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Physiotherapy Management After ACL Reconstruction Using Exercise and Cryotherapy: A Case Report

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Abstract

Introduction: The anterior cruciate ligament (ACL) is essential for knee stability, and its injury can result in pain, weakness, limited range of motion (ROM), muscle spasm, edema, and functional impairment. This case describes a patient who presented with pain during knee flexion-extension, decreased hamstring and quadriceps strength, restricted ROM, and difficulty performing daily activities. The case is notable for the patient's rapid recovery following a short-term physiotherapy program integrating exercise therapy and cryotherapy.

Methods: A case report design was applied at KRMT Wongsonegoro Regional Public Hospital, Semarang. Physiotherapy management included structured exercise therapy and cryotherapy. Patient outcomes were assessed in terms of pain, muscle strength, ROM, edema, muscle spasm, and functional activity.

Results: After four treatment sessions, the patient demonstrated decreased pain during knee movement, improved hamstring and quadriceps strength, enhanced ROM, reduced muscle spasms and edema, and better performance of functional tasks.

Conclusion: A short-term physiotherapy program combining exercise therapy and cryotherapy effectively reduced pain, improved muscle strength, enhanced ROM, and facilitated functional recovery following ACL reconstruction. This case emphasizes the potential benefits of multimodal physiotherapy in supporting early rehabilitation outcomes.

Keywords

Anterior cruciate ligament reconstruction, Knee joint, Exercise therapy, Cryotherapy, Physiotherapy, Functional recovery

Introduction

High-intensity physical activities and sports carry a risk of injury. Sports injuries may result from either direct or indirect trauma. Direct-contact injuries typically occur from collisions or impact, while non-contact injuries may result from twisting, sudden changes in direction, or landing in an improper body position. Anterior cruciate ligament (ACL) injuries are common knee injuries that frequently occur during sports involving cutting movements, rapid directional changes, and sudden deceleration, such as football, basketball, volleyball, and futsal.[1]

In 2016, ACL injury prevalence was reported to be higher in women than in men. Approximately 5% of patients with ACL injuries also experience meniscal tears. In acute ACL injuries, lateral meniscus tears are more common, whereas in chronic cases, the medial meniscus is more frequently involved. Epidemiological studies indicate an incidence of one ACL rupture per 3,500 individuals, equating to around 95,000 ACL ruptures annually. In the United States, over 200,000 ACL-related injuries occur each year, with approximately 100,000 ACL reconstruction surgeries performed annually. Sports such as basketball and soccer are associated with a higher incidence of ACL injury. Furthermore, based on participation frequency, the prevalence of ACL injuries is reported to be 2.4 to 9.7 times higher in women than in men.[2]

Post-anterior cruciate ligament reconstruction is a surgical procedure involving the replacement of the torn ACL using a tissue graft to restore knee function. Following reconstruction, patients may experience functional limitations such as muscle weakness, restricted range of motion (ROM), swelling, and impaired balance—complications that can be addressed through rehabilitation. During the recovery phase, compensatory changes in surrounding tissues may occur, potentially leading to secondary conditions such as jumper's knee, which has been frequently observed in patients recovering from ACL hamstring graft reconstruction.[3]

Physiotherapy plays a vital role in post-operative ACL rehabilitation. Common post-operative problems include pain, edema, weakness in flexor and extensor muscles, limited ROM, balance deficits, and reduced functional activity. These issues can be managed through physiotherapy interventions such as exercise therapy and cryotherapy. Exercise therapy refers to a structured and purposeful physical activity program designed to improve functional activity, prevent or correct impairments, and optimize overall health and fitness. Cryotherapy is one of the most effective physiotherapy modalities for managing pain and reducing acute swelling in sports injuries.[4] This case report presents a significant

functional recovery achieved within just four physiotherapy sessions through the combined application of exercise therapy and cryotherapy following ACL reconstruction.

The patient was a 28-year-old married female athlete currently pursuing her education in sports. Prior to the injury, she was actively involved in pencak silat training. The injury occurred during a training session, after which she was diagnosed with a left ACL rupture at Telogorejo Hospital. She was subsequently referred for surgical reconstruction at Kariadi Hospital. Post-surgery, the patient reported pain during left knee flexion and extension, reduced hamstring and quadriceps strength, limited ROM, muscle spasms, edema in the left knee, and difficulty performing functional activities such as stair climbing and wearing socks and shoes. The patient underwent physiotherapy at KRMT Wongsonegoro Regional Hospital based on these complaints.

