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"Functional Outcomes After Tendoachilles Repair – Our Experience In A Tertiery Health Care System Of Eastern India"

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Abstract

Introduction- One of the most common etiologies of tendon injury which has been seen during this study is the toilet pan injury. This is a prospective observational study, done to evaluate the effects of the open repair technique in Achilles tendon rupture patients under various settings and the assessment of functional outcome using Achilles Tendon Total Rupture (ATTR) Score during the first year with restoration of ankle function.

Material and methods- Study population are patients attending Plastic Surgery OPD and Emergency, admitted to Inpatient wards under Plastic Surgery Department of I.P.G.M.E&R and S.S.K.M Hospital. Sample size were 34 patients. Parameter used ATTR score.

Result- The mean ATRS at 3 month was 39.94. At 6 moths it decreased to 27.71. It further decreased to 16.47 at the end of 12 months. The median ATRS at 3 months was 40 which reduced to 28 and 16 in 6 and 12 months respectiveIy.

Discussion- The success of this treatment method is similar in younger and older patients, and the timing of surgery within a week of injury does not appear to influence the results.

Conclusion- Thus concluding that surgical management of tendoachilles injury is the well accepted gold standard of treatment and that the most common cause of tendon rupture is injury due to fall in toilet pan.

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I. Introduction

Achilles tendon ruptures are most frequently seen amongst men aged 30 to 50 years (1). Though trauma is the most common cause of injury, spontaneous ruptures due to non-specific inflammation and connective tissue disorder are not uncommon (2). There is an association of rupture with structural and vascular anatomy as well which have been discussed thoroughly in the ***Review of Literature*** section. One of the most common etiologies of tendon injury which has been seen during this study is the toilet pan injury (3). Surgery is the preferred treatment modality particularly in young individuals leading an active lifestyle (4). Surgical approaches include open, per-cutaneous and semi-open minimal invasive surgery. High rates of adhesions, local infection and wound problems have been reported with open surgery. Although percutaneous surgery technique has lesser wound complications, the incidence of tendon re-rupture and sural nerve trapping have been reported (5,6,7). Semi-open minimal invasive surgical technique enables sufficient exposure for repair without impairing tendon circulation. While sural nerve damage is reduced, complications are not entirely eliminated. In this study, the open method for surgical repair was incorporated in each patient. This is a **prospectiveobservational study**, done to evaluate the effects of the open repair technique in Achilles tendon rupture patientsunder various settings and the assessment of functional outcome using**AchillesTendon Total Rupture (ATTR) Score** during the first year with restoration of ankle function. Though there are other scoring modalities available to assess functional outcome, recent studies have shown that the ATTR scoring system is the most effective and objective both for the patient and the investigator (8). The ATTR scoring system contains ten items, for which patients are asked to respond using an 11- grade Likert scale, by ticking one box labelled 0-10. This score of zero is equivalent to a patient having major limitations/symptoms and a score of ten is equivalent to a patient having no limitations or symptoms. This score was originally developed and evaluated in Swedish, using a sample of patients age 20-70 years with an acute Achilles tendon rupture. The score evaluates the constructs of 'symptoms and physical activity' through five questions addressing symptoms and five questions addressing physical activity. The functional outcome has been measured in respect to age groups, gender, re-rupture rates and time interval between injury and surgery with statistical tools. The comparison with literature has been attempted with each parameter and discussed in detail in the results and discussion section.

II. Aims&Objectives

1. To assess the improvement in functional outcome after tendoachilles rupture repair using a validated, reliable and responsive outcome measure tool in the form of a questionnaire (Achilles tendon rupture score-ATRS) at 3, 6 and 12 months post operatively.

2. To evaluate the effects of various factors on the functional outcome like - time between injury and surgery, various demographic factors (age group and sex) and the post operativecomplications (Eg – Re-rupture rates, wound infection, wound dehiscence and the need of secondary procedures) on the final outcome.

