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Original Article

Modified Surgical Treatment for Achilles Tendon Rupture Secondary to Insertional Achilles Tendinopathy Using Midline Dorsal Approach

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Abstract

Objective: To assess the pain relief and functional outcomes of patients who undergo surgical management of Achilles tendon rupture secondary to insertional Achilles tendinopathy and associated conditions using a midline dorsal approach.

Methods: This prospective observational study included 30 patients diagnosed with Achilles tendon rupture secondary to insertional Achilles tendinopathy. This study recorded risk factors, predisposing factors, and co-morbidities for all cases. Pain relief and functional improvement were assessed by comparing Visual Analogue Scale (VAS) scores and American Orthopedic Foot and Ankle Score (AOFAS) at the time of presentation and at the final follow-up. This study conducted statistical analysis using SPSS 21.0 software, with a significance level of $p<0.05$.

Results: Of the participants, 17 (56.67%) were male and 13 (43.13%) were female, resulting in a male-to-female ratio of 1:0.76. The mean age of male and female patients was comparable (p=0.7515). The majority of patients (60%) were overweight, while 9 (30%) were obese, and 3 (10%) had a normal body mass index. This study observed a significant reduction in pain and functional improvement in the studied cases, as evidenced by a statistically significant reduction in VAS scores and improvements in AOFAS. Eight (26.66%) patients experienced minor complications that could be managed conservatively, but no major complications were observed.

Conclusion: Modified surgical treatment of Achilles tendon rupture secondary to insertional Achilles tendinopathy using a midline dorsal approach leads to significant improvements in pain and functional outcomes, with an acceptable complication rate.

Keywords: Achilles tendon rupture, functional outcome, midline dorsal approach, surgical management

Introduction

Insertional Achilles tendinopathy is a clinical condition that includes several acute and chronic pathologies involving the area around the Achilles tendon insertion and surrounding tissues. It is most commonly observed in young individuals, with a reported annual incidence of 7-9% in runners.[1]

The etiology of insertional Achilles tendinopathy is mainly overuse, particularly in professional and amateur athletes who engage in physical activity without taking appropriate precautions. Contributing factors include pes cavus, obesity, prolonged steroid use, hyperpronation, and the use of estrogen and fluoroquinolones. Predisposing factors also include connective tissue diseases (such as Ehlers-Danlos syndrome and Marfan's syndrome), systemic inflammatory diseases (psoriatic arthropathy, spondyloarthritis, rheumatoid arthritis, and Reiter's disease), and systemic illnesses like diabetes mellitus.[2,3]

Symptoms of Achilles tendinopathy can range from mild discomfort while walking to severe and debilitating pain that

significantly impairs function.[4] This pain may be exacerbated by external irritants such as wearing ill-fitting shoes or increasing activity levels. [5] In many cases of insertional Achilles tendinopathy, there is a prominent lateral posterosuperior calcaneal tuberosity, also known as Haglund's prominence. On imaging, apparent calcification may be visible at the tendon insertion. Clinical findings suggestive of Achilles tendinopathy, along with X-ray evidence of calcification within the tendon insertion and Haglund's lesion, are usually sufficient for diagnosis, although MRI may be necessary in selected cases.[6]

Patients with Achilles tendinopathy are at risk of tendon rupture, characterized by a sudden onset of sharp pain in the heel accompanied by a snapping sound as the tendon breaks. Tendon rupture is more common in people in their 30s to 50s, and approximately 2-6% of tendon ruptures in individuals over the age of 60 can be attributed to the use of fluoroquinolones.[7] Diagnosis is based on symptoms, history of events, and clinical examination, including the Simmond's test.[8]

Achilles tendon rupture can be treated with both surgical and nonsurgical approaches. Nonsurgical management is typically chosen for minor degrees of rupture, individuals with lower activity levels, and those with comorbid severe systemic illnesses that prevent surgery. Surgical outcomes are generally favorable, leading to improved pain and function.[9] The need for a modified surgical approach in management of Achilles tendon rupture arises out of limitations observed when standard operative techniques are used particularly in patients with underlying insertional Achilles tendinopathy. conventional methods often fail to address the altered biomechanical properties due to chronic inflammation and degenerative changes. The proposed midline dorsal approach differs significantly from conventional techniques by providing direct access to the affected insertion point, allowing for precise debridement and repair while minimizing disruption to the surrounding healthy tissue. This method also aims to reduce surgical trauma and associated postoperative complications, potentially leading to shorter recovery time and improved functional outcomes.[10]

This prospective observational study was conducted to analyze the outcomes of patients who were treated with a modified surgical approach for tendo Achilles rupture secondary to Insertional Achilles tendinopathy and associated conditions. The study utilized a midline dorsal approach.

