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ORIGINAL ARTICLE

Drainage does not Promote Post-operative Rehabilitation After Bilateral Total Knee Arthroplasties Compared With Nondrainage

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Objective To assess the effects of suction drainage *versus* nondrainage on the post-operative rehabilitation of patients receiving primary bilateral total knee arthroplasties (TKA).

Methods A prospective study including 40 patients was conducted. These patients were diagnosed with osteoarthritis and underwent primary bilateral TKA between October 2007 and September 2009 with the same operation team. A suction drainage was placed by randomization in only one knee for each patient, while the other knee as self-control. Pain visual analogue scale score, extremity swelling, wound healing, range of motion and incidence of early post-operative complications between the drained and nondrained group were compared statistically.

Results Each patient was followed up for 12 months. Placing drainage did not relieve the pain, extremity swelling, ecchymosis, or reduce the incidence of early complications (all $P>0.05$).

Conclusions Suction drainage in TKA does not exhibit substantial advantages in promoting post-operative rehabilitation after unsophisticated TKA, compared with nondrainage. On the other hand, it might complicate the surgical operation, and increase the incidence of post-operative hemorrhage and retrograde infection. Thus we do not recommend suction drainage in unsophisticated TKA.

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PLACING closed suction drainage of wound during total knee arthroplasty (TKA) is currently an established routine procedure in clinical practice in China. It is perceived that such a procedure helps to drain blood in the articular cavity, reduce incidence of ecchymosis and infection around the wound, and

prevent other surgical complications, thus benefits the post-operative rehabilitation of patients receiving TKA. However, a literature review failed to find firm evidence from clinical studies in China to support performing the procedure. Some reported closed drainage after TKA can reduce wound complications,¹ while others failed to prove the benefits.²⁻⁴ We conducted a prospective study containing 40 patients who received primary bilateral TKA at our department and were followed up for 12 months, in order

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to assess the effects of closed suction drainage on the post-operative rehabilitation. Each patient had only one drain placed by randomization of side in the bilateral knee replacement, so the patients served as their own controls.

PATIENTS AND METHODS

Patients

The research enrolled 40 patients diagnosed with osteoarthritis in both knees, including 16 male and 24 female patients with an average age of 66.5 (range 49-75) years. These patients had primary bilateral TKA at the author's institution between October 2007 and September 2009. To eliminate the possible subtle influences of age, gender, underlying disease, reaction to medicine and efforts and differences in rehabilitation, the patients served as their own controls. The operations were all performed by the first author, with the same operative technique. A suction drainage was placed by randomization in only one knee for each patient, while the other knee as self-control. Drains were removed 24-48 hours after the operation. And the drainage of the drained side was 440 (range 200-660) ml. All patients received low molecular weight heparin according to the Chinese Guideline of Deep Venous Thrombosis Prevention after Orthopaedic Surgery (Draft),⁵ as prophylaxis for deep vein thrombosis. And each patient had rehabilitation training on the knee joint function under systemic instructions. They were followed up for more than 30 days.

Clinical parameters observed and data collection

The circumference of both legs, at 10 cm above and below the patellae respectively, was measured pre-operatively, on post-operative day 2, 4, 6, 8, and 1 day before discharge. The difference between post- and pre-operative circumference was calculated on each day of measurement. The range of motion (ROM) in flexion and extension movements of both knee joints was measured pre-operatively, on post-operative day 7, 14, 30, and the difference between

post- and pre-operative ROM was calculated. Pain visual analogue scale (VAS) score for both knee joints was evaluated pre-operatively and on post-operative day 1, 3, 5, 7, and 14. ROM of bilateral knees was measured 1 year post surgery. The wound healing and complications were assessed by the same author in each patient.

Statistical analysis

SPSS 12.0 was used for statistical analysis. Incidence of wound complications was analyzed statistically by *fisher* exact test. All the other data were analyzed statistically by paired *t*-test. $P < 0.05$ was considered as significant.

