hospital.

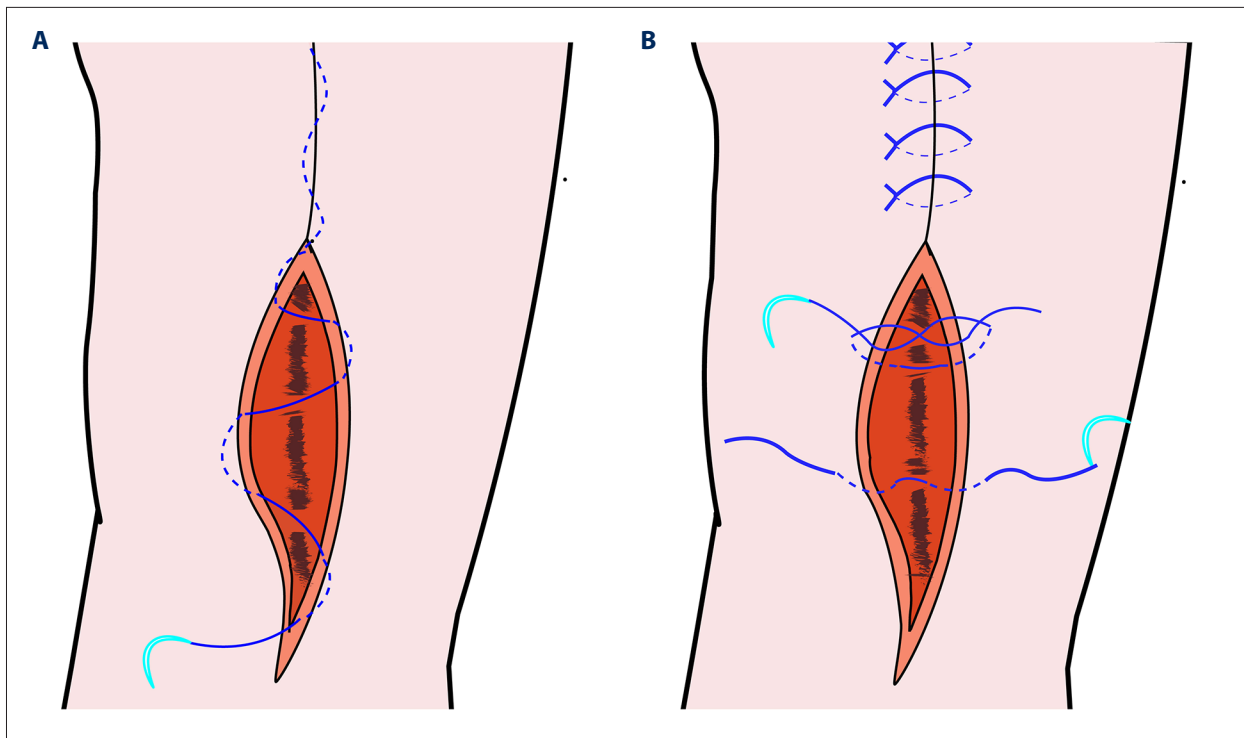


Figure 2. (A) Showed the running subcuticular technique for absorbable suture group. (B) Showed vertical mattress for nonabsorbable suture group. The dotted line means the suture is hidden in the soft tissue. The real line means the suture could be seen from outside.

The first follow-up was set up at 1 month after the operation and the second follow-up was at 3 months. Knee ROM was recorded at 3 months after surgery. The adverse events that were recorded included, but were not limited to, fat liquefaction and skin infections.

The visual analog scale (VAS) was used to evaluate the patients' satisfaction with appearance of the wound. The score ranged from 0 to 100 [6]. If the patients were satisfied with the wound, the score was rated as 100 out of 100 points. The higher the score was, the more satisfied the patients were. The first assessment was made when the patients did not see the wounds of the control group prior to discharge. The second assessment was made after the patients saw the wounds of the control group. The third assessment was made at 3-month follow-up.

