

Original Research Article

Evaluating the effectiveness of Baker's procedure in restoring functionality in neglected Achilles tendon injuries

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ABSTRACT

Background: Neglected Achilles tendon injuries present a significant challenge in orthopedic practice, often requiring complex surgical interventions for effective treatment. This study aims to evaluate the functional outcomes of patients with neglected Achilles tendon injuries treated using Baker's procedure, a surgical technique designed for complex cases.

Methods: This prospective interventional study was conducted at multiple medical centers in Dhaka, Bangladesh, from January 1, 2012, to May 31, 2013. It included 42 patients aged 18 to 60 years with signs of old Tendo-Achilles rupture. Participants were selected based on specific inclusion and exclusion criteria and underwent Baker's Procedure. Postoperative assessments included pain levels, ankle stiffness, calf-muscle weakness, footwear restrictions, range of motion, and patient satisfaction, evaluated using the Juhana Leppilahti modified score.

Result: The majority of patients (85.71%) reported no pain post-treatment, while 14.29% experienced mild pain. Ankle stiffness was absent in 71.43% of the patients and mild in 28.57%. Calf-muscle weakness varied, with 64.29% showing no weakness, 28.57% mild weakness, and 7.14% moderate weakness. Footwear restrictions were minimal, with 92.86% reporting no restrictions. Active range of motion was normal ($\leq 5^\circ$) in 64.29% of patients and mildly limited ($6-10^\circ$) in 35.71%. Patient satisfaction was high, with 71.43% being 'Very satisfied' with their treatment outcomes.

Conclusions: The study demonstrates that Baker's Procedure is an effective surgical intervention for neglected Achilles tendon injuries, leading to significant pain relief, restored functional mobility, and high patient satisfaction. These findings suggest that with appropriate surgical and rehabilitative care, patients with complex Achilles tendon injuries can achieve favorable outcomes, emphasizing the importance of tailored surgical approaches in orthopedic practice.

Keywords: Tendon, Achilles, Reconstruction, Baker's procedure

INTRODUCTION

Achilles tendon injuries are a common yet significant concern in orthopedic practice, with their prevalence and impact on patient quality of life drawing considerable attention in recent years.^{1,2} As the strongest and largest tendon in the human body, the Achilles tendon plays a pivotal role in locomotion, particularly in activities involving running and jumping.^{3,4} Injuries to this tendon,

ranging from mild strains to complete ruptures, can drastically affect an individual's mobility and quality of life. Neglected Achilles tendon injuries, often resulting from delayed diagnosis or treatment, pose a unique challenge. These injuries can lead to chronic conditions characterized by pain, decreased functionality, and a range of long-term complications.⁵⁻⁷ The prevalence of neglected cases is not insignificant, with studies indicating a notable portion of Achilles tendon injuries receiving suboptimal

initial treatment or diagnosis.⁵ The impact of these neglected injuries is profound, often leading to a decreased quality of life due to persistent pain and limited mobility. The anatomy and biomechanics of the Achilles tendon underlie its susceptibility to injury. Comprising primarily of collagen fibers, the tendon connects the calf muscles to the calcaneus, or heel bone, facilitating the transfer of muscular force for foot movement.^{8,9} Injuries typically occur due to overuse, sudden increases in physical activity, or direct trauma, with risk factors including age, gender, and certain lifestyle choices.^{10,11} The pathophysiology of neglected injuries is complex, often involving degeneration and weakening of the tendon structure, which complicates treatment. Current treatment approaches for Achilles tendon injuries encompass a range of surgical and non-surgical methods. Non-surgical treatments, such as immobilization and physiotherapy, are often the first line of intervention for less severe injuries.¹² However, in cases of neglected or chronic injuries, surgical intervention becomes necessary. Standard surgical techniques aim to repair and strengthen the damaged tendon, but their success varies, particularly in neglected cases where the tendon structure may be extensively compromised. Among the surgical techniques, Baker's procedure has emerged as a notable method for addressing neglected Achilles tendon injuries. Developed as a response to the limitations of traditional repair methods in severe cases, Baker's Procedure involves the use of grafts or tendon transfers to reconstruct the damaged tendon.^{13,14} The evolution of this technique over time reflects advancements in surgical methods and a deeper understanding of tendon healing and rehabilitation. Despite its clinical importance, a gap remains in the research, particularly concerning the long-term outcomes of Baker's procedure in neglected Achilles tendon injuries. While some studies have explored the immediate and short-term effects of this procedure, comprehensive data on long-term functional outcomes, patient satisfaction, and comparison with other surgical techniques are limited. This gap highlights the need for further research to evaluate the effectiveness of Baker's procedure in restoring functionality and quality of life in patients with neglected Achilles tendon injuries. The proposed study aims to address this gap by providing a detailed analysis of the functional outcomes following Baker's procedure in neglected cases. By focusing on long-term results, patient-reported outcomes, and comparing these with other treatment modalities, this research will contribute significantly to the existing body of knowledge.

