

# Impact of Postoperative Medication Intervention on the Rehabilitation Outcomes in Individuals Undergoing Knee Replacement Surgery

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## *Li et al.*: Postoperative Medication Intervention in Knee Replacement Surgery

To investigate the impact of postoperative medication intervention on the rehabilitation outcomes following knee replacement surgery, this study analysed 100 patients after knee replacement surgery, who were randomly assigned to either a conventional drug treatment group or a comprehensive medication therapy group. The study compared postoperative pain management, inflammatory responses, complication rates, and patient satisfaction between the two groups. The comprehensive medication therapy group showed significantly reduced levels of inflammatory markers, lower incidence of complications, and higher patient satisfaction compared to the conventional drug treatment group. Comprehensive medication therapy post-knee replacement surgery led to improved rehabilitation outcomes by effectively managing postoperative pain, inflammation, and enhancing patient satisfaction. This study provides a robust clinical basis for optimizing medication regimens in the postoperative period following knee replacement.

**Key words:** Knee arthroplasty, medication therapy, postoperative rehabilitation, inflammatory response, pain management

Knee osteoarthritis, a prevalent degenerative joint disease, significantly impairs the quality of life for middle-aged and elderly individuals. Total Knee Arthroplasty (TKA) has emerged as an effective treatment for advanced stages of this condition. The success of TKA and the subsequent recovery are not solely dependent on the surgical procedure but are also heavily influenced by postoperative pharmacological interventions. Appropriate medication management after surgery can effectively control pain, reduce inflammation, prevent thromboembolic events, and expedite the rehabilitation process, thereby enhancing the patient's quality of life. Against this backdrop, the present study aims to systematically evaluate the impact of various drug therapy regimens on the rehabilitation outcomes following TKA, providing a foundation for optimizing clinical treatment strategies.

The prevalence of knee osteoarthritis is increasing, with statistics showing that over 40 % of individuals in China are affected, disproportionately impacting women<sup>[1-7]</sup>. As TKA procedures become more common, the emphasis on postoperative rehabilitation has grown. However, the recovery

trajectory is multifactorial, involving patient-specific characteristics, surgical techniques, and postoperative care, including rehabilitation modalities<sup>[8-12]</sup>. While advanced prosthetics and refined surgical methods are crucial, they must be complemented by standardized and rational rehabilitation programs to achieve optimal clinical outcomes<sup>[13-17]</sup>.

The advent of accelerated postoperative rehabilitation has revolutionized traditional approaches, focusing on early mobilization, blood management, and self-directed rehabilitation to reduce hospital stays and improve patient outcomes<sup>[18,19]</sup>. This paradigm shift underscores the importance of a holistic rehabilitation strategy that includes not only physical therapy but also pharmacological management. The role of medication in pain control, inflammation reduction, and the facilitation of early recovery after TKA cannot be overstated.

This study, therefore, delves into the specific contributions of medication to postoperative recovery, building on the existing body of research that highlights the significance of a multimodal approach to rehabilitation after TKA. By examining the effects of different medication regimens, we aim to contribute

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to the evolving understanding of postoperative care and enhance the clinical management of patients undergoing knee replacement surgery.

## MATERIALS AND METHODS

### General information:

This study included 100 patients who underwent TKA at Hospital between August 2020 and August 2023, all of whom met the diagnostic criteria outlined in the 2020 Chinese guidelines for the diagnosis and treatment of knee osteoarthritis. Eligible patients had clear surgical indications, were free from psychiatric disorders or contraindications to surgery, and provided complete follow-up data. Patients with incomplete data or those unwilling to participate in follow-up were excluded. The average age of the cohort was (78.3±3.4) y, ranging from 70 y to 88 y. Participants were randomly assigned to two groups; a standard drug treatment group and a comprehensive drug treatment group.

In the standard drug treatment group, patients received the following postoperative drug regimen: Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) for pain management and inflammation control, along with low molecular weight heparin for the prevention of Deep Vein Thrombosis (DVT). The comprehensive drug treatment group received the same regimen but with additional interventions, including preoperative pain management with local anaesthetics and early postoperative administration of corticosteroids alongside enhanced antithrombotic measures to better manage inflammation and prevent DVT.