Statistical methods

The IBM SPSS 19.0 statistical software package was used to analyze the data. Data are expressed as mean \pm standard deviation. Comparisons between groups were made using the independent-samples *t* test, and test level was $\alpha=0.05$. For adverse events, the chi-square test was used to assess differences between groups, and the test level was $\alpha=0.05$.

Results

The average time for nonabsorbable suturing was 4.79 ± 0.72 min and 8.94 ± 1.50 min for absorbable suturing, with a statistically significant difference between the 2 groups ($p=0.000$). The average time spent in the surgical procedure was 68.36 ± 6.04 min in the nonabsorbable suture group and 72.5 ± 4.53 min in the absorbable suture group, with a statistically significant difference between the 2 groups. The frequency of gauze change was 2.49 ± 0.70 times in the absorbable group and 3.71 ± 1.54 times in the nonabsorbable group, with a statistically significant difference between the 2 groups. The postoperative LOS was 10.41 ± 3.51 days in the nonabsorbable group and 7.88 ± 1.51 days in the absorbable group, with a statistically significant difference between the 2 groups. Follow-up was performed in 72 out of 80 patients in the nonabsorbable group and in 86 of 100 patients in the absorbable group. The average knee ROM was $115.79\pm 12.99^\circ$ in the nonabsorbable group and $113.64\pm 11.47^\circ$ in the absorbable group, with no significant difference between the 2 groups. The average VAS score was 90.69 ± 5.54 in the nonabsorbable group and 93.66 ± 5.05 in absorbable group, with no significant difference between the 2 groups. The average VAS score was 94.76 ± 4.55 in 4-0 the absorbable group and 92.61 ± 5.34 in the 2-0 absorbable group, with no significant difference between the 2 groups. The results are shown in Table 2.

Table 2. Variable comparison between two types of sutures.

	Nonabsorbable and absorbable group		P
	Nonabsorbable	Absorbable	
Duration of closure	4.79±0.72	8.94±1.503	0*
Duration of operation	68.36±6.04	72.54±4.53	0.002*
Frequency of gauze change	3.71±1.54	2.49±0.70	0*
Postoperative LOS	10.41±3.51	7.08±1.51	0*
ROM	115.79±12.99	113.65±11.47	0.568
VAS scale			
Without seeing control	4.79±0.72	8.94±1.503	0*
See control	90.69±5.54	93.66±5.05	0*

Table 3. Variable comparison between 2-0 and 4-0 absorbable suture.

	2-0 vs. 4-0		P
	2-0	4-0	
Duration of closure	8.28±1.64	9.6±0.99	0.004*
Duration of operation	71.62±3.54	73.46±5.21	0.012*
Frequency of gauze change	2.6±0.76	2.38±0.64	0.229
Postoperative LOS	7.2±1.77	6.96±1.20	0.096
ROM	113.75±11.02	113.55±12.06	0.317
VAS scale	92.61±5.34	94.76±4.55	0.121

The average duration of suturing was 8.28±1.64 min in the 2-0 group and 9.60±0.99 min in the 4-0 group, with a significant difference between groups. The average time spent in the surgical procedure was 71.62±3.54 min in the 2-0 group and 73.46±5.21 min in the 4-0 group, with a significant difference between groups. There were no significant differences in frequency of gauze change, postoperative LOS, or ROM at 3-month follow-up. The results are shown in Table 3.

With regards to postoperative wound adverse events in the nonabsorbable group, there were 6 cases of fat liquefaction and aseptic exudate, and the wound healed after changing the gauze several times. There were 3 cases of poorly healed incision in the nonabsorbable suture group, which were removed and 1–2 additional stitches were added in the hospital. One diabetic patient experienced incision dehiscence in the nonabsorbable suture group, which was removed and treated with debridement and re-suturing. Superficial infection occurred in 1 case, which was treated with debridement and intravenous antibiotic.