She had a prior history of musculoskeletal injury, including lower extremity dislocation. There was no family history of connective tissue disorders or other musculoskeletal conditions. Although conclusive evidence is lacking, some studies suggest a potential genetic predisposition to ACL rupture, particularly in athletes with high physical demands.[5] Socially, the patient is an active athlete in pencak silat—a sport involving high-intensity physical activity and a significant risk of knee injury. No specific genetic factors were identified in this case that may have contributed to ligament injury. However, her active lifestyle and the mechanical demands of the sport are likely the primary contributors to her ACL injury.

Methods

This study employed a case report design, including a clinical case summary and problem analysis, to gain an in-depth understanding of the condition of a patient post-left anterior cruciate ligament (ACL) reconstruction. This design was chosen to assess the impact of the physiotherapy interventions on the patient's recovery process.

The study was conducted at KRMT Wongsonegoro Regional Public Hospital, Semarang. The assessment tools used included anthropometric measurements to evaluate edema, goniometry to assess range of motion (ROM), manual muscle testing (MMT) using a sphygmomanometer to assess muscle strength, and the Lower Extremity Functional Scale (LEFS) to evaluate functional capacity.

The case involved a 28-year-old female (Mrs. A) who reported pain and difficulty in bending her left knee following a fall and improper landing during pencak silat training. She was initially examined at Telogorejo Hospital and diagnosed with a rupture of the left ACL. On January 13, 2025, she underwent ACL reconstruction surgery at Kariadi Hospital. She was referred for physiotherapy at KRMT Wongsonegoro Hospital on January 23, 2025. The diagnosis confirmed a torn anterior cruciate ligament and minimal joint effusion in the pericondylar femur and posterior patella. Clinical examination was initially limited by restricted joint mobility, and a definitive diagnosis was established through MRI, which revealed a mild tear of the posterior horn of the lateral meniscus in the left knee.

The patient's rehabilitation journey is summarized in Table 1, which outlines the timeline of key clinical events—from the initial injury sustained during pencak silat training to the completion of four physiotherapy sessions. This table provides a structured overview of the critical milestones that guided the physiotherapy management following ACL reconstruction.

Table 1. Timeline of Clinical Events

Date	Clinical Event
Early Jan 2025	Injury occurred during pencak silat training
13 Jan 2025	ACL reconstruction surgery at Kariadi Hospital
23 Jan 2025	Referral to physiotherapy at RSUD KRMT Wongsonegoro
05 Feb 2025	Initial physiotherapy evaluation
06–20 Feb 2025	Four physiotherapy sessions conducted

The initial examination on February 5, 2025, revealed the following vital signs: blood pressure 120/90 mmHg, heart rate 80 bpm, respiratory rate 23 breaths/min, body temperature 36.0°C, height 169 cm, and body weight 59 kg. Physiotherapy assessments identified multiple clinical problems related to body structure and function, including pain during left knee flexion-extension, reduced hamstring and quadriceps strength, limited ROM, muscle spasms in the hamstrings and quadriceps, and edema in the left knee. Functionally, the patient experienced difficulty performing daily tasks such as climbing stairs and putting on socks and shoes. From a participation standpoint, family support was strong and contributed positively to the patient's prognosis. With consistent therapy and family involvement, functional improvement was expected within 4–6 weeks. However, continuous physiotherapy intervention was necessary to expedite recovery.

