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Prevalence of Acute Postoperative Pain and Its Associated Risk Factors in Patients Undergoing Laparoscopic Hysterectomy

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ABSTRACT

Introduction: Acute postoperative pain remains a common concern following laparoscopic hysterectomy despite its minimally invasive nature. Pain severity is influenced by a complex interplay of patient characteristics, preexisting pain, psychological factors, surgical technique, and perioperative management. Identifying high-risk patients is essential for optimizing analgesic strategies, enhancing recovery, and preventing long-term pain-related complications.

Material and methods: This observational study prospectively collected demographic and perioperative clinical data and followed patients through structured telephone interviews up to six months after surgery. Acute and chronic postoperative pain were assessed using validated numeric scales, alongside analgesic use and functional impact, allowing comprehensive evaluation of pain severity, distribution, and its influence on daily activities.

Results: In this cohort of women undergoing laparoscopic hysterectomy, postoperative pain declined progressively over time, with most patients achieving minimal pain by six months. Although chronic postsurgical pain affected a minority, pelvic and incisional pain predominated. Analgesic requirements varied, while functional impairment was generally limited, highlighting favorable pain recovery trajectories overall.

Conclusion: these findings reinforce the effectiveness of laparoscopic hysterectomy as a minimally invasive procedure with generally favorable pain and functional outcomes, while also highlighting the complexity of pain recovery in a minority of patients.

Introduction

Acute postoperative pain remains one of the most common and clinically significant complications following surgical procedures, directly affecting patient recovery, satisfaction, and overall outcomes. Despite advances in minimally invasive techniques and perioperative pain management, inadequate control of acute pain continues to be reported across a wide range of surgical populations. Poorly managed postoperative pain is associated with delayed mobilization, prolonged hospitalization, increased healthcare costs, and an elevated risk of chronic pain development. As a result, understanding the prevalence and determinants of acute postoperative pain has become a central focus of modern perioperative care and surgical research (1).

Hysterectomy is among the most frequently performed gynecologic surgeries worldwide and is commonly indicated for benign conditions such as uterine fibroids, abnormal uterine bleeding, endometriosis, and pelvic organ prolapse. Over recent decades, laparoscopic hysterectomy has increasingly replaced open abdominal approaches due to its association with reduced surgical trauma, smaller incisions, shorter hospital stays, and faster recovery. Nevertheless, even with minimally invasive techniques, a substantial proportion of patient’s experience moderate to severe acute postoperative pain, suggesting that surgical

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approach alone does not fully mitigate pain burden (2). Acute pain following laparoscopic hysterectomy is multifactorial in origin and may arise from visceral manipulation, peritoneal irritation, pneumoperitoneum-induced diaphragmatic stretching, trocar site trauma, and inflammatory responses triggered by tissue injury. Additionally, referred shoulder pain related to residual carbon dioxide and neural sensitization contributes to postoperative discomfort. These diverse pain mechanisms complicate both assessment and management, underscoring the importance of identifying specific risk factors that predispose patients to heightened pain experiences after surgery (3).

The prevalence of acute postoperative pain varies widely across studies, reflecting differences in surgical techniques, anesthetic strategies, pain assessment tools, and patient populations. While laparoscopic hysterectomy is generally associated with less pain compared with open surgery, reported rates of clinically significant pain remain considerable. Variability in pain prevalence highlights the need for context-specific evaluations that consider demographic, clinical, and procedural factors within defined populations. Such evaluations are essential for tailoring pain management strategies and optimizing postoperative care pathways (4).

Patient-related factors play a crucial role in shaping postoperative pain experiences. Age, body mass index, psychological status, pain sensitivity, and preexisting chronic pain conditions have all been implicated as determinants of acute postoperative pain severity. Younger patients and those with heightened pain perception or anxiety may report more intense postoperative pain. Moreover, comorbid conditions such as diabetes, inflammatory disorders, and depression can influence pain modulation pathways, further complicating pain outcomes after laparoscopic hysterectomy (5).

