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Evaluation of Surgical Reconstruction of Old Tendo Achilles Injury by Bosworth Technique

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Abstract **Original Research Article**

***Background*:** Chronic Achilles tendon rupture in the watershed hypovascular region (zone II) makes end-to-end repair less feasible. Bosworth's technique, involving gastrocnemius-soleus turndown, was studied to determine its efficacy and functional outcome in repairing chronic tendon in zone II. ***Objective*:** To evaluate surgical reconstruction of old Tendo Achilles injury by Bosworth technique. ***Methods*:** This prospective study was carried out in Dhaka Medical College Hospital (DMCH) form July 2006 to December 2007. 20 cases were selected as non-randomized purposive sampling technique who came to the out patients department of DMCH. All cases were diagnosed as old neglected Tendo Achilles injury and treated by surgical reconstruction by Bosworth technique. Two cases were lost from follow up and discarded from the study. Finally the study was done on 18 patients. ***Results*:** The mean age of the patients was 31.7 years and the lowest and highest cases were 17 and 47 years respectively. The male female ratio was 5:1. One-third (33.3%) patients were day labourer, 22.2% service holders, 16.7% house wives and the rest 27.8% students. Two-Third of the patients (67%) had involvement of left Tendo Achilles and the rest (33%) had right Tendo Achilles. Nearly 40% of patients' injury was caused by the overhanging edge of the toilet Pan, 27.8% by traumatic rupture, 11.1% assaulted by sharp weapon, another 11.1% by sharp edge of a metallic plate, 5.6% accidentally by sharp cutting knife and 5.5% by broken glass. The mediun level of injury was 3.5 cm above from the insertion of Tendo Achilles, while the lowest and highest level were 2.5 and 6 cm. Minimum delay from injury to operation was 6 weeks and maximum 32 weeks. 5 patients (27.8%) gained normal range of ankle movement, 6 patients (33.3%) decreased by 5° of unaffected side, 4 (22.2%) by 10° and 3 (16.7%) by more than 10º. Mean power of planter flexion, mean calf width and mean score to stand on tip toe on injured side relative to normal side were 85.6%, 87.9% and 64.8% respectively and ranged from 60- 100%, 68.9-95.4% and 15.4-85.7% respectively. The mean thickness of reconstructed tendon was 132.1% in relative to unaffected side and ranged from 120- 157.9% of unaffected side. Mean period of follow up was 9 months, range from 4 months to 15 months. Objective assessment depicts about 45% of patients functional outcome was excellent, 38.9% good, 11.1% fair and 5.6% poor. Final outcome of this study was satisfactory in 83.3% cases and unsatisfactory in 16.7% cases. 2 patients (11.1%) become complicated postoperative skin slough over reconstructed tendon, 1 (5.6%) by sensory deficit along the sural nerve distribution, 4 (22.2%) by persistent ankle swelling and 1 (5.6%) by ankle pain. ***Conclusion*:** Orthopaedic surgeons face challenges in managing old neglected Tendo Achilles injuries due to various factors affecting the outcome. Post-operative management and result evaluation protocols differ among authors, making it difficult to evaluate, communicate, and compare studies. Delays in diagnosis or presentation can cause rupture Tendo Achilles to contract, leading to a large gap and difficulty in end-to-end apposition. The Bosworth technique, which uses healthy tendon or fascia as a donor, is a useful option for reconstructing the gap in injured Tendo Achilles, particularly when the gap is large (4-5cm).

Keywords: Tendo Achilles, Bosworth Technique, Surgical Reconstruction.

INTRODUCTION

Achilles, the hero of Homer's Iliad, inspired the name of the body's strongest tendon - the Achilles tendon. Thetis made Achilles invincible by dipping him in the river styx, but forgot to wet his heel, which became his weak spot. Achilles conquered Troy and killed Hector. Paris killed Achilles with a poisoned arrow to his heel.

Hippocrates warned that injuring the Achilles tendon can cause madness and death. Wine and spice bandages for a ruptured Achilles? Dubious [1]. Frenchman Gustave Polaillon supported fixing a

ruptured Achilles tendon in 1888, but an Arabian doctor did it first in the 10th century. 12th century Italian surgeon, Guglielmo diFaliceto, thought nature couldn't heal split tendons and surgery was needed.