The physiotherapy intervention implemented in this case involved a structured rehabilitation program combining exercise therapy and cryotherapy, tailored specifically to the patient's clinical condition and tolerance. The primary therapeutic goals were to reduce pain and muscle spasms, improve muscle strength, enhance joint range of motion (ROM), and minimize edema in the left knee. The exercise therapy component included a series of targeted movements with progressive resistance. Quadriceps exercises were performed in 4 sets of 10 repetitions, using resistance levels adjusted according to pain tolerance and strength gains, aiming to improve ROM and muscular strength. Ankle pumping exercises using a theraband were carried out in 3 sets of 10 repetitions, with resistance modified to support ankle flexibility and circulation. Heel slide exercises were conducted in 4 sets of 10 repetitions, also with progressive resistance, to promote knee flexion and overall ROM. Hamstring strengthening exercises were administered in 4 sets of 10 repetitions, with resistance gradually increased within the patient's pain threshold. Straight leg raises were completed in 3 sets of 10 repetitions, emphasizing controlled movement and resistance progression. Bridging exercises, targeting the core and lower limb muscles, were performed in 3 sets of 10 repetitions with resistance adjusted based on

comfort and tolerance. Finally, prone hang exercises were incorporated in 3 sets of 10 repetitions, emphasizing knee extension flexibility and strength.

This personalized and progressive approach facilitated functional improvements within a short period. Cryotherapy was administered at a temperature range of 5–15°C for 8 minutes to the affected knee area. This approach was complemented with patient education on safe movement strategies and injury prevention techniques. Exercise therapy was chosen due to the patient's decreased muscle strength and ROM, while cryotherapy was used to alleviate pain and edema after active therapy sessions.

Results

The patient demonstrated a high level of compliance throughout the physiotherapy program, attending all scheduled sessions and adhering to prescribed home exercises as recommended by the physiotherapist. No adverse effects or complications were observed during the intervention period that could have hindered the rehabilitation process. The outcomes of the physiotherapy intervention were evaluated using several clinical parameters across four treatment sessions. Pain intensity was assessed using the Visual Analogue Scale (VAS), which demonstrated a consistent reduction in pain across palpation, movement, and resting conditions (Table 2).

Table 2. Pain Assessment Using Visual Analogue Scale (VAS)

Pain Type	T1	T2	T3	T4
Palpation Pain (hamstring, quadriceps)	5	5	4	1
Movement Pain (flexion, extension)	8	8	4	3
Resting Pain	3	2	0	0

VAS results indicate a reduction in palpation pain from a score of 5 on Day 1 (T1) to 1 on Day 4 (T4), a decrease in movement-related pain from 8 to 3, and a complete resolution of resting pain from 3 to 0 by the final session. A significant decrease in edema was observed through anthropometric measurements at the knee joint using the midline method, particularly at the tuberosity level, where circumference reduced from 40 cm to 35 cm (Table 3).

Table 3. Anthropometric Measurement of Edema (Midline Method)

Reference Point	T1	T2	T3	T4
Knee (Tuberosity)	40	35	35	35
5 cm proximal	38	38	38	38
10 cm proximal	40	40	40	40
15 cm proximal	44	44	44	44
5 cm distal	34	34	34	34

Anthropometric measurements showed a decrease in knee circumference at the tuberosity level, from 40 cm on Day 1 to 35 cm by Day 4, indicating a reduction in edema over the course of treatment. Improvements in joint mobility were recorded using a goniometer, showing progressive increases in both active and passive knee range of motion (ROM) over time (Table 4).

Table 4. Range of Motion (ROM) Evaluation Using Goniometer

Time Point	Active ROM (°)	Passive ROM (°)
T1	0–0–100	50–105
T2	0–0–95	50–100
T3	0–0–105	0–0–115
T4	0–0–115	0–0–120

ROM assessment indicated progressive improvement in both active and passive knee flexion. Active ROM increased from 100° (T1) to 115° (T4), and passive ROM improved from 105° to 120°. Muscle strength evaluation using a sphygmomanometer indicated enhanced strength in both knee flexors and extensors throughout the intervention period (Table 5).

Table 5. Muscle Strength Using Sphygmomanometer

Movement	T1	T2	T3	T4
Knee Flexion	50	50	70	80
Knee Extension	50	60	70	70

Muscle strength showed notable improvement, with knee flexor strength increasing from 50 mmHg (T1) to 80 mmHg (T4), and knee extensor strength from 50 mmHg to 70 mmHg. Furthermore, functional ability in daily lower extremity tasks, measured using the Lower Extremity Functional Scale (LEFS), showed a gradual increase in scores, reflecting positive functional recovery (Table 6).