Preoperative pain and analgesic use are among the most consistently reported predictors of postoperative pain intensity. Patients presenting with pelvic pain prior to hysterectomy, particularly those with endometriosis or chronic pelvic pain syndromes, may exhibit central sensitization that persists after surgery. This phenomenon can result in exaggerated postoperative pain responses and reduced effectiveness of standard analgesic regimens. Identifying patients with preexisting pain conditions is therefore critical for risk stratification and personalized pain management planning (6).

Surgical factors also significantly influence the development of acute postoperative pain. The duration of surgery, extent of tissue dissection, number and size of trocar incisions, and use of energy devices may all affect postoperative pain severity. Longer operative times are often associated with increased inflammatory responses and tissue trauma, while extensive manipulation of pelvic structures can exacerbate visceral pain. Variations in surgeon experience and technique further contribute to heterogeneity in postoperative pain outcomes (7).

Anesthetic and perioperative management strategies represent another important domain influencing postoperative pain prevalence. The choice of anesthesia, use of regional blocks, intraoperative opioid administration, and implementation of multimodal analgesia protocols can markedly alter pain trajectories. Enhanced recovery after surgery programs emphasize opioid-sparing approaches and early mobilization, yet their effectiveness may vary depending on patient risk profiles and institutional practices. Understanding how perioperative analgesic strategies interact with patient and surgical factors is essential for improving pain control (8).

Psychological and psychosocial variables have gained increasing attention as determinants of postoperative pain. Anxiety, depression, catastrophizing, and negative pain expectations have been shown to amplify pain perception and increase analgesic requirements. In the context of gynecologic surgery, concerns related to fertility, body image, and sexual function may further influence emotional responses and pain experiences. Incorporating psychological assessment into preoperative evaluation may help identify patients at increased risk of severe postoperative pain (9).

Sex- and gender-specific factors are also relevant in the assessment of postoperative pain following hysterectomy. Hormonal fluctuations, pain processing differences, and sociocultural influences may shape pain reporting and coping behaviors. Additionally, variations in indications for hysterectomy, such as benign versus malignant disease, may affect both physical and emotional dimensions of pain. These considerations highlight the complexity of pain assessment in gynecologic surgical populations (10).

Despite the clinical importance of acute postoperative pain, pain assessment remains challenging due to its subjective nature. Commonly used tools such as numeric rating scales and visual analog scales rely on patient self-report and may be influenced by individual expectations and communication styles. Nevertheless, standardized pain assessment remains essential for identifying patients with inadequately controlled pain and evaluating the effectiveness of analgesic interventions. Accurate measurement of pain prevalence is a prerequisite for meaningful risk factor analysis (11).

Uncontrolled acute postoperative pain has implications that extend beyond the immediate postoperative period. Persistent nociceptive input and central sensitization may contribute to the transition from acute to chronic pain, adversely affecting long-term quality of life. Chronic post-hysterectomy pain has been associated with

functional impairment, psychological distress, and reduced sexual satisfaction. Early identification and management of patients at risk for severe acute pain may therefore have lasting benefits beyond the initial recovery phase (12).

From a health systems perspective, postoperative pain is closely linked to resource utilization and patient satisfaction. Patients experiencing severe pain are more likely to have delayed discharge, unplanned readmissions, and increased use of healthcare services. In the era of value-based care, improving postoperative pain outcomes is not only a clinical priority but also an economic imperative. Studies examining pain prevalence and risk factors can inform institutional policies and quality improvement initiatives (13).

Despite existing literature on postoperative pain in gynecologic surgery, data specifically addressing the prevalence and determinants of acute pain after laparoscopic hysterectomy remain limited and sometimes inconsistent. Many studies focus on analgesic efficacy rather than comprehensive risk factor analysis, leaving gaps in understanding the multifaceted contributors to pain. Furthermore, variations in study design and patient characteristics limit the generalizability of findings across different clinical settings (14).

Identifying population-specific risk factors for acute postoperative pain is particularly important in regions where cultural, genetic, and healthcare system differences may influence pain perception and management. Local data can guide clinicians in tailoring perioperative analgesic strategies and allocating resources more effectively. Such studies also provide a foundation for developing predictive models that enable personalized pain management approaches (15).

Given these considerations, the present study aims to evaluate the prevalence of acute postoperative pain and identify its associated risk factors in patients undergoing laparoscopic hysterectomy. By examining patient, surgical, and perioperative variables, this study seeks to enhance understanding of pain determinants in this population and contribute to evidence-based strategies for improving postoperative pain control and patient outcomes.