Achilles tendon rupture can be caused by various disorders including inflammation, genetics, infection, and neurological issues. No consensus on its cause. Disease can make tendons break easily. As we age, blood flow to the tendon decreases. The Achilles tendon is especially prone to rupture because it has less blood flow than other parts of the tendon [2]. Tendon retracts, so we use grafts. Limited cases and subjective assessment inform reported results [3].

More sports, more injuries - Achilles tears on the rise. The diagnosis is often missed at first. Scheller *et al.*, found 25% of patients misdiagnosed due to insignificant rupture features. Weak toe flexion may mislead novice observers to assume a partial rupture [4].

Replacing Tendo Achilles with fibrous tissue is not a good solution. Tissue in defect stretches, can't handle calf stress. Long ago, doctors stopped using subcutaneous tenotomy for Tendo Achilles and started using double "L" incision or other open techniques instead. A bit of tissue can bridge the gap and reform the tendon. Tissue doesn't grow back after being cut or torn.

The tendon graft is not strong enough to resist calf muscle forces, but acts as a bridge to connect the separated ends. Plastering the foot in a downward position without putting weight on it for six weeks causes tendon growth. Over six weeks, the tendinous mass gradually shrinks as weight bearing is restored. Weight bearing allowed after 3 months post-op.

Fixing a fresh torn Achilles tendon is different from fixing an old one. Calf muscle contracture happens fast. In 2-4 days, it's hard to connect the torn tendon. After tearing, the tendon may be so damaged that it shortens. To gain coaption, shorten the tendon structure below its original length during repair. Transplanting tendons is needed for repairing fresh ruptures [5].

A week post-rupture, scar tissue fills the gap between tendon ends. Untreated tendon = long, no push off. Stairs and movement are hard. Severe heel issues require prompt repair or reconstruction. Older rupture, treatment based on age, activity, and impairment [6].

Achilles tendon rupture is tough to treat if there's a gap between the two ends. This can happen due to various factors. Delayed diagnosis led to tendon damage and fraying. Various ways to fix the Achilles tendon. Making flaps from the tendon [7]. Plantaris tendon used for tendo calcaneus [8]. When a torn tendon is too damaged, it may not be possible to stitch it back together [9]. He uses the peroneus brevis tendon for transfer and reinforcement. Tendo Achilles made of tendon strip from gastrosoleus complex. Flap for fixing a torn Achilles tendon [10].

OBJECTIVES

- To evaluate surgical reconstruction of old Tendo Achilles injury by Bosworth technique.

PATIENTS AND METHODS

This prospective study was carried out in Dhaka Medical College Hospital (DMCH) from July 2006 to December 2007. 20 cases were selected as nonrandomized purposive sampling techniques who came to the out patients department of DMCH. All cases were diagnosed as old neglected Tendo Achilles injury and treated by surgical reconstruction by Bosworth technique. Two cases were lost from follow-up and discarded from the study. Finally the study was done on 18 patients.

Inclusion Criteria

A. Cases were selected between 16 to 48 years of age of any sex.
B. All cases had minimum 2 weeks and maximum 32 weeks old Tendo Achilles injury, either cut or ruptured, which had no previous treatment or in adequate treatment.
C. Difficulty in walking, running, jumping as well as in ascending or descending stairs.
D. Positive thompson test in all cases.
E. Site of injury between 2 cm to 6 cm from the insertion of Tendo Achilles.

Exclusion Criteria

A. Age below 16 years and above 50 years
B. Partially cut or ruptured, infected, bad scar and adhesion in and around the injured tendon.
C. Fresh injury (open or close) were not included in this series.
D. Associated fracture of tibia/fibula of affected limb.
E. Injuries within 2 cm and above 6 cm of insertion of Tendo Achilles.

Data Collection and Analysis

Data were collected by taking history, clinical examination and investigation, preoperative findings, postoperative complications and postoperative follow up. Collected data were recorded in a pre-designed structured data collection sheet. Collected data were edited manually. Then it was entered into SPSS computer software programme. The entered data were checked, verified and analyzed by the same programme.

RESULTS

Table 1 shows that nearly 17% of the patients were 20 or below 20 years of age, 38.9 % between 21 – 30 years, 27.8% between 31 - 40 years and the remaining 16.7% more than 40 years of age. The mean age of the

patients was 31.7 ± 9.8 years and the lowest and highest ages were 17 and 47 years respectively.

Table 1: Distribution of patients by age (n = 18)

Age (yrs)*	Frequency	Percentage
≤20	03	16.7
21-30	07	38.9
31-40	05	27.8
>40	03	16.7

*Mean age = (31.7 ± 9.8) years; range = (17-47) years.