METHODS

This prospective interventional study was conducted at the department of orthopaedic surgery, Dhaka medical college and hospital, the national institute of traumatology and orthopaedic rehabilitation (NITOR), and selected private hospitals in Dhaka, Bangladesh, from January 1, 2012, to May 31, 2013. The study cohort included 42 patients aged between 18 and 60 years, presenting with signs of neglected tendo-Achilles rupture and seeking treatment for

functional impairments in activities such as running and climbing stairs. Participants were purposively sampled, adhering to strict inclusion and exclusion criteria. Inclusion criteria were defined as ruptures persisting for more than 4 weeks without prior treatment, while exclusion criteria involved individuals younger than 18 or older than 60 years, recent ruptures, concurrent muscle or nerve injuries, fractures in the affected limb, and other significant health conditions. A neglected Achilles tendon injury was operationally defined as a delay in presentation exceeding 4 weeks post-injury, untreated or inadequately treated. The primary objective of the study was to evaluate the functional outcomes following the reconstruction of neglected rupture Achilles tendons using Baker's Procedure, introduced by LD Baker in 1956, involves the gastrocnemius aponeurosis advancement in a 'Tongue-in-groove' or inverted 'U' fashion for Achilles tendon reconstruction.¹⁵ Postoperative care involved elevating the limb for 24-48 hours, followed by immobilization using a long leg anterior plaster slab with the knee positioned at 30-40 degrees of flexion and the ankle at 20-25 degrees of plantar flexion for two weeks. During this period, patients were advised to perform isometric quadriceps exercises and toe movements. After two weeks, sutures were removed, and a long leg full plaster cast was applied, maintaining the knee at 30 degrees of flexion and the ankle in gravity equinus for an additional four weeks. At the six-week mark, the long leg cast was replaced with a short leg full plaster, positioning the ankle in a neutral/plantigrade position for another four weeks. During this phase, patients were instructed in the quadriceps exercises and non-weight-bearing ambulation with crutches. At the tenth week, the plaster was removed, and patients were advised to walk with the 3-5 cm heel lift for another four weeks, gradually reducing the heel lift by 1 cm per week. Continuation of the physiotherapy, including quadriceps strengthening exercises and knee and ankle movements, was recommended. The functional outcomes were assessed using the Juhana Leppilahti modified scoring system.¹⁶

RESULTS

Table 1 presents the distribution of baseline characteristics among the 42 participants in the study. The age of participants varied, with a mean age of 30.7 years (SD=9.19). The age distribution was relatively balanced across different age groups: 14.29% (n=6) were aged 20 years or below, 35.71% (n=15) fell into each of the 21-30 and 31-40 age brackets, and the remaining 14.29% (n=6) were aged 40 years or above. In terms of gender distribution, the majority of the participants were male, accounting for 71.43% (n=30), while females represented 28.57% (n=12) of the study population. The interval between the injury and the operation was also recorded. A significant portion of the participants, 57.14% (n=24), underwent the operation between 6 to 10 weeks post-injury. Those who had the operation within 6 weeks of injury constituted 35.71% (n=15), and a smaller group, 7.14% (n=3), had the operation after 10 weeks or more.

The mean interval between injury and operation was 7.5 weeks (SD=1.99).

Table 1: Distribution of baseline characteristics, (n=42).

Variables	N	Percentage (%)
Age (In years)		
≤20	6	14.29
21-30	15	35.71
31-40	15	35.71
≥ 40	6	14.29
Mean ± SD	30.7±9.19	
Gender		
Male	30	71.43
Female	12	28.57
Interval between injury and operation (Weeks)		
≤6	15	35.71
6-10	24	57.14
≥ 10	3	7.14
≤ 6	15	35.71
Mean ± SD	7.5±1.99	

Table 2: Distribution of participants by injury related characteristics, (n=42).