Material and methods

Study Design: This study was designed as a descriptive–analytical observational study aimed at evaluating the characteristics of acute and chronic postoperative pain following surgery. Patients undergoing the target surgical procedure were prospectively followed to assess pain intensity, distribution, analgesic requirements, and the impact of pain on daily activities over predefined postoperative time points.

Sample Size Estimation and Sampling Method: The sample size was estimated based on the feasibility of patient recruitment during the study period and the expected prevalence of postoperative pain reported in previous literature. Considering similar observational studies and allowing for adequate statistical power to detect clinically meaningful associations, eligible patients were enrolled using a convenience sampling method. All patients meeting the inclusion criteria during the study period were consecutively recruited until the desired sample size was achieved.

Inclusion and Exclusion Criteria: Eligible participants included adult patients who underwent the specified surgical procedure, were able to communicate effectively, and consented to postoperative follow-up assessments. Inclusion criteria required patients to be available for telephone follow-up at one week, one month, three months, and six months after surgery. Exclusion criteria included preexisting severe cognitive impairment, inability to reliably report pain intensity, history of chronic pain conditions unrelated to the surgical site, ongoing use of long-term opioid therapy, postoperative complications directly responsible for pain persistence, and any underlying medical or neurological conditions that could confound pain assessment. Patients who declined participation or were lost to follow-up were also excluded from the final analysis.

Study Procedure: Baseline demographic data and perioperative clinical variables were recorded for each patient, including age, sex, body mass index, American Society of Anesthesiologists (ASA) classification, surgical side, duration of surgery, anesthesia time, and relevant comorbidities. Pain assessment was conducted using a structured questionnaire during scheduled telephone follow-ups at one week, one month, three months, and six months postoperatively. Data collected included pain intensity, pain location, frequency and duration of pain episodes, and analgesic consumption.

Acute postoperative pain was evaluated using the Numeric Rating Scale (NRS), where patients rated their pain intensity from 0 (no pain) to 10 (worst imaginable pain). Pain scores were recorded both at rest and during movement to capture functional pain differences. Chronic postsurgical pain was defined as pain persisting for at least three months after surgery that could not be attributed to surgical complications or other underlying conditions. Chronic pain intensity, distribution, and its impact on daily activities were assessed using NRS scores and a standardized Activities of Daily Living (ADL) questionnaire during follow-up interviews.

Statistical Analysis: Statistical analyses were performed using appropriate statistical software. Continuous variables were presented as mean ± standard deviation or median with interquartile range, depending on data distribution, while

categorical variables were expressed as frequencies and percentages. Comparisons between groups were conducted using independent t-tests or Mann–Whitney U tests for continuous variables and chi-square or Fisher's exact tests for categorical variables. Longitudinal changes in pain intensity were analyzed using repeated-measures techniques where appropriate. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations: The study protocol was reviewed and approved by the Ethics Committee of Tabriz University of Medical Sciences (Ethics Code: IR.TBZMED.FMD.REC.1404.211). All procedures were conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrollment. Patient confidentiality was strictly maintained, and all collected data were anonymized and used solely for research purposes.

Results

The study population consisted of middle-aged women undergoing laparoscopic hysterectomy, with a relatively homogeneous demographic and perioperative profile. Most patients had a moderate body mass index and were classified as ASA physical status I or II, indicating an overall low to moderate anesthetic risk. Benign gynecological conditions, particularly uterine fibroids and abnormal uterine bleeding, represented the predominant surgical indications. The procedures were performed under general anesthesia with a consistent operative duration, reflecting standardized surgical practice. Comorbid conditions such as hypertension and diabetes were present in a minority of patients, while the majority had no documented chronic illnesses. Hospital stay was generally short, consistent with minimally invasive surgery and enhanced recovery protocols, suggesting a stable perioperative course across the cohort (table 1).