Methods

This is a prospective observational study conducted on adult patients undergoing surgery for tendo Achilles rupture caused by insertional Achilles tendinopathy and associated conditions, using a midline dorsal approach. The study took place in the Department of Orthopedics at Prakash Institute of Medical Sciences and Research Centre in Islampur, Sangli, India, from October 2023 to September 2024. Informed and written consent was obtained from all patients. Since this was an observational study without ethical concerns, no ethical committee clearance was required. The study included adults aged 18 and above with a diagnosis of Achilles tendon rupture confirmed through clinical examination and imaging, specifically with underlying insertional Achilles tendinopathy. Patients with non-insertional Achilles tendinopathy, previous Achilles tendon surgeries, systemic inflammatory diseases not controlled by medication, active infections at the surgical site, and those unwilling to provide informed consent were excluded. The sample size was calculated using the formula:

$$n= (Z_{\alpha}^{2}) \text{ X } SD^{2}/ \text{ Precision}^{2}$$

with OpenEpi, Version 3.01, 2013 USA, based on a pilot study on the surgical management of Achilles tendon rupture. With 90% power and a 95% confidence interval, a sample size of 30 patients was determined.

Demographic details, such as age, gender, and occupation, were recorded for all cases. The medical history of significant illnesses, including systemic diseases like diabetes mellitus, hypertension, autoimmune disorders, or arthropathies, was noted. All cases underwent comprehensive blood tests, including a complete blood count (CBC), C-Reactive Protein (CRP), erythrocyte sedimentation rate, and rheumatoid factor. Foot X-rays (lateral view with plantarflexed foot) were performed to check for calcification in and around the Achilles tendon and to rule out fractures or arthropathies. Upon presentation, a visual analogue score was used to assess the severity of pain in all cases, and patients were informed about the management options and the type of surgery, including its potential outcome. Ultrasound examination

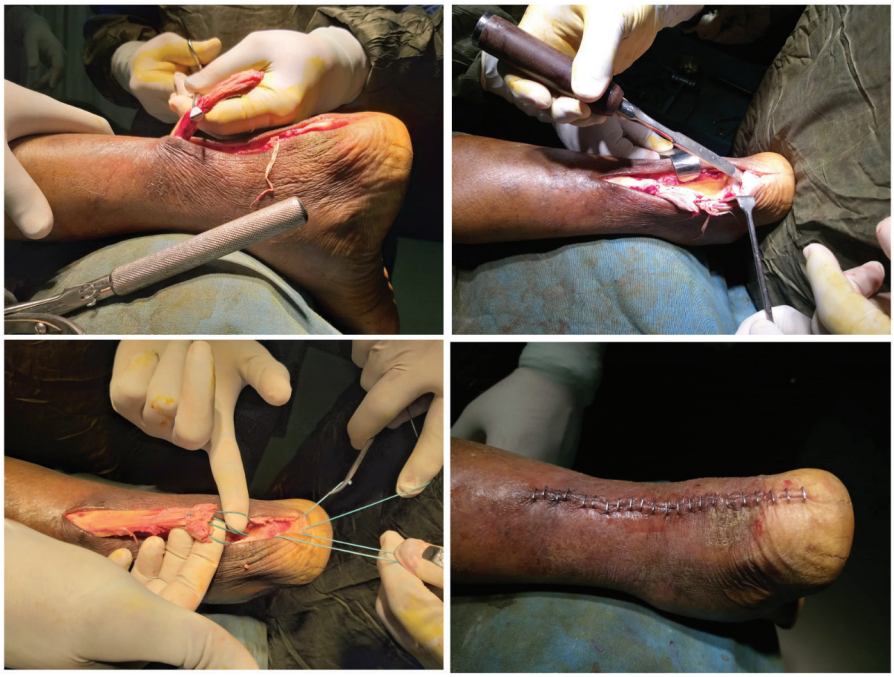

Fig. 1 (Clockwise from left upper) Posterior Longitudinal Midline Incision, Exposing the Posterosuperior Calcaneal Tuberosity, Suturing and Final Completion of Procedure

of the affected foot was performed in all cases, and magnetic resonance imaging was advised for selected cases where peroneal and posterior tibial tendon involvement was suspected. After confirming the diagnosis, patients were evaluated for pain severity using the Visual Analogue Score[11] and functional assessment using the American Orthopaedic Foot and Ankle Score (AOFAS).[12]