RESULTS

Difference between post- and pre-operative circumference of lower limb at 10 cm above and below the patellae

Statistical analysis showed significant difference in the difference between post- and pre-operative circumference at 10 cm above patellae between the drained and nondrained sides on post-operation day 2 only ($P = 0.035$), and did not show significant difference between the two groups on other days (all $P > 0.05$, Table 1).

The difference between post- and pre-operative circumference at 10 cm below patellae on post-operation showed no statistical significance between the drained and non-drained sides (all $P > 0.05$, Table 1).

ROM in the drained and nondrained sides

At the side with drains, ROM during flexion of knee joints, measured pre-operatively, on post-operative day 7, 14 and 30, were $106.88^\circ \pm 21.29^\circ$, $95.75^\circ \pm 10.77^\circ$, $107.63^\circ \pm 11.49^\circ$, and $119.75^\circ \pm 5.31^\circ$, respectively. While at the side without drains, ROM during flexion measured on the same days were $109.50^\circ \pm 23.12^\circ$, $92.75^\circ \pm 11.60^\circ$, $105.13^\circ \pm 10.22^\circ$, and $119.88^\circ \pm 5.49^\circ$. The post- and pre-operation differences in ROM at the drained side, calculated on post-operative

Table 1. Changes in post-operative bilateral limb circumference at 10 cm above and below patellae[§] ($n=40$)

Group	Difference between post- and pre-operative circumference at 10 cm above patellae (cm)					Difference between post- and pre-operative circumference at 10 cm below patellae (cm)				
	Post-operation day 2	Post-operation day 4	Post-operation day 6	Post-operation day 8	1 day before discharge	Post-operation day 2	Post-operation day 4	Post-operation day 6	Post-operation day 8	1 day before discharge
Nondrained knee	1.80±1.58	1.95±1.68	1.56±1.39	1.30±1.45	0.58±0.99	1.49±1.13	1.95±1.68	1.66±1.39	1.30±1.45	0.59±0.99
Drained knee	2.38±1.94	2.12±1.84	1.72±1.83	1.05±1.61	0.70±1.19	1.24±1.19	2.12±1.84	1.72±1.83	1.05±1.61	0.71±1.19
<i>t</i> value	-2.18	-0.615	-0.568	1.36	-0.95	1.48	1.800	2.100	1.530	1.89
<i>P</i> value	0.035	0.54	0.57	0.18	0.35	0.15	0.079	0.061	0.133	0.07

§: Plus-minus values are means±SD.

day 7, 14 and 30, were $-11.13^{\circ} \pm 20.71^{\circ}$, $-0.75^{\circ} \pm 21.44^{\circ}$, and $12.88^{\circ} \pm 21.09^{\circ}$, while at the nondrained side were $-16.75^{\circ} \pm 3.72^{\circ}$, $-4.38^{\circ} \pm 23.32^{\circ}$, and $10.38^{\circ} \pm 22.57^{\circ}$. The difference in ROM during flexion between knees with and without drains was not statistically significant (all $P > 0.05$).

At the side with drains, ROM during extension of knee joints, measured pre-operatively, on post-operative day 7, 14 and 30, were $4.03^{\circ} \pm 6.88^{\circ}$, $0.50^{\circ} \pm 1.52^{\circ}$, $0.50^{\circ} \pm 1.52^{\circ}$, and $0.10^{\circ} \pm 0.44^{\circ}$, respectively. While at the side without drains, ROM during extension measured on the same days were $3.88^{\circ} \pm 6.55^{\circ}$, $0.63^{\circ} \pm 1.68^{\circ}$, $0.38^{\circ} \pm 1.33^{\circ}$, and $0.10^{\circ} \pm 0.43^{\circ}$. The post- and pre-operation differences in ROM during extension at the drained side, calculated on post-operative day 7, 14 and 30, were $-3.52^{\circ} \pm 5.98^{\circ}$, $-3.53^{\circ} \pm 5.98^{\circ}$, and $3.93^{\circ} \pm 6.76^{\circ}$, while at the nondrained side were $-3.25^{\circ} \pm 5.49^{\circ}$, $-3.50^{\circ} \pm 5.90^{\circ}$, and $3.78^{\circ} \pm 6.35^{\circ}$. The difference in ROM during extension between knees with and without drains was not statistically significant (all $P > 0.05$).