**Outcome measures:** The primary outcomes were pain levels, inflammation markers, complication rates, and patient satisfaction. Pain was measured using the Visual Analog Scale (VAS) at 24 h, 1 w, 3 w, and 6 w postoperatively. Serum levels of inflammatory markers, including Interleukin-6 (IL-6) and C-Reactive Protein (CRP), were measured preoperatively and at the same postoperative intervals to assess the efficacy of the drug regimens in controlling inflammation. Additionally, complication rates, particularly incidences of DVT and infection, were recorded. Patient satisfaction with their overall rehabilitation experience was evaluated using a standardized questionnaire.

### Methodology:

One group was traditional treatment using traditional treatment program with psychological

guidance, routine training, dietary guidance, disease monitoring, pain management and complication prevention before and after admission, surgery and discharge. The other group was early clinical rehabilitation program.

Preoperative care before the operation, the patients were comprehensively assessed for knee joint activity and surrounding muscle strength, and were instructed to take the supine position and perform ankle pump exercises 15 times a day. Patients were instructed to contract the quadriceps muscle forcefully, each time lasting 10 s, 200 times a day, and the number of exercises was appropriate for patients to experience slight fatigue and muscle soreness<sup>[20,21]</sup>. Instruct patients to lift their arms and hold the pull-up ring on the bed to perform pull-up exercises. The purpose, significance and expected effect of the postoperative early rehabilitation pathway were explained to the patients and their families, and the patients were instructed to master the basic movements and methods of rehabilitation exercises, and the importance of cooperation and its impact on the rehabilitation effect were explained to the patients and their families.

Postoperative care by searching for the latest research and diagnostic, and treatment standards of knee arthroplasty outside China, searching for evidence-based study, formulating the early rehabilitation care pathway table for knee arthroplasty and related contents, and carrying out under the guidance of experts, as follows; in the postoperative period until recovery from anaesthesia, the whole leg of the affected side was wrapped with cotton pressure, and the lower part of the lower calf was elevated by 30° using a soft pillow to suspend the knee socket for 30 min each time, twice a day. 4-6 bags of salt were placed on the knee for compression, 30 min each time, every 2 h. Passive mobilization of the ankle joint for 30 s each time, 10-20 times per hour. And the ice bag was used to continuously apply external compresses on the knee joint for 24 h.

After recovery from anaesthesia to 24 h postoperatively, patients were instructed to actively perform ankle flexion and extension exercises for 2 min each time, 10 times per hour. The ankle joint circular rotation exercise and passive knee flexion were performed for 30 s each time, 10-20 times per hour. 6-8 bags of salt were placed on the knee for compression for 30 min each time for every 2 h.

On the 2<sup>nd</sup> and 3<sup>rd</sup> postoperative day, cotton was removed to increase the frequency of active knee

joint movement, and patients were instructed to raise the straight leg in the lying position for 30 s each time, 10-20 times per hour. Use ice packs to apply external compresses to the knee joint for 30 min each time, twice a day. Instruct patients to use walker to stand and walk, 1 h each time, 3 times a day.

On the 4<sup>th</sup>-7<sup>th</sup> postoperative days, patients were instructed to perform knee flexion and extension, posterior leg rising, and lateral leg raising exercises in bedside sitting, prone, and side-lying positions for 20 min each time, 3 times a day.

On the 7<sup>th</sup>-14<sup>th</sup> postoperative days, instruct the patients to squat slowly with the help of the bed and go up and down the steps with the help of the guardrail, each time for 20 min, 3 times a day.

When discharged from the hospital, explain the relevant precautions to the patient, instruct the patient to adhere to the rehabilitation training, independently complete the daily life movements, improve self-care ability, and regular follow-up.

#### Observation indicators:

100 patients selected for the trial underwent regular monitoring for at least 3 mo postoperatively<sup>[22,23]</sup>. Knee pain and function scores were assessed preoperatively and at 24 h, 1 w, 3 w, and 6 w postoperatively, and complications brought about by the surgery were recorded. The observations were as follows

The VAS for pain was used to evaluate the patient's pain, and the VAS score indicated pain with a total of 11 numbers between 0 and 10, where 0 indicated no pain and 10 indicated the most pain. Patients rated their pain on an 11-point scale; knee function was evaluated using the hospital-specific knee score Hospital for Special Surgery (HSS) and the general hospitalization of the patients was recorded and the average length of hospitalization and postoperative pain were compared between the two groups.