Surgeries were performed by a team of five surgeons, three of whom were senior surgeons. The surgeries were done under spinal anesthesia, with intravenous antibiotics administered before the procedure. To ensure proper tourniquet placement and avoid lumbar strain, the involved extremity was exsanguinated using an elastic bandage and an inflated tourniquet (280 mm Hg) before placing the patient in a prone position on the operating table. The patient's ankle was positioned at the end of the table, and a roll of foam was placed under the affected leg to slightly flex the knee. The skin was scrubbed with povidone iodine, and the affected limb was draped up to the level of the popliteal fossa.

A midline posterior longitudinal incision was made over the calcaneus and distal Achilles tendon using a size 22 blade. A sleeve of tendon material attached to the insertion site was identified for extraction of the diseased portion. The remnant insertion of the Achilles tendon and Sharpey's fibers were sharply elevated and secured with a size 15 blade. Double prong skin hooks were used for soft tissue retraction, limited to deeper tissues. Superficial tissue planes were sparingly dissected, except for careful mobilization of the paratenon for layered closure. The sural nerve was protected by the lateral limb of the Achilles tendon. The paratenon was debrided, and a longitudinal incision in the anterior wall facilitated closure over the sutured tendoachilles.

The retracted tendon's terminal inches were squeezed with Allis forceps to achieve the desired length. Tendon inspection revealed tendinosis and calcification, with the diseased portions excised. Inflammatory tissue in the retrocalcaneal bursa was also debrided. A direct posterior approach exposed the posterosuperior calcaneal tuberosity and diseased insertion site, where a calcaneal exostectomy was performed with an osteotomy. Small Hohmann retractors were used for exposure without skin tension. An intra-tendinous spur was excised with an osteotome, and Haglund's prominence was removed.

The posterior calcaneus was decompressed

for tendon reattachment. The elevated Achilles tendon insertion was reattached to the calcaneus with a size 5 coated braided nonabsorbable polyester suture through drill holes. Three drill holes were made, and a Kessler-type suture facilitated balanced reattachment. After excision of the affected tendon and bone, the wound was irrigated to remove resected fragments. The tendon split was repaired with 2-0 vicryl suture, and the paratenon was sutured with a running 2-0 vicryl suture (Fig 1).

Patients were instructed to remain non-weightbearing, and their ankle was immobilized in the posterior sugar tong splint position. This positioning was done in order to avoid placing excessive tension on the tendon for a period of six weeks, allowing for satisfactory wound healing. After this, a weight-bearing cast was applied for an additional four (4) weeks to help the patient regain mobility while still protecting the repair. Typically, patients can begin using athletic shoes around two to three months after surgery. Postoperatively, physiotherapy was initiated, which included gentle ankle motion exercises and a graduated program to strengthen the gastrocnemius and soleus muscles. Once the repair was deemed adequately healed, an eccentric stretching protocol could be beneficial. Full recovery typically took between six to twelve months. It was strongly recommended that patients be educated about the extended recovery period prior to surgery.

Patients were followed up monthly for the first few months, and then every three months until one year. The Visual Analog Scale (VAS) was used to assess pain. The VAS score ranged from 0 (indicating no pain) to 10 (indicating the worst pain imaginable). Patients marked a point on the line that corresponded to their current pain intensity. The AOFAS scores were used to evaluate functional outcomes. The outcomes were categorized as follows: excellent (90–100), good (80–89), fair (60–79), and poor (less than 60). Statistical analysis was performed using SPSS version 21.0. Quantitative data was presented as mean and standard deviation, while qualitative data was presented using incidence and percentage tables. The unpaired t-test was used for analyzing quantitative data, with a p-value less than 0.05 considered statistically significant.