With regards to postoperative wound adverse events in the absorbable group, there was 1 case of fat liquefaction and the

wound healed after multiple gauze replacements. Subcutaneous nonabsorbable sutures were used in 2 cases and they were removed easily. The incidence of adverse events was compared using the chi-square test and χ^2 was 0.007, with a significant difference. With regards to wound exudation, the chi-square test result was $\chi^2=0.025$ and there was a significant difference.

Discussion

Cosmetic appearance is an important factor influencing patient satisfaction [7]. Although previous studies have reported that there was no significant difference in cosmetic appearance among various methods of suturing [8,9], we found that absorbable suture does influence cosmetics significantly. For this reason, we obtained VAS score at an early stage when the patients did not see the wounds of the control group, and no significant difference between the scores was found. Another VAS score was obtained before patients were discharged from the hospital, and this time they were allowed to see the wounds of the control group. Interestingly, this time there was a significant difference. We obtained a third VAS score at 3-month follow-up, and there was a significant difference again. It can

be inferred from the above observations that absorbable suture is cosmetically superior to nonabsorbable suture.

There is still some skepticism among orthopedic surgeons regarding use of absorbable sutures in KA, probably due to the increased risk of wound dehiscence during flexion exercise. Although some surgeons use biological glue after use of absorbable sutures to reduce the risk of wound dehiscence [10], the increased risk and technical difficulties of using absorbable sutures affect decision making. It is well known that wound dehiscence is affected by the surgical approach [11,12]. All of our patients underwent anterior medial surgical approach and the extent of exercise was similar in each group. In our absorbable group, there was no evidence of wound dehiscence after initiation of knee exercises, probably due to the following reasons. Firstly, the knee was maintained at flexion position during suturing, which can reduce the tension across the incision site during flexion exercise. Secondly, there were 3 layers to resist tension in the nonabsorbable group and only 2 layers in the absorbable group. Hence, in the absorbable group we treat the inner 2 layers carefully and check the efficacy of closure at the end of suturing each layer. Thirdly, we made sure to include more dermis tissue while suturing the last layer.

It is worrisome when the skin edge is sutured too tightly, which in turn hinders draining of liquefaction of subcutaneous fat and exudates. This leads to extensive subcutaneous necrosis and further accumulation of necrotic tissue, causing infection. It has been previously reported that there is no significant difference between nonabsorbable and absorbable sutures with regards to complications [13,14]. On the contrary, we found a lower incidence of liquefaction in the absorbable group than in the nonabsorbable group. Skin incisions in the absorbable group dried up after changing the gauze once or twice. This

reduced the frequency of gauze change and prevented the inconvenience of removing the suture or staple. This may be why running subcuticular closure has a robust perfusion [15].

It has been reported that operations lasting ≥ 110 min or > 120 min have significantly more adverse events [16,17]. Others found that a 15-min increase in operative time had no significant influence [18]. In our study, the average operative time was less than 75 min and was only 4 min longer in the absorbable group. Therefore, we think there is no significant adverse effect caused by an operative time that is 4 min longer.

In the absorbable group, there were 2 cases of subcutaneous nonabsorbable suture excretion from the skin during the follow-up period. This might be due to failure to include more subcutaneous tissue during closure; the thin dermis layer or epidermis layer could have worn out. We suggest including more subcutaneous tissue while suturing the last layer to prevent this. Our study has certain limitations. Although certain factors, like long-term corticosteroid use, history of smoking, peripheral vascular disease, and long-term anti-coagulant, use interfere with wound healing and probably confounded the results, we did not take those into account in our study.

Conclusions

Use of absorbable suture in TKA can reduce the incidence of fatty liquefaction, reduce the frequency of gauze change, reduce hospital LOS, improve cosmetic appearance, and reduce the overall economic expenditure. There is no significant effect on early functional exercise and postoperative long-term ROM. In conclusion, absorbable sutures can be used in TKA when appropriately indicated.

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