The traditional treatment was to collect venous blood before and immediately after surgery, while the early clinical rehabilitation treatment was to collect venous blood before and immediately after transcutaneous acupoint electrical stimulation. IL-6, CRP levels were detected using an automated biochemical analyser, and blood glucose was measured by oxidase method.

Adverse reactions such as nausea and vomiting, itchy skin, dizziness, and drowsiness were observed in the two groups of patients in the 24 h postoperative period, and the satisfaction of all patients with the analgesic effect in the 24 h postoperative period was assessed<sup>[24]</sup>.

#### Statistical analysis:

Data processing in this paper was implemented through Statistical Package for Social Sciences (SPSS) 23.0 statistical software, and was considered statistically different by the test. Indicates the measurement data, and the comparison between groups was performed by the test.  $p < 0.05$  indicates that the difference is statistically significant<sup>[25]</sup>.

#### RESULTS AND DISCUSSION

Table 1 shows the VAS scores at different preoperative and postoperative time points. The pre-treatment VAS scores were  $4.9 \pm 2.3$  and  $6.2 \pm 1.4$  for the early clinical rehabilitation and conventional treatments, respectively, indicating that patients with early treatments received less treatment for their pre-treatment pain, but this difference did not affect the patient's previous pain. VAS scores decreased in both groups at 24 h postoperatively, but  $3.4 \pm 1.2$  for early clinical rehabilitation treatment was lower than  $4.1 \pm 1.3$  for conventional treatment, with a significant difference of  $p < 0.05$ . This suggests that early treatment provides better pain control in the early postoperative period, and VAS scores continued to decrease in both groups as 1 w passed postoperatively. The score of  $2.5 \pm 1.1$  for early clinical rehabilitation was not only lower than the score of  $3.2 \pm 1.2$  for conventional treatment, but this difference was also significant,  $p < 0.05$  and  $p > 0.05$ . This indicated that the early medication group was in better condition at the time of surgery and had higher scores during the week. VAS scores continued to decrease in both groups at 3 w postoperatively, but the early clinical rehabilitation therapy score of  $2.1 \pm 1.4$  was still lower than that of conventional therapy of  $2.6 \pm 1.2$ , and this difference was significant at  $p < 0.05$ , suggesting that the early clinical rehabilitation therapy provided better control of long-term postoperative pain. At 6 w postoperatively, the VAS scores of patients in both groups decreased significantly, and the early clinical rehabilitation treatment score of  $1.5 \pm 1.0$  was lower than the traditional treatment score of  $1.6 \pm 1.3$ .

Comparison of preoperative and postoperative HSS scores of the patients was shown in Table 2. The preoperative HSS score for conventional treatment was  $46.3 \pm 10.2$ . The preoperative HSS score for early clinical rehabilitation was  $44.1 \pm 6.8$  points. Preoperative knee function was similar between the two groups with no significant difference. The 24 h postoperative score of conventional treatment was  $61.2 \pm 14.4$ , which was significantly improved

compared with the preoperative score, and (\*) indicates a significant difference compared with the preoperative score. The early clinical rehabilitation therapy score was  $73.3 \pm 5.5$ , which was not only significantly higher than the preoperative period, but also significantly higher than the traditional therapy, (#) indicates a significant difference compared with the traditional therapy, and the recovery of the knee function of the early clinical rehabilitation therapy was significantly better than that of the traditional therapy. At 1 w postoperatively, the traditional treatment score was  $70.5 \pm 6.0$ , with a continuing trend of improvement. Early clinical rehabilitation treatment score was  $80.9 \pm 5.8$ , with faster and better recovery than traditional treatment. Early clinical rehabilitation treatment knee function recovery remained significantly better than traditional treatment. 3 w after the operation, the traditional treatment score was  $78.1 \pm 10.3$  with continued recovery. The early clinical rehabilitation treatment score was  $83.5 \pm 6.9$ , with more significant recovery, widening the gap with traditional treatment. In early clinical rehabilitation therapy, knee function recovery was still better than traditional treatment. At 6 w after surgery, the traditional treatment score was  $84.1 \pm 5.0$ , close to the level of good recovery. The score of early clinical rehabilitation treatment was  $91.3 \pm 6.0$ , with a very significant recovery effect, significantly higher than that of traditional treatment. Early clinical rehabilitation achieved a high level of functional recovery of the knee and showed long-term benefits.