Figure 1 shows that majority (83%) of the patients was male. The male to female ratio was roughly of 5:1.

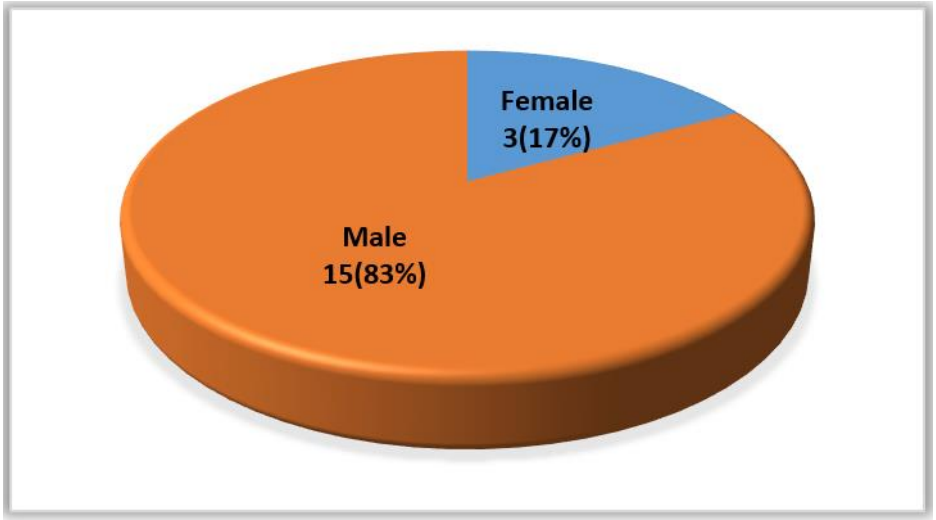

Fig. 1: Distribution of patients by sex (n=18)

Table 2 depicts that one-third (33.3%) of the patients was day laborer, 22.2% service holders, 16.7% housewife and the rest 27.8% students.

Table 2: Distribution of patients by occupation (n = 18)

Age (yrs)*	Frequency	Percentage
Day laborer	06	33.3
Service-holder	04	22.2
Housewife	03	16.7
Student	05	27.8

Figure 2 shows that over two-third (67%) of the patients had involvement of left Tendo Achilles and the rest (33%) right Tendo Achilles.

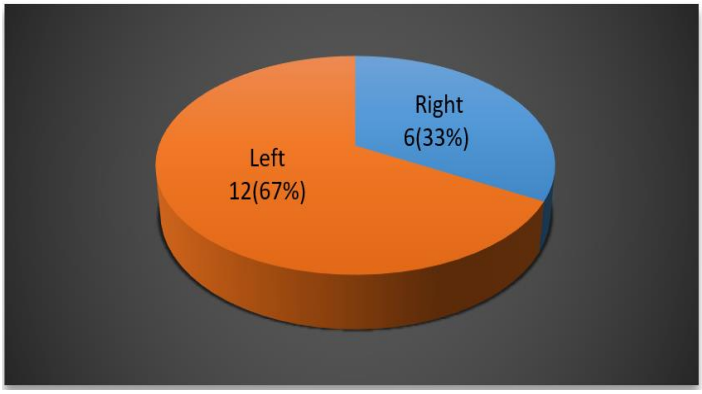

Fig. 2: Distribution of patients by side involved

Approximately 40% of the patient's injury was caused by toilet pan, followed by 27.8% by traumatic rupture, 11.1% assaulted by sharp weapon, another 11.1% by sharp edge of the metallic plate, 5.6% by sharp cutting weapon and 5.5% by the broken glass (Fig. 3).