Table 6. Functional Activity Using Lower Extremity Functional Scale (LEFS)

Time Point	LEFS Score
T1	20
T2	22
T3	35
T4	40

Functional evaluation using the LEFS revealed a consistent increase in scores, from 20 (T1) to 40 (T4), reflecting improved ability in performing lower extremity functional activities. The maximum possible LEFS score is 80.

The patient was scheduled for a follow-up evaluation two weeks after the final physiotherapy session to monitor the stability of the intervention outcomes and ensure no recurrence of symptoms. The combined intervention of structured exercise therapy and cryotherapy demonstrated a positive effect in reducing pain and edema, enhancing ROM, improving muscle strength, and restoring functional performance of the lower limb.

The outcome measures—VAS, goniometer, MMT via sphygmomanometer, anthropometric data, and LEFS—collectively indicate consistent clinical progress and support the ongoing rehabilitation strategy.

Discussion

Evaluation of Physiotherapy Management Following Left Anterior Cruciate Ligament Reconstruction Using Exercise Therapy

To further illustrate the progress in joint mobility, both active and passive range of motion (ROM) of the left knee were visually evaluated during the intervention period. Figure 1 presents the assessment of active ROM, highlighting the patient's voluntary movement capacity. Meanwhile, Figure 2 displays the evaluation of passive ROM, reflecting joint flexibility when moved by the therapist without patient effort. These visual assessments complement the goniometric data provided in the earlier tables and demonstrate the effectiveness of the physiotherapy program in improving knee mobility.

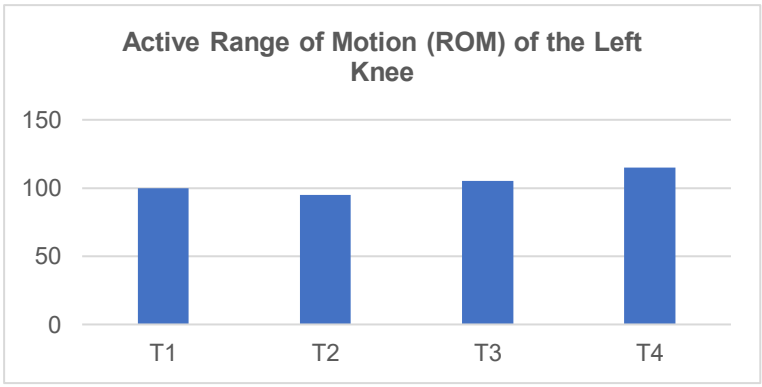

Figure 1. Evaluation of Active Range of Motion (ROM) of the Left Knee

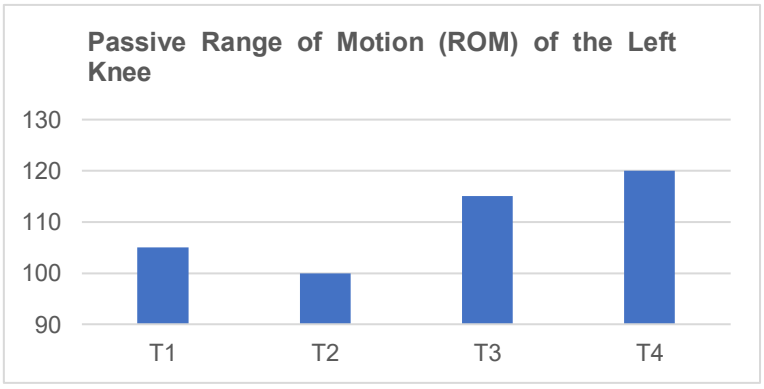

Figure 2. Evaluation of Passive Range of Motion (ROM) of the Left Knee

Exercise therapy is a physiotherapeutic intervention involving both active and passive movement exercises, aimed at patients across health conditions. It is beneficial in restoring tendon and ligament strength, enhancing muscle power, maintaining joint stability, and improving the range of motion (ROM).[6] Based on Figure 1, the goniometric evaluation of active knee ROM revealed a significant improvement from 00-00-100° at T1 to 00-00-115° at T4. Similarly, Figure 2 demonstrates an increase in passive ROM from 00-00-105° at T1 to 00-00-120° at T4. These improvements are attributed to the implementation of quadriceps setting exercises and heel slides.