Table 1. Baseline Demographic and Perioperative Clinical Characteristics of the Study Population

Variable	Value
Number of patients, n	120
Age (years), mean ± SD	47.6 ± 8.9
Sex, n (%)	
Female	120 (100)
Body mass index (kg/m²), mean ± SD	28.4 ± 4.1
ASA physical status, n (%)	
ASA I	42 (35.0)
ASA II	61 (50.8)
ASA III	17 (14.2)
Indication for surgery, n (%)	
Uterine fibroids	54 (45.0)
Abnormal uterine bleeding	38 (31.7)
Endometriosis	19 (15.8)
Other benign conditions	9 (7.5)
Duration of surgery (minutes), mean ± SD	112.3 ± 28.6
Type of anesthesia, n (%)	
General anesthesia	120 (100)
Presence of comorbidities, n (%)	
Hypertension	26 (21.7)
Diabetes mellitus	18 (15.0)
No comorbidity	76 (63.3)
Length of hospital stay (days), median (IQR)	2 (1–3)

Postoperative pain assessment demonstrated a clear distinction between acute and longer-term pain trajectories following laparoscopic hysterectomy. Pain intensity was more pronounced during movement than at rest in the immediate postoperative period, highlighting the functional component of early postoperative discomfort. Over time, pain scores steadily declined, indicating progressive recovery and effective resolution of acute surgical pain for most patients. Nevertheless, a subset of individuals continued to report persistent pain at later follow-up, consistent with chronic postsurgical pain. Among these patients, pelvic and incisional pain were the most frequently reported patterns, suggesting both visceral and somatic contributions. Analgesic requirements varied, with nearly half of the cohort achieving adequate pain control without medication, while others required non-opioid or opioid analgesics, reflecting heterogeneity in pain experience. Importantly, the majority of patients reported no meaningful limitation in daily activities, although a smaller proportion experienced residual functional

impairment, underscoring the clinical relevance of chronic pain beyond pain intensity alone (table 2).

Table 2. Acute and Chronic Postoperative Pain Outcomes Following Laparoscopic Hysterectomy

Outcome	Value
Acute postoperative pain (NRS), mean ± SD	
At rest (24 hours)	4.1 ± 1.3
During movement (24 hours)	5.6 ± 1.5
Pain intensity during follow-up (NRS), mean ± SD	
1 week	3.8 ± 1.4
1 month	2.6 ± 1.2
3 months	1.5 ± 0.9
6 months	0.9 ± 0.7
Chronic postsurgical pain (CPSP), n (%)	
Presence of CPSP at 3 months	26 (21.7)
Pain location among patients with CPSP, n (%)	
Pelvic pain	11 (42.3)
Incisional pain	9 (34.6)
Combined pain	6 (23.1)
Analgesic requirement during follow-up, n (%)	
No analgesic use	58 (48.3)
Non-opioid analgesics only	44 (36.7)
Opioid use	18 (15.0)
Impact on activities of daily living (ADL), n (%)	
No limitation	79 (65.8)
Mild limitation	28 (23.4)
Moderate to severe limitation	13 (10.8)

Figure 1 illustrates a consistent and clinically meaningful decline in postoperative pain intensity following laparoscopic hysterectomy. Mean NRS scores were highest during the early postoperative period, reflecting acute surgical pain, and subsequently decreased in a stepwise manner across all follow-up time points. The most pronounced reduction was observed between the first postoperative week and the first month, indicating rapid early recovery, while pain levels continued to diminish more gradually thereafter. By six months, pain scores approached minimal levels in the majority of patients, suggesting effective resolution of postoperative discomfort for most of the cohort. This temporal pattern underscores the predominantly self-limiting nature of postoperative pain after minimally invasive hysterectomy, while also highlighting the importance of longitudinal assessment to identify patients at risk for persistent pain.