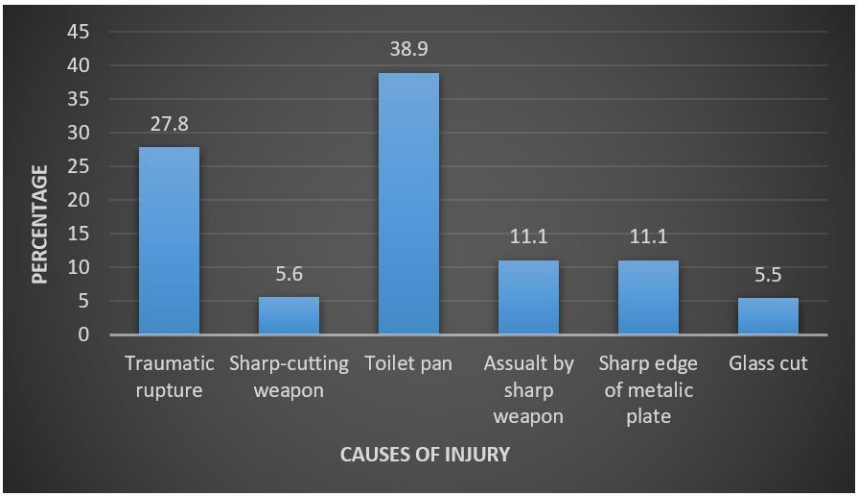

Fig. 3: Distribution of patients by causes of injury

Over 60% of the patients had injury within 5 cm above from the insertion often do Achilles. The remaining 38.9% had injury 5 or > 5 cm above from the insertion. The median level of injury was 4.5 cm above from the insertion, while the lowest and highest levels were 2.5 and 6 cm (Table 3).

Table 3. Distribution of patients by level of injury (n = 18)

Level of injury	Frequency	Percentage
< 5 cm	11	61.1
≥ 5 cm	07	38.9

Half the patients were operated within 10 weeks of sustaining injury and the rest half 10 or after 10 weeks of injury. The median time lapsed between injury and operation was 9.5 weeks and the least and highest time lapsed were 6 and 32 weeks respectively (Table 4).

Table 4: Delay between injury and operation (n = 18)

Delay between injury and operation	Frequency	Percentage
< 10 weeks	09	50.0
≥ 10 weeks	09	50.0

Table 5 depicts that nearly 28% of the patients' ankle movement was in normal range. Over one-third (33.3%) of the patients' range of ankle movement decreased by 5° of the unaffected side, 22.2% by 10° and 16.7%by more than 10º.

Table 5: Changes in ankle movement (Dorsiflexion & Plantarflexion)

Change in movement	No of cases	Percentage
Normal range	05	27.8
No more than 5° decrease or increase	06	33.3
No more than 10° decrease or increase	04	22.2
More than 10° decrease or increase	03	16.7

According to criteria followed by Howerd *et al.*, (1984) table 6 illustrates that the mean power of plantar-flexon, mean calf width and mean score of ability to stand on tiptoe on the injured side and mean thickness of tendon on reconstructed side relative to unaffected side were 85.6%, 87.9% and64.8% and 132.1 % respectively and ranged from 60 - 100%, 68.9-95.4%,15.4-85.7% and 120-157.9% respectively.

Table 6: Assessment of patient after surgery (n = 18)

Outcome variables	Score after operation (%)	
	Mean	Range
Power of plantar-flexon	85.6	60-100
Diameter of the calf	87.9	68.9-95.4
The ability to stand on tiptoe	64.8	15.4-85.7
Thickness of the tendon	132.1	120-157.9

Clinical assessment depicts that about 45% of the patients functional outcome were excellent 39.9% good, 11.1% fair and 5.6% poor (Fig. 4).

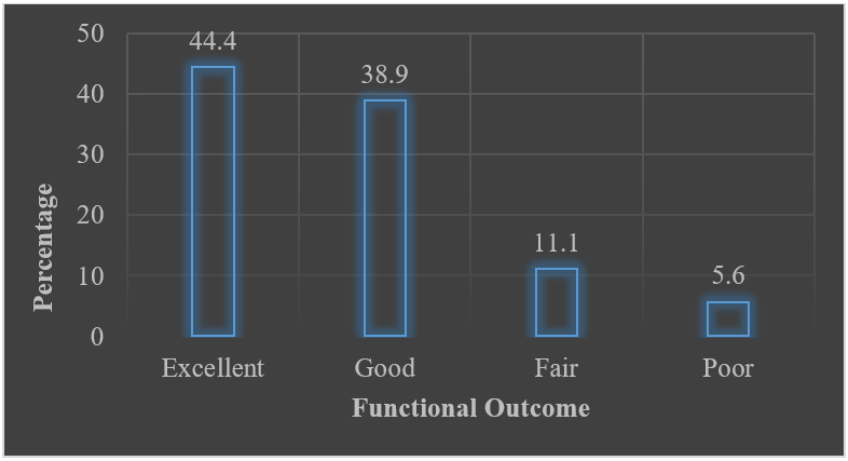

Fig. 4: Distribution of patients by functional outcome of the study

Final outcome was based on objective assessment. Patients with excellent and good outcome were together considered as satisfactory outcome, while patients with fair and poor outcome were rated as unsatisfactory. The majority (83.3%) of the patients had satisfactory outcome and the rest (16.7%) had unsatisfactory outcome (Table 7).