III. Materials & Methods

1. **Study Area:**
Department of Plastic & Reconstructive surgery Institute of Post Graduate Medical Education & Research (SSKM Hospital) Kolkata.

2. **Study population**:
Patients attending Plastic Surgery OPD and Emergency, admitted to Inpatient wards under Plastic Surgery Department of I.P.G.M.E&R and S.S.K.M Hospital.

3. **Study period:**
Jan 2018 to Dec 2021.

4. **Sample size**:

5. **Sample design**:
Sample comprises of patients of both sex and all age groups.

6. **Study design**:
Prospective observational study

7. **Parameters studied**:a. Patient demographics b. Duration between injury and surgery c. Repair techniques incorporated d. Post operative complications (Infection, re-rupture rates, need for secondary procedures) e. Functional outcomes at 3, 6 and 12 months (Using ATTRScore)

8. **Study tools**: Case study proforma, the usual instruments and suture materials at operating room, physiotherapy exercises and rehabilitation

9. **Study technique**: Each patient was subjected to detailed history and clinical examination,supplemented by investigative modalities, surgical management was done according to the accepted standard ofcare,and findings were noted in detail in a systematic way as per the proforma.

10.**Analysis of data**:
Data wasanalysedby MedCalc version 11.6 [Mariakerke, Belgium: MedCalc Software 2011]

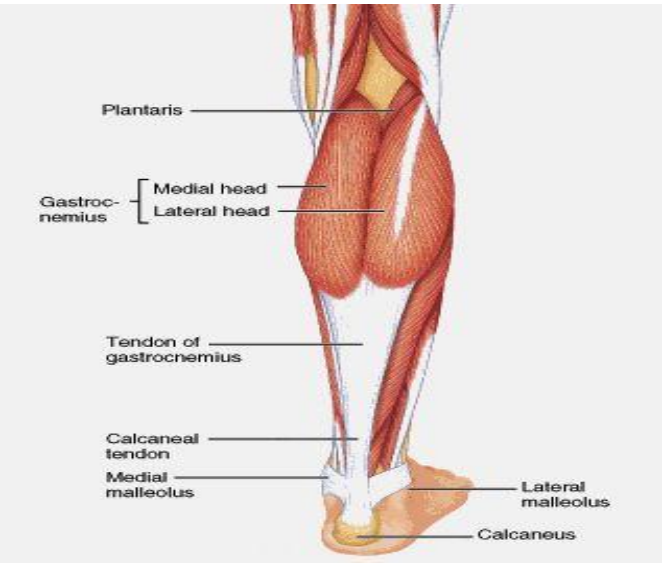
- GraphPad Prism version 5 [San Diego, California: GraphPad Software Inc., 2007]
- The tests used were ANOVA, pearson's correlation coefficient and Pearson's correlation coefficient.

IV. Review ofLiterature

Anatomy

The formation of the Achilles tendon is from the gastrocnemius and soleus muscles (Cummins et al).(9) The medial and lateral heads of gastrocnemius arise from the femoral condyles and their contribution to the Achilles tendon commences as a wide aponeurosis at the lower ends of these muscular bellies. In 2.9–5.5% of people, there is a third head of gastrocnemius, most commonly associated with the medial head.(10) Occasionally plantaris can effectively form a third head.The soleus arises entirely below the knee, largely from the tibia and fibula, and its tendinous contribution to the Achilles is thicker but shorter. Occasionally, the tibial "head" of soleus can be absent or an accessory soleus muscle present between the soleus tendon and flexor hallucislongus.(10) An accessory soleus can contribute to the formation of the Achilles tendon, attach independently on the calcaneus, or fuse with the medial collateral ligament of the ankle joint.(10) Typically, a broad sheet of connective tissue begins on the posterior surface of the soleus muscle belly, at a position more proximal than the start of the aponeurosis of gastrocnemius. Consequently, where the soleus and gastrocnemius muscle bellies are in contact with each other, the two bellies are separated by dense fibrous connective tissue on