This finding aligns with previous research by Indriastuti and Pristianto, which reported that quadriceps exercises and heel slides effectively improved ROM in patients following ACL reconstruction.[7] The mechanism involves enhanced cardiac output, promoting metabolic efficiency and reducing edema. As edema decreases, nociceptive mediators are reduced, leading to pain reduction and subsequent ROM improvement.

Muscle strength assessment was performed using a modified sphygmomanometer test, which provided a practical and reliable method for quantifying isometric muscle force. As shown in Figure 3, the evaluation focused on knee flexor and extensor strength throughout the physiotherapy sessions. This visual documentation supports the tabulated measurements and illustrates the progressive improvement in muscle strength over time.

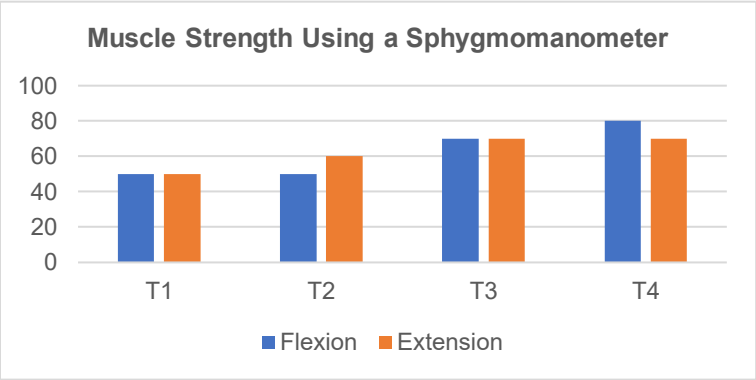

Figure 3. Evaluation of Muscle Strength Using a Sphygmomanometer

Figure 3 illustrates progressive muscle strength gains, with knee flexion increasing from 50 mmHg to 80 mmHg and extension from 50 mmHg to 70 mmHg over four sessions. This outcome is consistent with findings from Ni'mah, who demonstrated that interventions such as quadriceps setting, hamstring setting, gluteus exercises, straight leg raises, and ankle pumping exercises promote strength, endurance, and ROM improvements.[8] Wijayanti and Munzirin also supported these results, explaining that strengthening exercises reduce pain by interrupting the pain-spasm-pain cycle, activating large-diameter afferent fibers, enhancing venous return, and reducing swelling.[9]

Evaluation of Physiotherapy Management Following Left Anterior Cruciate Ligament Reconstruction Using Cryotherapy

Edema reduction was monitored using the midline method of anthropometric measurement, focusing on specific reference points above and below the knee. As illustrated in Figure 4 and Figure 5, changes in segmental circumference, particularly at the tuberosity level, provide visual evidence of the patient's progress in managing swelling throughout the physiotherapy sessions.

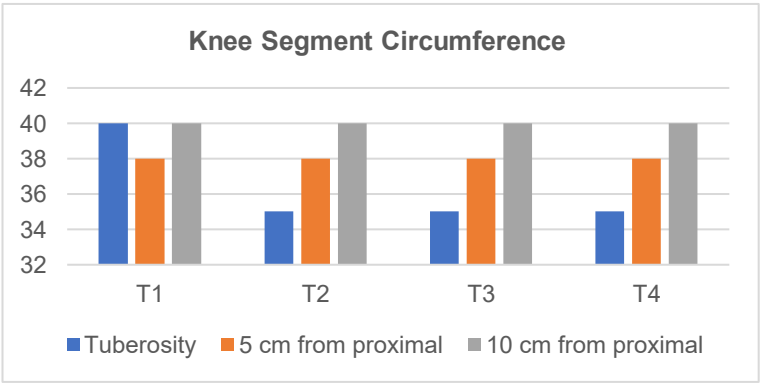

Figure 4. Evaluation of Knee Segment Circumference (Midline Method)