Pain VAS score on the wounds with and without suction drainage

Pain VAS score of the nondrained knee joint evaluated pre-operatively and on post-operative day 1, 3, 5, 7, and 14 were 4.79 ± 2.97 , 6.46 ± 2.38 , 5.20 ± 1.85 , 3.50 ± 2.17 , 3.01 ± 2.17 , and 1.64 ± 1.34 , respectively. While pain VAS score of the drained knee joint evaluated on the same days were 4.47 ± 2.90 , 6.01 ± 2.21 , 5.01 ± 1.83 , 3.28 ± 2.18 , 2.81 ± 2.04 , and 1.60 ± 1.21 , respectively.

The post- and pre-operation differences in pain VAS score on the wounds with suction drainage, calculated on post-operative day 1, 3, 5, 7, and 14, were 6.01 ± 2.21 , 5.01 ± 1.83 , 3.28 ± 2.18 , 2.81 ± 2.04 , and 1.60 ± 1.21 , while without suction drainage were 6.46 ± 2.38 , 5.20 ± 1.85 , 3.50 ± 2.17 , 3.01 ± 2.17 , and 1.64 ± 1.34 , respectively. The difference in pain VAS score on the wounds with and without suction drainage on post-operative day 1 was statistically significant ($P = 0.000$), but not significant on post-operative day 3, 5, 7, and 14 (all $P > 0.05$).

ROM in drained and nondrained side at 1-year follow-up

At the side with drains, ROM of knee joints measured on post-operation 1 year was $122.78^{\circ} \pm 4.57^{\circ}$. While at the side without drains, ROM during flexion measured on the same days was $123.03^{\circ} \pm 4.35^{\circ}$. The difference in ROM between knees with and without drains was not statistically significant ($t = 0.524$, $P = 0.603$).

Wound healing and complications

One patient had wound redness at post-operative day 2 at

the side with drains, but healed well at post-operative day 10. All wounds healed by the first intention, with no early infection. Two patients developed venous thrombosis in the lower limb. One of them had bilateral calf muscular venous thrombosis, the other had calf muscular venous thrombosis at the side without drains. No other complications are found. The difference was not statistically significant by *fisher* exact test ($P = 1.00$).

DISCUSSION

With the ever increasing prevalence of TKA surgeries and improvements in surgical techniques, some perioperative details are now being thoroughly investigated. Controversy exists regarding whether closed suction drainage for wound after primary bilateral TKA have any benefit.

Effect of drainage on the post-operative long term ROM

Our results proved whether placing drainage or not does not make a difference on post-operative 1-year ROM of knees. Hematoma will be stuffed in the knee joint cavities of nondrained side,⁶ and later plenty of scar tissues will be formed after hematoma organization. Theoretically, it is suggested ROM may be reduced. But our results showed no statistically significant difference between drained and nondrained groups. We concluded the reason may be the arduous physical exercise early after the operation. ROM almost reached to 110-130 degrees at post-operative 2 weeks to 4 weeks, and later patients were urged to insist the arduous exercise to remain the ROM. And we got the conclusion that "full" (to the post-operative patients) ROM everyday may prevent the formation of adhesion of scar tissues and ROM will not be reduced then.