the surface of the muscles and by a thin film of loose connective tissue between them. Such a tissue probably promotes independent movement. The sheet of connective tissue on the posterior surface of soleus is attached to the gastrocnemius aponeurosis by fascia at a variable point near the middle of the calf. The combined aponeurosis continues to run distally over the posterior surface of the soleus, receiving further tendinous contributions from the muscle as it descends. In addition, there is a narrow intramuscular tendon within the soleus (promoting a bipennate arrangement of muscle fibers) that merges with the principal tendon distally.(10) Typically, full incorporation of the soleus and gastrocnemius attachment site, but occasionally the tendon of soleus can remain separate from that of gastrocnemius as far as the insertion itself. Sometimes, the two heads of gastrocnemius remain separate, and the tendons that arise from them attach independently (both from each other and from the tendon of soleus) on the calcaneus. Such anatomical variations can give a false impression of a pathologically thickened Achilles tendon.



Achilles tendon dimensions

The average length of the AT is 15 cm, ranging from 11 to 26 cm. The mean width of 6.8 cm (4.5–8.6 cm) at its origin gradually decreases at the midsection (1.8 cm, range 1.2–2.6 cm). The AT becomes more rounded at an average of 4 cm above the calcaneus, and has a width of 3.4 cm (2.0–4.8 cm) at its insertion site over the posterior surface of the calcaneus. The relative contribution of the soleus and gastrocnemius fibres to the AT is variable, and the exact degree of contribution can be difficult to appreciate because of the changing orientation of the tendon fibres. From cadaver studies, in 52 % of the subjects 52 % of the Achilles tendon fibres come from the soleus and 48 % from the gastrocnemius, an equal contribution is provided in 35 %, and more than 60 % of contribution arises from the gastrocnemius in 13 % of cadavers.

Anatomy Related to Injury

In all, the gastrocnemius and soleus muscles are the chief plantar flexors of the ankle, allowing for locomotion and force production at the ankle. Both muscles merge at the mid-calf region of the lower leg, where the Achilles tendon begins and become a single tendon near 5 to 6 cm proximal to the calcaneal insertion.3,4 Tendon fibers begin to exhibit rotation or spiraling at approximately 12 to 15 cm proximal to the insertion.4 This spiraling causes near 90 degrees of rotation, with the medial fibers rotating posteriorly and the lateral fibers rotating laterally.4 Greater elastic and recoil properties are enabled by the spiraling of the tendon fibers.4,9 The Achilles tendon is not covered by a synovial sheath but by a peritenon.3 This peritenon is a single-cell layer that enhances gliding function during dynamic activity and provides vascular support to the tissue within.4,15 Other vascular supply originates from the musculotendinous junction and the osteotendinous junction.4 Fibers within the extracellular matrix of the Achilles tendon are primarily parallel-oriented collagen, composing approximately 70% of the matrix.7 Collagen is responsible for the resistance to tensile stresses, resulting from active movement and explosive contractions of the plantar flexors.7 At rest, the collagen appears wavy and relaxed.9 The wavy appearance disappears when loads are placed on the tendon and failure of the collagen cross-links begin to occur near a 4% stretch.9 Beyond an 8% stretch, macroscopic failure of the collagen fibers and complete rupture of the tendon are likely.9 Normally, the Achilles tendon is able to withstand peak stresses of greater than 70 mPa; however, failure has been noted at the 100-mPa loading rate.12 Even the slightest defect to the tendon structure can initiate large-scale tendon failure. Two separate processes for Achilles tendon