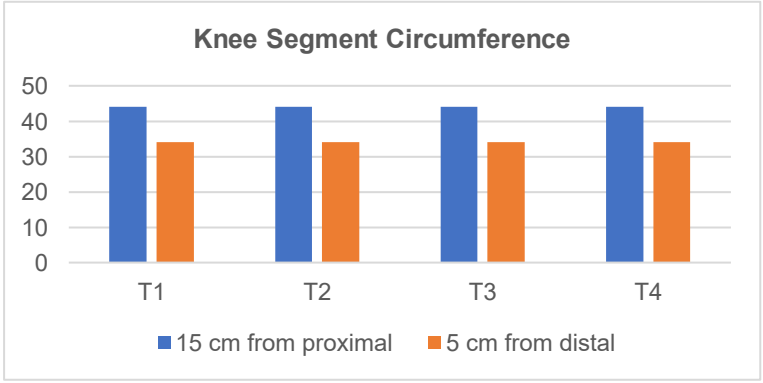

Figure 5. Evaluation of Knee Segment Circumference (Midline Method)

Cryotherapy is a modality primarily used in acute injuries to alleviate pain and swelling, thus facilitating ROM recovery. Cryotherapy was applied post-exercise to assist in the breakdown of metabolic waste produced during training.[7,10] As shown in Figures 4 and 5, anthropometric assessments using the midline method revealed a decrease in edema. The measurement at the tibial tuberosity decreased from 40 cm (T1) to 35 cm (T4). Other segmental measurements remained constant, indicating localized edema reduction.

This observation supports the study by Nurhasana et al., who concluded that cryotherapy reduces metabolic activity, thereby limiting secondary tissue damage and diminishing nociceptive input to the central nervous system.[11]

Cryotherapy functions through conduction, lowering tissue temperature, raising the pain threshold, reducing swelling, and temporarily decreasing motor performance.

This case report illustrates that the combination of structured exercise therapy and cryotherapy yields significant clinical improvements in a short period following ACL reconstruction. Exercise therapy enhances muscle strength and ROM, while cryotherapy effectively reduces edema and pain. The primary takeaway is the importance of individualized, evaluation-based physiotherapy planning, appropriate modality selection based on the recovery phase, and active patient involvement in rehabilitation. This case study involved a single post-ACL reconstruction patient receiving both exercise and cryotherapy interventions.

Evaluations revealed substantial improvements: pain reduction (VAS), ROM enhancement (goniometer), increased muscle strength (MMT), and better functional capability (LEFS). Follow-up over four sessions indicated stable, sustainable outcomes. Compared to patients undergoing conventional therapy without cryotherapy, the subject demonstrated faster recovery and superior functional results.

Although this report is based on a single case, the presence of a comparative reference and longitudinal monitoring offers promising evidence for the combined intervention's effectiveness. Physiotherapists and clinical practitioners are encouraged to integrate cryotherapy into early post-operative ACL rehabilitation to reduce inflammation and improve comfort during exercise.

Progressive exercise therapy, transitioning from passive and isometric to functional activities, should consider tissue healing stages and individual patient conditions. Regular evaluation using objective tools (VAS, goniometer, MMT, LEFS) is essential to track progress and adjust the intervention plan accordingly.

Individualized rehabilitation approaches are crucial, given the variability in patient tolerance and needs. Long-term follow-up is recommended to ensure lasting therapeutic results and prevent recurrence. Patient education on home-based exercises and injury prevention strategies is also vital to the overall success of physiotherapy programs.

Conclusion

The patient, a 28-year-old female, was in the post-operative phase following anterior cruciate ligament (ACL) reconstruction of the left knee. After undergoing four physiotherapy sessions at KRMT Wongsonegoro General Hospital in Semarang, clinical improvements were observed. These included reduced pain during flexion and extension movements of the left knee, increased strength of the hamstring and quadriceps muscles, improved range of motion (ROM), decreased muscle spasms in the hamstring and quadriceps, reduced edema of the left knee, and enhanced functional activity.

Author Contribution

Oktavia Pratiwi and Kuswardani contributed equally to the conception and design of the study, data collection, physiotherapy intervention, analysis, and interpretation of results. Oktavia Pratiwi drafted the manuscript, while Kuswardani critically revised it for important intellectual content. Both authors approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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Conflict of Interest Statement

The authors declare that there are no conflicts of interest related to this study.

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Ethics Statement

This case report was conducted in accordance with the ethical principles of the Declaration of Helsinki. Written informed consent was obtained from the patient for both treatment and publication of this case report, including relevant clinical details. Ethical approval was not required for a single-patient case report according to institutional guidelines.

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