Table 7: Distribution of patients by final outcome

Final outcome	No of cases	Percentage
Satisfactory	15	83.3
Unsatisfactory	03	16.7

Table 8 shows the complications encountered by the patients following operation. Nearly one-quarter (22.2%) of the patients exhibited persistents welling of ankle, 11.1% had skin sloughed out, 5.6% complained of sensory deficit along the sural nerve distribution and the rest 5.6% ankle pain.

Table 8: Distribution of patients by complication (n = 18)

Complications	Frequency	Percentage
Skin sloughed out	02	11.1
Sensory deficit along the sural nerve distribution	01	5.6
Persistent swelling of the ankle	04	22.2
Ankle pain	01	5.6

DISCUSSION

Traumatic injury of Tendo Achilles may occur at any age. In this series, the mean age of the patients was 31.7+9.8 years (range 17 to 47 years), of which3 cases were 20 or below 20 years of age, 7 between 21-30 years, 5 between31-40 year, and remaining 3 more then 40 years of age. The peak incidence of rupture in 4th decade. 68 patients of rupture Tendo Achilles. Average age of their patent was 42 years [11].

In this series 15 patients (83%) were male and 3 (17%) were female. The male to female ratio was 5:1. 96 male and 11 female in total 107 cases [12]. 10 males and 2 females among study group of 12 cases, male-female ratio 5:1 in a study group of 48 cases [13]. Male preponderance in Tendo Achilles injury by the lower physical activity in female than male; they found 4 females and 39 male out of 43 patients [14].

6 Patients (33.3%) were day labourer, 4 (22.2%) service holder, 5 (27.8%) student and the rest 3 (16.7%) were house wife. It was found that traumatic rupture was common among day labourer. It might be due to slipage while taking heavy load.

12 cases (67%) were injured on left side and 6 cases (33%) on Right side.58 cases on left side and 48 cases on right side out of106 cases [12]. 27 cases on left side and 14 cases on right side out of 41 patients [15]. 28 cases on left side and 16 on the right side out of 44 cases [16]. 29 cases on left side and 17 in right side out of 46 patients [10].

In the present series of 18 patients, approximately 40% of the patents injury was caused by over hanging edge of toilet pan, 27.8% was caused by traumatic rupture, 11.1% assaulted by sharp weapon, another 11.1% by sharp edge of metallic plate, 5.6% accidental cut by sharp cutting weapon and another 5.6% cut by broken glass. Our people commonly use squatting toilet pan, Bath room and toilet are situated in same room. Floor of toilet always remain wet. That is why they frequently get accidental slippage in to water closet of toilet pan. During accident, victims are panic stricken and try to withdraw foot forcefully and get lacerated injury to Tendo Achilles by overhanging edge of toilet pan. As western people use high commode this type of injury is uncommon there. In western developed countries athletic activities and sports is common cases of Tendo Achilles injury [10, 14, 17]. Among 5cases of traumatic rupture, two cases had a history of taking local steroid injection in Tendo Achilles for posterior heel pain 1 & 2 months before rupture.

In this series minimum duration from injury to operation was 6 weeks and maximum 32 weeks. 9 Patients (50%) were operated within 10 weeks of sustaining injury and the rest 9 cases (50%) 10 or after 10 weeks of injury. Level of injury of our patients was between 2.5 cm and 6 cm above from insertion of Tendo Achilles. 61.1% patients had injury within 5 cm from insertion and 38.9% had more than 5 cm above from insertion. Between 2 and 6 cm proximal to the insertion often do Achilles are most hypovascular and so the common site of rupture [2].

8 cases of which the lesion was just proximalto the insertion and 5 cases between 2.5 -3.5 cm. Lynn (1966) found the level of injury within 1.25 cm-5 cm from the insertion [17]. The common site of lesion approximately 3.8 cm from insertion [10].