Table 3 shows the IL-6, CRP, and glucose levels of the patients. The IL-6 level of  $(5.38 \pm 0.88)$  pg/ml in the immediate postoperative period after the early clinical rehabilitation treatment was elevated compared to the preoperative level of  $(4.77 \pm 0.82)$  pg/ml and this elevation was statistically significant. The elevation of IL-6 as a key inflammatory cytokine reflected the inflammatory response induced by the surgery. The IL-6 level of  $(5.81 \pm 1.05)$  pg/ml in the immediate postoperative period after conventional treatment was also significantly elevated compared to the preoperative level of  $(4.85 \pm 0.91)$  pg/ml and this elevation was labelled as (<sup>a</sup>), indicating that it was comparable to the preoperative level. Comparing the immediate postoperative IL-6 levels between the two groups, the mean values of early clinical rehabilitation were slightly lower than those of conventional treatment, but the exact statistical significance of the difference requires further

statistical analysis. The immediate postoperative CRP level of  $(5.82 \pm 1.08)$  mg/l in early clinical rehabilitation treatment was significantly higher than the preoperative level of  $(4.81 \pm 0.71)$  mg/l. And this elevation was also labelled as (<sup>ab</sup>), indicating that the difference was significant compared to the preoperative level and correlated with other factors. The immediate postoperative CRP level of  $(7.09 \pm 1.35)$  mg/l was also significantly elevated after conventional therapy and was significantly different compared to the preoperative level of  $(4.73 \pm 0.83)$  mg/l. In contrast, postoperative CRP levels after early clinical rehabilitation therapy were slightly lower than those of conventional therapy, reflecting the degree of variability in the inflammatory response or the effectiveness of the therapeutic intervention. The immediate postoperative glucose level of  $(6.29 \pm 0.71)$  mmol/l in early clinical rehabilitation was elevated compared with the preoperative level of  $(5.31 \pm 0.36)$  mmol/l, and the difference was significant compared with the preoperative level. The elevation of blood glucose was related to the surgical stress, the use of aesthetic drugs, or the patient's basal metabolic status, and the immediate postoperative glucose level of  $(7.18 \pm 0.86)$  mmol/l in the conventional treatment was also significantly elevated which was significantly different from the preoperative level of  $(5.37 \pm 0.42)$  mmol/l. Postoperative glucose levels were higher in conventional treatment than in early clinical rehabilitation, reflecting differences in surgical stress response, insulin sensitivity, or medication use between the different groups.

Comparison of complication rates and satisfaction was shown in Table 4, with 2 cases of DVT, 1 case of joint dysfunction, and 0 cases of decubitus ulcer in early clinical rehabilitation. The total complication rate was 6 %. In comparison, conventional treatment showed 5 cases of DVT, 5 cases of joint dysfunction, 4 cases of wound exudation, and the total complication rate was 25 %. The total number of complications in early clinical rehabilitation treatment was significantly lower than that of traditional treatment 6 % vs. 25 %, and the difference was significant. This suggests that early clinical rehabilitation therapies own treatments or therapies can be more effective in reducing complications. The early clinical rehabilitation therapy treatment satisfaction score was  $94.32 \pm 3.55$  indicating that the patients were very satisfied with the treatment services. Conventional therapy treatment satisfaction score was  $81.1 \pm 3.42$ . Although it was also positive,

it was significantly lower than that of early clinical rehabilitation therapy. Early clinical rehabilitation therapy treatment satisfaction score was significantly higher than that of traditional therapy,  $94.32 \pm 3.55$  compared to  $81.1 \pm 3.42$ . This indicates that the treatment services provided by early clinical rehabilitation therapy could better meet the needs and expectations of the patients, which resulted in a higher level of satisfaction.