Variables	N	Percentage (%)
Side of injury		
Right Achilles tendon	24	57.14
Left Achilles tendon	18	42.86
Cause of injury		
Sharp-metal injury	24	57.14
Toilet-pan injury	15	35.71
Sports injury	3	7.14
Presence of palpable gap		
Yes	30	71.43
No	12	28.57

Table 2 details the distribution of participants based on injury-related characteristics among the 42 individuals included in the study. The side of the Achilles tendon injury was almost evenly split among the participants: 57.14% (n=24) had injuries to the right Achilles tendon, while the remaining 42.86% (n=18) had injuries to the left Achilles tendon. Regarding the cause of the injury, the majority of participants, 57.14% (n=24), sustained their injuries due to sharp-metal objects. Injuries caused by toilet-pan incidents accounted for 35.71% (n=15) of the cases. Sports-related injuries were less common, comprising only 7.14% (n=3) of the total injuries. The presence of a palpable gap in the tendon was another key characteristic observed. A significant 71.43% (n=30) of the participants had a palpable gap, while 28.57% (n=12) did not exhibit this feature.

Table 3 presents the final outcomes for the 42 participants in the study. The majority, 64.29% (n=27), achieved an

'Excellent' outcome. 'Good' outcomes were observed in 21.43% (n=9) of the cases, while 14.29% (n=6) had a 'fair' outcome.

Table 3: Distribution of participants by final outcome, (n=42).

Final outcome	N	Percentage (%)
Excellent	27	64.29
Good	9	21.43
Fair	6	14.29

Table 4: Functional outcome assessment of the participants by Juhana Leppilahti modified score.

Variables	N	Percentage (%)
Pain		
No pain	36	85.71
Mild pain	6	14.29
Stiffness of affected ankle		
No stiffness	30	71.43
Mild stiffness	12	28.57
Calf- muscle weakness		
None	27	64.29
Mild weakness	12	28.57
Moderate weakness	3	7.14
Footwear restrictions		
None	39	92.86
Mild	3	7.14
Active range of motion		
Normal (≤5°)	27	64.29
Mildly limited (6-10°)	15	35.71

Table 4 details the functional outcome assessment of the 42 participants using the Juhana Leppilahti modified score. In terms of pain, a significant majority, 85.71% (n=36), reported no pain, while 14.29% (n=6) experienced mild pain. Regarding ankle stiffness, 71.43% (n=30) of the participants had no stiffness, and 28.57% (n=12) reported mild stiffness.

Calf-muscle weakness was observed in varying degrees: 64.29% (n=27) of the participants showed no weakness, 28.57% (n=12) had mild weakness, and 7.14% (n=3) experienced moderate weakness. Footwear restrictions were minimal, with 92.86% (n=39) of the participants reporting no restrictions and only 7.14% (n=3) experiencing mild restrictions. In terms of the active range of motion, 64.29% (n=27) of the participants had a normal range (≤5°), and 35.71% (n=15) had a mildly limited range (6-10°).

Figure 1 depicts the distribution of participants' subjective satisfaction with the treatment outcomes, based on their personal assessments. Among the 42 participants in the study, a substantial majority, 71.43% (n=30), reported being 'very satisfied' with their treatment results. The remaining 28.57% (n=12) indicated that they were 'satisfied with minor reservations.'

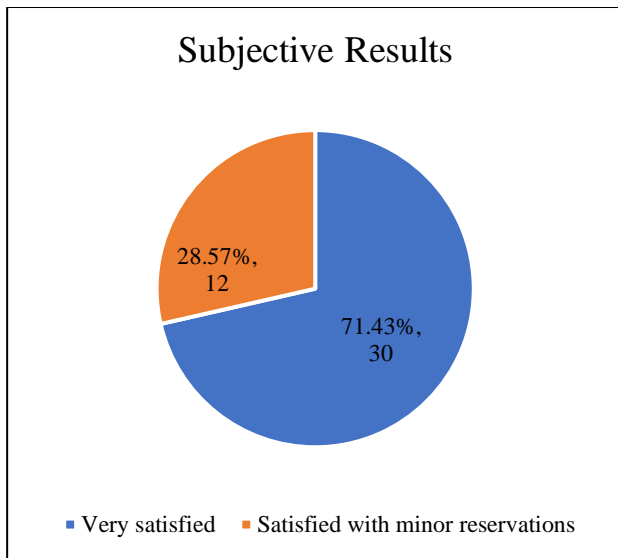


Figure 1: Distribution of participants by patient's subjective result, (n=42).