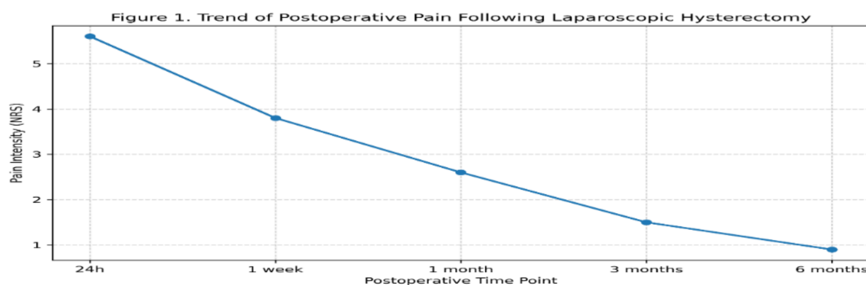

Figure 1. Trend of postoperative pain following laparoscopic hysterectomy

Figure 2 delineates the distribution of chronic postsurgical pain characteristics and postoperative analgesic requirements following laparoscopic hysterectomy. Among patients who developed chronic postsurgical pain, pelvic pain emerged as the most prevalent presentation, followed by incisional pain, while a smaller proportion reported combined pain patterns, indicating the coexistence of visceral and somatic pain mechanisms. Analysis of analgesic use revealed substantial variability in postoperative pain management needs, with nearly half of the cohort achieving satisfactory pain control without pharmacological intervention. In contrast, a considerable proportion required non-opioid analgesics, and a smaller subset necessitated opioid therapy, reflecting more severe or persistent pain experiences. Collectively, these findings underscore the heterogeneity of chronic pain manifestations and

analgesic dependence after laparoscopic hysterectomy, emphasizing the importance of individualized postoperative pain assessment and tailored analgesic strategies.

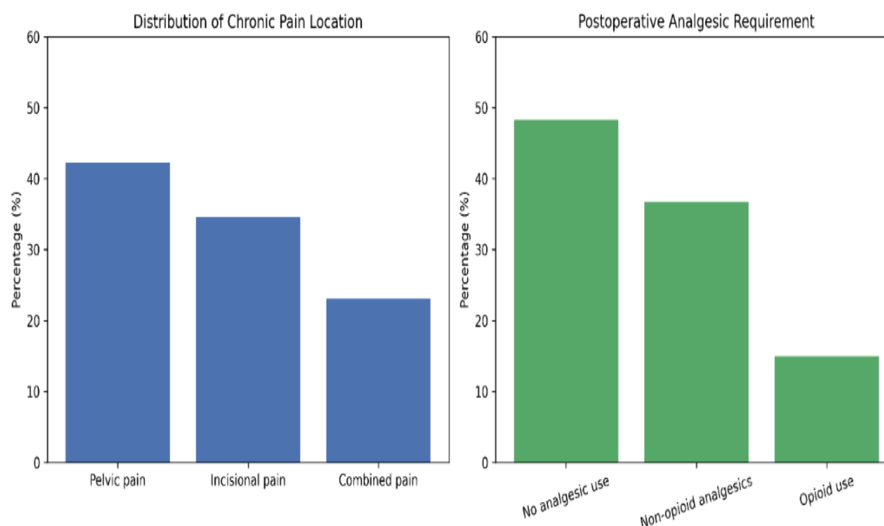

Figure 2. Distribution of chronic pain location and postoperative analgesic requirement following laparoscopic hysterectomy

Discussion

The present study demonstrates that postoperative pain following laparoscopic hysterectomy follows a generally favorable course, with most patients experiencing gradual resolution of pain and minimal long-term functional limitation. Although a subset developed persistent postoperative pain, the overall trajectory was characterized by declining pain intensity, limited reliance on opioid analgesics, and preserved daily functioning. These findings highlight the effectiveness of minimally invasive hysterectomy and contemporary perioperative care in promoting recovery while also underscoring the clinical relevance of chronic pain in a minority of patients. The relatively homogeneous demographic and perioperative profile of the study population likely contributed to the consistency of postoperative outcomes observed. Middle-aged women with limited comorbidity burden and predominantly low anesthetic risk represent a population with substantial physiological reserve, which may facilitate tissue healing and pain resolution after surgery. Furthermore, the predominance of benign gynecological indications suggests that inflammatory and neuroendocrine stress responses were less pronounced than those typically associated with oncologic or extensive pelvic procedures, potentially explaining the overall favorable pain outcomes observed in this cohort (16). The standardized surgical and anesthetic approach used across patients may also have played a central role in shaping the postoperative pain trajectory. Uniform use of general anesthesia, relatively consistent operative duration, and adherence to minimally invasive techniques likely reduced variability in tissue trauma and perioperative nociceptive input. Laparoscopic hysterectomy is known to limit muscle disruption and nerve injury compared with open approaches, which can attenuate central sensitization and reduce the risk of prolonged pain states, thereby supporting the declining pain trend observed over time (17).