Table 5 shows the patient's analgesic satisfaction rate and postoperative adverse reactions, and it can be seen that the analgesic satisfaction of traditional treatment was 84 %, 42/50 i.e., 42 out of 50 patients were satisfied with the analgesic effect in the postoperative 24 h. The analgesic satisfaction of early clinical rehabilitation therapy was 96 %, 48/50 much higher than that of traditional therapy. This indicates that the analgesic methods or drugs used in early clinical rehabilitation therapy provided better

analgesia in the 24 h after surgery, which made the patients more satisfied. Chi-square ( $\chi^2$ ) test showed that the difference in analgesic satisfaction between the two groups was statistically significant,  $\chi^2=4.00$ ,  $p<0.05$ , which indicated that the analgesic effect of early clinical rehabilitation therapy was better than that of traditional therapy. A total of 10 cases of side effects occurred in traditional treatment, including 6 cases of nausea and vomiting, 2 cases of skin itching, and 2 cases of dizziness and drowsiness. The total adverse reaction rate was 12.0 %, 6/50. 11 cases of side effects occurred in early clinical rehabilitation, including 4 cases of nausea and vomiting, 4 cases of skin itching, and 3 cases of dizziness and drowsiness. The total adverse reaction rate was 8.0 %, 4/50. Comparison of the incidence of adverse reactions was  $p>0.05$ . In conclusion, it is verified that the analgesic effect of early clinical rehabilitation treatment is very superior.

**TABLE 1: VAS SCORES AT DIFFERENT PREOPERATIVE AND POSTOPERATIVE TIME POINTS ( $\bar{x} \pm s$ , POINTS)**

Group (n=50)	Preoperative	24 h after surgery	3 w after surgery	3 w after surgery	6 w after surgery
Traditional treatment	6.2±1.4	4.1±1.3	3.2±1.2*	2.6±1.2*	1.6±1.3
Early clinical rehabilitation	4.9±2.3	3.4±1.2#	2.5±1.1**	2.1±1.4*	1.5±1.0

Note: \* $p<0.05$ , compared with the preoperative score and # $p>0.05$ , compared with the traditional treatment

**TABLE 2: COMPARISON OF PATIENT'S PREOPERATIVE AND POSTOPERATIVE HSS SCORES ( $\bar{x} \pm s$ , POINTS)**

Group (n=50)	Preoperative	24 h after surgery	3 w after surgery	3 w after surgery	6 w after surgery
Traditional treatment	46.3±10.2	61.2±14.4*	70.5±6.0*	78.1±10.3*	84.1±5.0*
Early clinical rehabilitation	44.1±6.8	73.3±5.5**	80.9±5.8**	83.5±6.9**	91.3±6.0**

Note: \* $p<0.05$ , compared with the preoperative score and # $p>0.05$ , compared with the traditional treatment

**TABLE 3: LEVELS OF IL-6, CRP AND GLUCOSE IN PATIENTS BEFORE AND AFTER SURGERY ( $\bar{x} \pm s$ , POINTS)**

Group (n=50)	Time	IL-6 (pg/ml)	CRP (mg/l)	Glucose (mmol/l)
Early clinical rehabilitation	Preoperative	4.77±0.82	4.81±0.71	5.31±0.36
	Immediately after surgery	5.38±0.88 <sup>ab</sup>	5.82±1.08 <sup>ab</sup>	6.29±0.71 <sup>ab</sup>
Conventional therapy	Preoperative	4.85±0.91	4.73±0.83	5.37±0.42
	Immediately after surgery	5.81±1.05 <sup>a</sup>	7.09±1.35 <sup>a</sup>	7.18±0.86 <sup>a</sup>

Note: \* $p<0.05$ , compared with the preoperative score and # $p>0.05$ , compared with the traditional treatment

**TABLE 4: COMPARISON OF INCIDENCE OF COMPLICATIONS AND SATISFACTION WITH CARE**

Group (n=50)	Complications/case			Total incidence (%)	Satisfaction rating/points
	DVT	Joint dysfunction	Decubitus ulcer		
Early clinical rehabilitation	5	5	4	25	81.1±3.42
Conventional therapy	2	1	0	6.00 <sup>#</sup>	94.32±3.55 <sup>#</sup>