Results

Out of the 30 patients included in this study, 17 (56.67%) were males and 13 (43.13%) were females, resulting in a male-to-female ratio of 1:0.76. The analysis of age group distribution revealed that the most common age group among males was 51–60 years (23.33%), followed by 41–50 years (20%). Similarly, among females, the most common age group was 51-60 years (16.67%), followed by 41-50 years (13.33%). The mean age of male patients was 53.24 +/- 12.56 years, while for female patients it was 51.68 +/- 14.10 years, showing no significant difference (p=0.7515).

Regarding patients' occupations that might predispose them to Achilles tendonitis, 40% of patients were daily wage workers involved in strenuous labor, 26.67% were housewives, 6.66% had sedentary office jobs, and 13.33% were engaged in various sports activities. The remaining 6.66% consisted of two policemen and two conductors.

The analysis of patients based on the presence of co-morbidities revealed that the most common co-morbidity among the studied cases was diabetes mellitus, which was present in 11 (33%) patients. Other co-morbidities included hypertension (20%), seronegative spondyloarthropathy (6.66%),

Table 1 Presence of Co-Morbidities in Studied Cases

Co-morbidity	Number of cases	Percentage
No Co-Morbidity	10	33.33
Diabetes Mellitus	11	36.67
Hypertension	6	20.00
Ankylosing spondylitis	2	6.67
Seronegative spondyloarthropathy	2	6.67
Psoriatic arthritis	1	3.33
Rheumatoid arthritis	1	3.33

* 3 patients had diabetes as well as hypertension

Table 2 Duration of Pain, Precipitating Factor, Physical Findings and Previous Interventions

Duration of Pain and History		Number of Patients	Percentage
Duration of pain	1–6 months	4	13.33
	6–12 months	6	20.00
	1–2 years	10	33.33
	2–3 years	5	16.67
	3–5 years	3	10.00
	More than 5 years	2	6.67
	Total	30	100.00
	Mean duration of pain = 28.54 +/- 14.48 Months		
Precipitating factor for rupture	History of trivial trauma	20	66.66
	Spontaneous rupture	10	33.33
Physical findings	Tenderness at insertion zone	30	100
	Bony prominence at lateral aspect of calcaneus (haglund deformity)	27	90
History of previous interventions	Physiotherapy	7	23.33
	Steroid injection	10	33.33

ankylosing spondylitis (6.66%), psoriatic arthritis (3.33%), and rheumatoid arthritis (3.33%) (Table 1).

Out of 30 cases, the majority of individuals (60%) were overweight, while 9 (30%) patients were obese and 3 (10%) patients had a normal body mass index. In most cases, the history of pain had been present for over a year. In 10 (33.33%) cases, the pain had been present for 1–2 years, followed by 6-12 months in 6 cases (20%) and 2-3 years in 5 cases (16.67%). The mean duration of pain was 28.54 +/- 14.48 months. In 20 (66.66%) cases, there was a history of trivial trauma such as slipping a step, loss of balance, or a small jump, while in the remaining 10% of patients, there was no precipitating factor present. On physical examination, tenderness at the insertion of the tendo-Achilles was present in all cases (100%), and 27 (90%) had a bony prominence at the lateral aspect of the calcaneus (Haglund deformity). In 10 (33.33%) patients, there was a history of steroid injection, and 7 (23.3%) patients were undergoing physiotherapy sessions for heel pain (Table 2).

Table 3 Severity of Pain (VAS Score) at Presentation and During Follow Up

VAS Score	Mean	Std Deviation
At Presentation	8.12	2.34
1 month	5.10	1.92
2 months	3.98	1.46
3 months	2.90	1.12
6 months	1.24	0.92
9 months	0.90	0.62
1 year	0.86	0.52

95% CI- -6.6979 to -5.7821; p<0.0001* (Highly significant)

All patients underwent surgical treatment using a midline dorsal approach. Pain severity was assessed using the VAS score, and functional assessment was done using the American Orthopaedic Foot and Ankle Score (AOFAS) score. The mean VAS score at the initial presentation was 8.12 +/- 2.34. After surgery, the VAS score gradually decreased, with mean scores of 5.10 +/- 1.92, 3.98 +/- 1.46, and 2.90 +/- 1.12 at 1 month, 2 months, and 3 months follow-up, respectively. At the final follow-up, the mean VAS score was 0.86 +/- 0.52. Pain reduction was observed in almost