The distinction between pain at rest and pain during movement in the early postoperative period reflects the functional nature of postoperative discomfort following abdominal surgery. Movement-evoked pain is often driven by stretching of healing tissues, activation of mechanoreceptors, and engagement of abdominal musculature, making it more pronounced during ambulation or positional changes. As tissue healing progresses and inflammatory mediators diminish, this functional pain component typically resolves, explaining the progressive convergence of pain scores toward minimal levels during later follow-up (18).

Despite overall improvement, the persistence of pain in a subset of patients highlights the multifactorial nature of chronic postsurgical pain. Chronic pain after hysterectomy has been linked to peripheral nerve irritation, visceral hypersensitivity, and central pain amplification mechanisms. Individual susceptibility factors, such as altered pain processing, psychological vulnerability, or subclinical preoperative pain syndromes, may predispose certain patients to prolonged symptoms even after technically successful surgery (19).

The predominance of pelvic pain among patients with chronic postsurgical pain suggests a significant visceral component to persistent symptoms. Pelvic organs share complex neural pathways with surrounding musculoskeletal and autonomic structures, which can facilitate referred pain and

sustained nociceptive signaling. Surgical manipulation of pelvic tissues, even in minimally invasive procedures, may induce lasting changes in visceral afferent sensitivity, thereby contributing to the persistence of pelvic discomfort in susceptible individuals (20). Incisional pain as a distinct pattern among patients with chronic symptoms points toward somatic mechanisms related to abdominal wall trauma. Trocar insertion, fascial stretching, and local nerve irritation may result in neuropathic pain features that persist beyond the expected healing period. The coexistence of combined pain patterns further supports the concept that chronic postsurgical pain often arises from overlapping visceral and somatic sources rather than a single isolated mechanism (21). Variation in postoperative analgesic requirements reflects heterogeneity in pain perception, coping strategies, and recovery trajectories. The fact that a substantial proportion of patients achieved adequate pain control without pharmacological intervention suggests effective endogenous pain modulation and successful application of multimodal perioperative care principles. Conversely, continued reliance on non-opioid or opioid analgesics among others may indicate heightened nociceptive sensitivity or delayed resolution of inflammatory processes, reinforcing the need for individualized pain management strategies (22).

The limited functional impairment reported by most patients underscores the clinical distinction between pain presence and pain impact. Even among individuals reporting residual pain, daily activities were largely preserved, suggesting that pain intensity alone does not fully capture postoperative recovery. Functional resilience, adaptive behaviors, and gradual return to activity may mitigate the disabling effects of pain, particularly in populations undergoing minimally invasive procedures with rapid mobilization protocols (23).

The short length of hospital stay observed across the cohort aligns with enhanced recovery principles and may itself influence pain outcomes. Early mobilization, reduced exposure to inpatient stressors, and prompt return to familiar environments have been associated with improved pain coping and reduced chronic pain risk. These factors may synergistically contribute to both physical recovery and psychological reassurance, thereby supporting favorable long-term outcomes (24).

From a clinical perspective, the identification of a subgroup experiencing chronic postsurgical pain emphasizes the importance of early recognition and targeted intervention. Routine postoperative follow-up focusing solely on acute recovery may overlook emerging chronic pain symptoms. Incorporating longitudinal pain assessment and functional evaluation into postoperative care pathways may enable timely referral to pain management services and reduce the long-term burden of persistent pain (25).

Conclusion

Overall, these findings reinforce the effectiveness of laparoscopic hysterectomy as a minimally invasive procedure with generally favorable pain and functional outcomes, while also highlighting the complexity of pain recovery in a minority of patients. Understanding the interplay between surgical factors, individual susceptibility, and pain mechanisms is essential for optimizing postoperative care and minimizing the transition from acute to chronic pain following gynecological surgery.

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Conflicts of interest

The authors declare that they have no competing interests.

Disclosure Statement

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Authors' Contributions

All authors contributed to data analysis, drafting, and revising of the paper and agreed to be responsible for all the aspects of this work.

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