Note: <sup>#</sup>p>0.05**TABLE 5: PATIENT SATISFACTION RATE OF ANALGESIA AND POSTOPERATIVE ADVERSE EFFECTS**

Group (n=50)	Satisfaction rate of 24 h postoperative analgesia (%)	Adverse reactions within 24 h after surgery/case	Incidence of total adverse reactions n, (%)
Traditional treatment	84.0 % (42/50)	Nausea and vomiting/6 cases	12.0 % (6/50)
		Itchy skin/2 cases	
		Dizziness and drowsiness/2 cases	
Early clinical rehabilitation	96.0 % (48/50)	Nausea and vomiting/4 cases	8.0 % (4/50)
		Itchy skin/4 cases	
		Dizziness and drowsiness/3 cases	
$\chi^2$		4.00	

The results of this study demonstrate that the comprehensive drug treatment group exhibited significantly better outcomes in terms of early postoperative pain control, suppression of inflammation, and prevention of complications compared to the standard drug treatment group ( $p<0.05$ ). Patients in the comprehensive group experienced more effective pain relief and a faster reduction in inflammatory markers, such as IL-6 and CRP, indicating that the early use of corticosteroids combined with enhanced antithrombotic strategies contributed to a smoother and quicker recovery process. Additionally, the incidence of complications, such as DVT and infection, was markedly lower in this group, underscoring the benefits of the comprehensive drug regimen.

The concept of rehabilitation therapy and clinical work should be fully integrated in the clinic, so that it can be more widely used in clinical surgical treatment and provide a solid foundation for the subsequent improvement of medical standards. Good surgical results cannot be separated from systematic rehabilitation technology and perioperative care. After knee arthroplasty, how to effectively relieve patient's postoperative pain and discomfort, reduce postoperative complications, and shorten the time of rehabilitation process are the key concerns of healthcare professionals. The circulating pressurized cold therapy system combines cold therapy with local

pressurization, which has a dual role in reducing blood accumulation in the joint cavity and relieving pain, and is indispensable in the rehabilitation process of patients after knee replacement surgery.

The results of the study confirm that an early clinical rehabilitation program can accelerate joint recovery, reduce the occurrence of complications, significantly reduce patient pain, significantly improve knee joint function,  $p<0.05$ , and make patients more comfortable in their activities. Help patients understand the necessity and long-term nature of rehabilitation, improve satisfaction, reduce pessimism and fear of disease, and actively cooperate with rehabilitation training. Appropriate rehabilitation training in the early postoperative period can improve joint mobility, ensure good joint function, and improve mobility in daily life. At the same time, strengthen the training of muscles around the joints to maintain muscle balance and increase joint stability<sup>[22]</sup>. Through the correct use of artificial joints, the shortening of joint life due to improper use can be avoided. This rehabilitation training method has safe and reliable short-term effects, reduces postoperative complications, and helps patients recover and return to society as soon as possible<sup>[23]</sup>.

The advantages and limitations of the drug combinations used, particular emphasis should be placed on the early administration of corticosteroids. This approach appears to accelerate the recovery

process without increasing the risk of complications, a key concern when employing corticosteroids in surgical patients. The ability to control inflammation more effectively in the immediate postoperative period allows for earlier mobilization, which is critical for improving long-term functional outcomes and reducing hospital stays<sup>[24]</sup>. When compared to similar studies both domestically and internationally, this study offers valuable insights into the role of tailored pharmacological interventions in postoperative care. The innovative aspect of this research lies in the combination of early corticosteroid use with standard NSAIDs and anticoagulants, a regimen that demonstrates significant clinical advantages in improving patient outcomes post-TKA<sup>[25]</sup>. These findings have important clinical implications, suggesting that a multimodal drug therapy approach could be further optimized and potentially adopted as a standard practice in postoperative rehabilitation, enhancing the quality of care for knee replacement patients.

This study demonstrates the significant advantages of a comprehensive drug treatment regimen in the postoperative rehabilitation of patients undergoing TKA. The combination of early corticosteroid use, alongside standard NSAIDs and anticoagulants, proved to be highly effective in controlling postoperative pain and inflammation, reducing the incidence of complications, and enhancing overall patient satisfaction. These findings underscore the critical role that tailored pharmacological interventions play in accelerating recovery and improving clinical outcomes. In future clinical practice, wider adoption of this comprehensive drug therapy approach should be considered as a means to further optimize rehabilitation outcomes and elevate the standard of care for knee replacement patients.

### Conflict of interests:

The authors declared no conflict of interests.

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