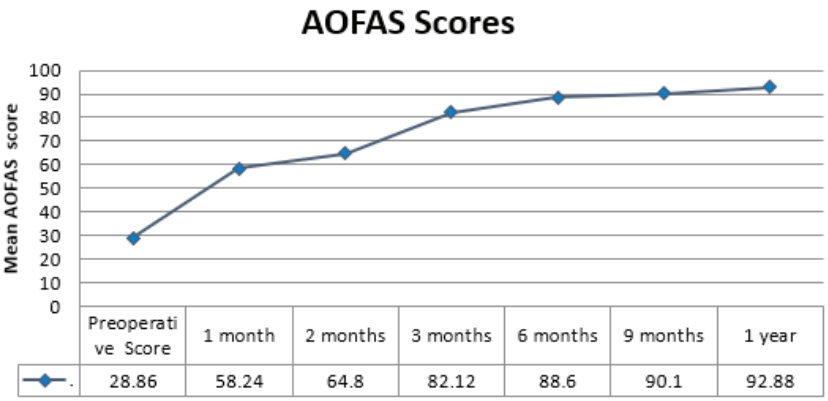

Fig. 2 Comparison of AOFAS Score at Presentation and During Follow Up

all patients. The mean VAS score at the 1-year follow-up was significantly lower compared to the initial presentation ($p<0.0001$) (Table 3).

The patients were assessed functionally based on the AOFAS score. All patients had significant functional impairment at the time of presentation. The mean AOFAS score at presentation was 28.86 +/- 11.02. After surgery, the AOFAS score gradually increased. At the 1-month, 3-months, and 6-months follow-up visits, the mean AOFAS scores were found to be 58.24 +/- 18.36, 82.12 +/- 20.36, and 88.60 +/- 22.34, respectively. At the final follow-up, the mean AOFAS score was 92.88 +/- 10.24. There was a considerable functional improvement in patients at the time of the final follow-up compared to the time of presentation ($p<0.0001$) (Fig. 2).

The analysis of complications in patients who underwent surgical treatment showed that out of 30 cases, 22 (73.33%) patients experienced no side effects. Transient pain was reported in 3 (10%) patients, while 2 (6.66%) patients experienced limping. Skin discoloration, allergic reaction, and tissue swelling were each observed in 1 (3.33%) patient (Fig 3).

Discussion

In this study, a higher number of males were found to have Achilles tendon rupture, with a male-to-female ratio of 1:0.76. The average age of male patients was 53.24 +/- 12.56 years, while the average age of female patients was 51.68 +/- 14.10 years, showing comparability.

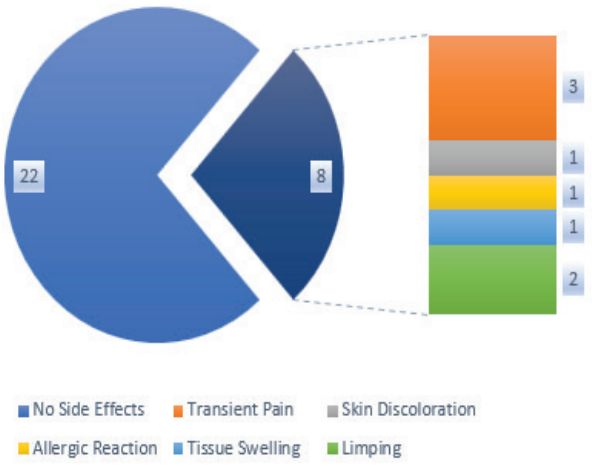

Fig. 3 Complications in the Studied Cases

Houshian *et al.* conducted a study over a period of more than a decade to examine the epidemiology of Achilles tendon ruptures.[13] The mean age of the patients in the study was 42.1 years, ranging from 3 to 82 years old, with the majority (62%) falling within the 30–49 age group. Of the ruptures, 74.2% were sport-related, with 89% occurring during ball and racket games. The annual occurrence rate of Achilles tendon ruptures increased from 18.2 per 100,000 individuals in 1984 to 37.3 per 100,000 in 1996. The highest frequency of sport-related ruptures was observed among individuals aged 30–49 years, while non-sport-related ruptures were more common in older patients, particularly those aged 50–59 years. The average age of the patients in our study closely mirrored that of the aforementioned research. Similar demographic characteristics of patients with Achilles tendon rupture were also reported by Ganestam *et al.*[14] and Weinfeld.[15]