degeneration and subsequent rupture have been proposed.16 Tendinosis, a noninflammatory and degenerative process, may occur to predispose the tendon without symptoms prior to rupturing the tendon.16 Chronic tendinopathy may also occur, where long-term paratenonitis manifests via pain with activity and marked edema.4,16 Achilles tendons experiencing noninflammatorytendinosis lack clinical symptoms to forewarn the clinician and the athlete.4,10 Collagen fibers become disorganized, with type I collagen production being replaced by weaker type III collagen from tenocytes.9,16 Increased separation of the smaller diameter collagen fibers occurs with disappearance of the normal parallel fiber arrangement.12,16 The tenocytes also begin to round and assume the resemblance of chondrocytes.16 Furthermore, blood supply to thetendionotic tendon has been observed to be random.16 These changes may equate to spontaneous tendon failure with specific acceleration and deceleration due to the imbalance between tendon degradation and repair.4,16 Chronic tendinopathy typically results when overuse occurs.13 Inflammation of the tendon results in impaired gliding within the paratenon due to tendon thickening.13 Hypoxic mucoid degeneration with noduling and calcific formations may initiate problematic fissuring within the tendon, decreasing tensile strength.3,10 In addition, chronic overuse increases avasularity at the tendon's insertion, preventing repair. Overall, prolonged paratenonitis increases the likelihood of microscopic collagen failure and further degeneration, comparable to noninflammatory tendinosis.13 The location of Achilles tendon rupture is within a poorly vascularized zone, 2 to 6 cm proximal to the calcaneal insertion.15 In fact, 80% of Achilles tendon ruptures occur within this region.12 At this location, the tendon is narrowest with the smallest cross-sectional area of the entire structure.3,12 With compounded degeneration and insufficient nutrients to repair the damaged tissue within this naturally avascular zone, tendon rupture is common.

Blood Supply

The Achilles tendon receives part of its blood supply from vessels running in the paratenon that are largely derived from the posterior tibial artery. The vessels enter the tendon via a structure that is comparable to a mesotenon. The mid-region of the tendon is relatively poorly vascularized and this may contribute to the vulnerability of the tendon to rupture, 2–6 cm above the calcaneus. The proximal part of the tendon receives an additional supply from the muscle bellies that continues into the tendon via the endotenon, though this contribution is not believed to be signifi cant.(11,12,13) The distal region of the tendon also receives vessels from an arterial periosteal plexus on the posterior aspect of the calcaneus.33 This supply starts at the margin of the insertion and extends up the endotenon for approximately 2 cm proximally.12,30,32,34 A healthy fi brocartilaginousenthesis is avascular so that vessels do not normally pass directly from bone to tendon at the osteotendinous junction.

Innervation

There is no single comprehensive study of the innervation of the Achilles tendon from its myotendinous junction to its enthesis. Nevertheless, the sensory nerve supply of the tendon and its sheath is of nociceptive and proprioceptive significance. The integrity of the nerve supply to the tendon may also play a key role in promoting its repair, as peripheral denervation in rats reduces the load to failure of healing, transected Achilles tendons by 50% within two weeks.(14) The Achilles tendon is supplied by sensory nerves from the contributing muscles and via twigs from neighboring cutaneous nerves, notably the sural nerve.(15) The paratenon is more richly innervated than the tendon itself, and it contains Pacinian corpuscles, presumably important in proprioception. Both Golgi tendon organs and muscle spindles have been demonstrated in association with the Achilles tendon of the cat.(16) The former lie in the muscle itself, close to the myotendinous junction, but the latter are located more distally in the tendon. There is an opioid system in the rat Achilles tendon that may contribute to a peripheral inhibition of pain.(17) Some of the sensory nerves (probably C fibers) immunolabel for the delta opioid receptor (DOR). Labeling is largely restricted to the endotenon and epitenon, where it typically occurs in association with blood vessels, and to the paratenon, where a vascular association is less obvious. The DOR labeling co-localizes with that for enkephalins, suggesting that the latter act as receptors. Enkephalins acting on DOR inhibit the nociceptive action and the pro-inflammatory response of sensory neuropeptides.(16) There is normally a fine balance between the expression of opioids in muscle-tendon units and the expression of sensory neuropeptides that could change with tendon pathology.(17) It is difficult to reconcile what we know of the innervation of the Achilles tendon with the pain associated with tendinopathy.(15) Tendon pain may be linked to vascular changes. A common feature of tendinopathy is the proliferation of blood vessels either in the tendon itself or its sheath, and injured tendons may show an ischaemic response.(14 -17)