Changes in the range of ankle movement indicate either tendon shortening or lengthening [10, 18]. In our study 5 (27.8%) patients gained a normal range of ankle movement. 6patients (33.3%) range of ankle movement decreased by 5° of unaffected site, 4 patients (22.2%) by 10° and 3 patients (16.7%) by more than 10º11 patients out of 33 cases gained a normal range of movement [19]. A change of 5° or less was found in 20 patients; there was a decrease in plantar flexion and in 9 patients and a decrease in dorsiflexion in 11 cases. In two patients the change in the range of movement was more than 10º.

Functional outcome of treatment was assessed in terms of power plantarflexion, diameter of the calf, ability to stand on tip toe and thickness of reconstructed tendon. In this series, the mean power of planter flexion was85.6% (rang 60-100%). 8 (44.4%) cases regained normal power as BMRC score 5; 7 (38.9%) cases regained BMRC Score 4 and remaining 3 (16.7%) regained score 3. Power of plantar flexion on the injured side ranged from 70% to 99% of that on the uninjured side [3]. 25 patients by external fixator [19]. He showed 3 patients regained normal power. The remaining 22 patients had less power on the injured side: in 19 patients power was 90-95%; two patients regained 85-87% and one patients regained 50% of uninjured side.

Reduction of calf circumference is usual even many years after rupture [14]. In this study, it was found the mean calf width of affected side was 87.9% (range 68.9% to 95.4%) of the unaffected side. The average calf width of operated side was 94% (range 89% to 98%) of the normal side [3]. Calf muscle rapidly atrophy after a period of immobilization after Tendo Achilles rupture and soleus muscle biopsy show a selective decrease in type-1 fibre in relation to type II b fibre [20].

In affected side the mean score of ability to stand on tip toe relative to normal side was 64.8% (range 15.4%-85.7%) 5 late presenting case of Tendo Achilles injury by repair using carbon fiber to inducea neotendon [3]. He showed ability to stand on tip toe of affected side in comparison to unaffected side ranged from 79% to 87.5%.

The thickness of the reconstructed tendon was increased. Mean thickness of reconstructed tendon was 132.1% of unaffected side (range 120-157.9%). Howard found average thickness of repaired tendon 148% of unaffected side (range 120% to 167%). The tendon at the site of rupture was noted in all patients [19]. He found 5-9mm thicker than on uninjured site.

Patients with excellent and good results are recommended as satisfactory and those with fair and poor are recommended as unsatisfactory. We found satisfactory outcome in 15 (83.3%) patients and unsatisfactory in 3 patients (16.7%). Satisfactory outcome (83.3%) of this series is comparable with the result as 91%, 92%, 85.7%, 93% patients were satisfied with their operative treatment [11, 19, 21-26].

Various complications were encountered among the patients of this series. 2patients (11.1%) had major complications of skin slough over the constructed tendon. That might be due to more tension in skin

closure. More than 15 to 20° ankle equinus make skin closure difficult without excessive tension. One patient was treated with full thickness skin graft and another with a sural artery island flap.

04 Patients (22.2%) had persistent ankle swelling, and 1 patient (5.6%) had sensory deficit along the sural nerve distribution. Another patient had ankle pain. Two re-rupture in 44 patients, one in 48 patients, and 7 re-ruptures out of 32 patients. We found no re-rupture [11, 12].

92 patients often do Achilles injury repaired with some augmentation technique, and encountered major complications such as wound infection in 3 patients, skin slough in 11 cases, sinuses in 4 cases, re-rupture in 4 cases, and minor complications like adhesion of tendon to the skin in 23 cases, sural nerve injury in 16 cases [7]. 45 patients by open surgical repair and found complication of wound infection in 2 cases, re-rupture in 2 cases, adhesion of tendon to the skin, and sural nerve injury in 9 cases [12]. 2 wound infections, 2 re-rupture, 20 adhesion of tendon to skin, and 9 sural nerve injury in 74 patients treated by open surgical repair [26]. Two post-operative skin slough in sixteen patients [27].

CONCLUSION

The management of old neglected Tendo Achilles injuries remains challenging due to various factors affecting the outcome. Post-operative management and result evaluation protocols differ among authors, making it difficult to evaluate, communicate, and compare studies. Delays in diagnosis or presentation can cause rupture Tendo Achilles to contract, leading to a large gap in the injured tendon. The Bosworth technique, which uses healthy tendon or fascia as a donor, is found to be useful in reconstructing the gap in injured Tendo Achilles, especially when the gap is large (4-5cm) and the injury is between 2.5 cm and 5 cm from the insertion of the tendon.

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