In this study, the majority of patients were overweight (BMI>25) and had occupations that required prolonged standing or long hours. Being overweight is considered a significant factor because a higher BMI can increase the load and stress on the Achilles tendon, potentially contributing to tendinopathy. Occupations that involve prolonged standing, repetitive motion, or high physical activity may also predispose individuals to this condition due to the consistent strain placed on the tendon.

The definitive treatment for significant Achilles tendinopathy with rupture is surgery, which involves removing the affected and calcified tendon, as well as excising the retrocalcaneal bursa. This is followed by resection of the posterior calcaneal prominence and tendon repair. In general, postoperative time to full recovery tends to be proportional to the extent of the disease. A recent comparison of outcomes for surgical management of Achilles tendinopathy and isolated retrocalcaneal bursitis suggests that patients with insertional Achilles tendinopathy take longer to achieve maximum relief of symptoms and have a lower proportion of "satisfying outcomes."[16]

Several surgical procedures have been used to treat insertional Achilles tendinopathy, including resection of retrocalcaneal bursa and the prominent posterior calcaneal process. Various types of incisions can be used for this, including vertical and J-shaped incisions on both the medial and lateral sides of the tendon, peritendinous incisions, transverse incisions, and a single central incision.[17] The central longitudinal Achilles tendon splitting incision is preferred because it allows for optimal visualization of all pathologies associated with insertional Achilles tendinosis, such as intra-substance tendinosis, calcification, retrocalcaneal bursitis, and Haglund's prominence. This type of repair also enables pullout sutures and suturing to the remaining tendon.

Hammit *et al*. conducted a study to assess wound healing in 33 consecutive patients with Achilles tendon rupture who underwent surgery using the modified midline posterior approach. The patients had an average age of 48 years, ranging from 16 to 83 years. The average follow-up period was 24 months, with a range of 12 to 73 months. The surgical interventions included procedures such as ankle and pantalar arthrodesis (both primary and revision), talectomies with tibio-calcaneal arthrodesis, nonunion fracture repairs, reconstruction of chronic Achilles rupture, and hardware removal, as well as multiple debridements for chronic osteomyelitis. The study found no cases of skin flap necrosis. One patient with diabetic neuropathic arthropathy developed a minor superficial wound eschar, which healed with only dressing changes. Four patients experienced deep infections, two of whom had a history of deep infection, while the other two had significant comorbidities. Based on these results, the authors concluded that the modified midline posterior approach to the distal tibia, ankle, and hindfoot has a low rate of primary wound complications while providing sufficient exposure.[18] This approach is suitable for any procedure requiring posterior access to the distal tibia, ankle joint, or subtalar joint. In our study, diabetic patients were under strict glycemic control so significantly to minimize wound infection. Similar results with the posterior approach were also reported by Pellegrini *et al*.[19]

In this study, there was a significant decrease in pain at the final follow-up visit compared to the time of presentation, as demonstrated by a significant reduction in the VAS score. Furthermore, there was a notable improvement in function, as indicated by a significant improvement in the American Orthopaedic Foot and Ankle Score (AOFAS). The authors, such as Tejwani *et al.,*[20] also reported pain reduction and functional improvement in their studies. No significant complications were observed in any of the surgically treated cases in our study. However, eight cases (26.66%) did experience

minor adverse effects that were successfully managed conservatively. Postoperative pain was the main cause of limping, but it subsided with the use of analgesics.

One limitation of the study was the relatively short follow-up period of only one year, which prevented an assessment of long-term complications. Thus, future research with a longer follow-up period is needed to evaluate potential long-term complications.

The central tendon-splitting approach proved to be an effective surgical technique for managing insertional Achilles tendinopathy with tendo Achilles rupture. This approach provided optimal exposure and allowed for good closure of the peritendinous sheath, resulting in a high success rate with improvements in pain and functional outcomes and an acceptable complication rate.

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