DISCUSSION

The demographic profile of participants in this study, with a mean age of 30.7 years and a male predominance (71.43%), aligns with the general understanding that Achilles tendon injuries are more common in younger adults and have a higher incidence in males.^{17,18} This gender disparity has been noted in various studies, often attributed to higher participation rates in activities that predispose to such injuries among males.^{18,19} The age distribution also reflects the peak physical activity period in adults, where the risk of sports and activity-related injuries is higher. The interval between injury and operation in our study, with a mean of 7.5 weeks, raises important considerations about treatment timing. Previous research has indicated that delayed treatment of Achilles tendon injuries can affect outcomes, with early intervention often leading to better prognosis.^{20,21} The fact that a significant portion of our participants underwent surgery between 6 to 10 weeks post-injury suggests a potential delay in seeking or receiving treatment, which could be a factor in the final outcomes observed. The cause of injury in our study, predominantly due to sharp-metal objects (57.14%) and toilet-pan incidents (35.71%), is somewhat atypical compared to the commonly reported sports-related causes in other literatures. This might reflect specific environmental or occupational hazards in the study population and underscores the need for targeted prevention strategies. The presence of a palpable gap in 71.43% of participants is a notable finding, as it indicates a severe degree of injury. Studies have shown that the physical examination findings, including the presence of a gap, can be critical in determining the severity of the injury and the appropriate course of treatment.²² The functional outcome assessment of the participants in this study, as measured by the Juhana Leppilahti modified score, reveals several key insights. The high percentage (85.71%) of participants reporting no pain post-treatment is a

significant finding, aligning with the objectives of Achilles tendon injury management, which prioritize pain relief as a primary outcome. This result is consistent with other studies that have reported successful pain management as a critical indicator of effective Achilles tendon repair.^{22,23} The reported levels of ankle stiffness and calf-muscle weakness in the study also provide valuable information. While a majority of participants experienced no (71.43%) or only mild (28.57%) stiffness and weakness (64.29%) with no weakness, 28.57% with mild weakness, and 7.14% with moderate weakness), these symptoms are not uncommon following Achilles tendon repair.¹⁶ The presence of mild symptoms in a portion of the participants could be attributed to factors such as the severity of the initial injury, the specific surgical technique used, and the effectiveness of postoperative rehabilitation. The minimal footwear restrictions and the preservation of an active range of motion in most participants are encouraging outcomes. These findings suggest that the surgical intervention and rehabilitation protocols employed in the study were effective in restoring functional mobility, a key goal in Achilles tendon injury treatment. This aligns with other studies that have emphasized the importance of restoring normal gait and footwear use as indicators of successful treatment. Specifically, 92.86% of participants reported no footwear restrictions, and 64.29% had a normal active range of motion ($\leq 5^\circ$), while 35.71% had a mildly limited range ($6^\circ - 10^\circ$). Finally, the high level of patient satisfaction, with 71.43% of participants reporting being 'very satisfied,' is a crucial aspect of the study's outcomes. Patient-reported satisfaction is increasingly recognized as an important measure of treatment success, reflecting not only the physical but also the psychological and social aspects of recovery. The satisfaction rates in this study compare favorably with other reports in the literature, where patient satisfaction has been linked to factors such as pain relief, functional recovery, and return to normal activities.

Limitations

The study was conducted in few numbers of hospitals with a small sample size. So, the results may not represent the whole community.

CONCLUSION

This study provides valuable insights into the treatment and recovery of patients with neglected Achilles tendon injuries undergoing Baker's procedure. The findings indicate a predominantly positive outcome, with a significant majority of patients experiencing substantial pain relief, minimal stiffness, and limited calf-muscle weakness post-treatment. The high rate of functional mobility restoration, as evidenced by minimal footwear restrictions and the preservation of an active range of motion in most participants, underscores the effectiveness of the surgical and rehabilitation protocols employed. Notably, the high level of patient satisfaction, with over 70% of participants reporting being 'very satisfied,'

highlights the success of the treatment not only in physical recovery but also in addressing the psychological and social aspects of patient well-being. These outcomes are encouraging and suggest that Baker's Procedure, when executed with appropriate surgical expertise and followed by effective rehabilitation, can be a highly effective treatment for neglected Achilles tendon injuries. This study contributes to the growing body of evidence supporting specific surgical techniques in orthopedic practice and underscores the importance of patient-centered approaches in surgical outcomes and recovery.

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