Blood loss

Placing drainage is a routine procedure in TKA surgery, which means severe trauma and wound. The total blood loss during and after the surgery can be 600 to 1200 ml, and maybe even more in complicated cases. The use of tourniquet can substantially reduce blood loss during operation to a minimum level, but the problem of post-operation blood loss remains to be solved. Meanwhile, joint replacement surgery is a risk factor for venous thrombosis and pulmonary embolisms. So that patients are routinely given low molecular heparin for prophylaxis. Because of reasons mentioned here, post-operative blood loss accounts for a considerable part of total blood loss, sometimes even much greater than during surgeries. Joint cavity and peripheral hematoma, usually developed after

post-operative blood accumulation, is a predisposing factor for infection. Theoretically, wound drainage can prevent the accumulation of blood in joint cavity, thus avoiding hematoma formation. Besides the advantages mentioned above, placing drainage can reduce ecchymosis, erythema, frequency of dressing replacement, as well as patients' mental disturbance after seeing blood soaked dressings.¹ Thus, 87% of orthopedic surgeons in England place a drain when performing TKA.⁷

However in recent years, more and more literature supports nondrainage in uncomplicated TKA. According to those studies, drainage does not reduce hematoma or wound drainage.⁸ And the use of drainage increases blood loss and chances of blood transfusion after the operation.

Currently, we have not reached a conclusion whether drainage will increase blood loss after operations. Research by Sundraram and Parkinson⁹ showed that there is not significant difference on the post-operative blood hemoglobin level between groups with or without drainage, suggesting that drainage does not increase post-operative blood loss, as well as the amount of blood transfused. Seyfert *et al*¹⁰ reached similar conclusion in a study. While Tao *et al*¹¹ found that dressing exudation from the wound is greater in the group without a drain, but in the drained group, a significant higher level of total post-operative blood loss, as well as drop in blood hemoglobin level 48 hours after operation are observed. Others found that early clamping of the drain tube can reduce the amount of post-operative blood loss, without obvious side effects.^{12, 13} However, none of the researches draw a conclusion to support the use of drainage in uncomplicated TKA.

In our study, we did not take the systemic parameters caused by blood loss as observation parameters for the design of self control. But a visual difference existed for the average drainage is 440 ml in one side but no drainage at all on the other side. And there is no physical examination proving much more occlusive blood loss (such as more ecchymosis or great swelling) on the nondrained side comparing the drained side.

Post-operative complications

Currently, there is no solid evidence showing drainage will increase surgical site infection rate. On the other hand, it is empirically accepted to be preventive. Even so, the presence of a drainage tube provides a possible route for retrograde spreading of bacteria. Jing *et al*¹⁴ reported that in 80 TKA patients with drain, bacteria culture of the subcutaneous segment of drain tube, removed at 24 and 48 hours after operation, reported 1 and 3 cases of test positive staphylococcus epidermidis respectively, which

suggests that drainage could lead to infection, especially placed more than 24 hours. However, Weinrauch¹⁵ did not fully accept the diagnostic value of routine drain tip culture in primary joint arthroplasty. Early infection cases are not found in our study, while mid to late infection cases still needs to be followed up.

Other complications include 2 cases of calf muscular venous thrombosis and 1 case of wound redness, without statistical significance between the two groups.

Character and significance of the research

Compared with previous studies, our research employed self-controls, which to a maximum extent eliminates the possible influences of age, gender, underlying disease, reaction to medicine and efforts and differences in rehabilitation. All TKA operations were performed by the same surgeon with the same technique, with the same type of prosthesis, avoiding possible surgery related violating factors.

Our research focuses more on the rehabilitation of joint function and the subjective feelings of patients. The pain VAS score, extremity swelling, complication rate, recovery of knee function and ROM did not show statistical significance between groups with or without drain. This suggests placing a drain after TKA does not prevent hematoma formation, and reduce swelling, pain and exudation as expected. In our opinion, tight closure of wound as well as suitable compression can maintain an appropriate pressure in the joint cavity, resulting in hemostasis, prevention of ecchymosis and substantial drainage from the wound. Besides, placing a drain tube complicates the operative procedure. It also adds to the mental disturbance of a patient during recovery, such as fear of the drain tube, worries about blood loss and so on.

In conclusion, we recommend not placing drain for patients undergoing uncomplicated TKA.

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