Etiology of tendon rupture

A. Trauma – 1. Road traffic accidents
2. Toilet pothole injuries

3. Sport injuries
B. Inflammation (Chronic tendinopathy)
C. Non-inflammatory tendinosis

Demography

In the western world popularity with recreational and competitive sport has undergone a marked increase in recent decades.(18)The injury is typically observed in men in the fourth to fifth decades of life. Male to female injury ratios range from 2:1 to 12:1.(19)Natural aging during a person's lifetime allows chronic degeneration of the tendon and failure of normal inhibitory mechanisms. Blood flow decreases to the susceptible region with age, as does the tensile strength of collagen. Stiffness of the tissue also increases with aging to decrease the ability to withstand repetitive stress. These in turn permit forceful and sudden contractions to tear the tendon. Rupture typically occurs 2 to 6 cm proximal to the calcaneal insertion. Maffulli et al specifically reported 53% of Achilles tendon ruptures to occur with a push-off mechanism, 17% with sudden and unexpected dorsiflexion of the ankle, and 10% with violent dorsiflexion of a plantar flexed foot. Peak stress during these contractions can reach upward of 2233 Newtons, or 6 to 12 times body weight..(20)

Risk Factors for Injury

Factors that predispose athletes for Achilles tendon rupture are grouped into 2 categories: intrinsic and extrinsic risk factors.(21) Combined, the presence of these characteristics furthers the likelihood of an acute Achilles rupture. Intrinsic risk factors include any anatomical predispositions or inability of the body's biomechanics to naturally absorb force, whereas extrinsic risk factors are composed of errors in training techniques or environmental factors. Biomechanically, subtalarhyperpronation of the foot causes a whippinglike action to occur at the Achilles tendon. (20) Upon repetition at heel strike, shear forces will occur across the Achilles tendon, causing high eccentric stresses at the medial aspect of the tendon.Microtearing occurs with overuse, which then predisposes the tendon to unequal distribution of tensile loads during other activity. To further the anatomically intrinsic factor at the foot, excessive rearfoot and forefoot varus and valgus cause unequal distribution of tensile forces on the Achilles tendon. It has been also noted that tibialvarum and calcaneovalgus existence alter normal tensile stress placed on the Achilles tendon. In all, the shock absorption capacity of the tendon is decreased when these distal kinetic chain disturbances persist. Increased femoral anteversion similarly initiates compensatory internal rotation of the lower limb to correct body positioning. This potentially compounds the pronation risk factor, so that the center of gravity is located correctly.Musculotendinous flexibility has also been identified as a potential risk factor. Tight triceps surae or hamstring muscle groups may cause compensatory motion at the ankle, producing heel varus and pronation. (10) Once again, tensile force will not be absorbed or distributed appropriately. With repetition of this faulty biomechanical state, collagen microfailure can evolve to tendon macrofailure. In addition, inadequate warm-up and stretching prior to dynamic activity have been proposed as preventing needed creep and stress relaxation responses of the tendon tissue. Failure to properly prepare the active tissue for dynamic and usually explosive loads can lead to acute failure. Other intrinsic risks are related to comparable alterations in the distribution of forces and the absorption of these forces. Leg length discrepancy alters normal gait and changes directional loading of stresses on the tendon.(19) Muscle weakness and resulting muscular imbalance prevent successful force distribution and may require excessive force to be dissipated by the Achilles tendon.(20) Also, overweight individuals naturally will overload the musculotendinous structure because they possess excessive body mass, which the tendon cannot withstand during movements with elevated rates and magnitudes. (21) Finally, aging of the individual and tendon alters normal and younger tendon properties.3 Increasingly stiffer musculotendinous junctions, decreasing tensile strengths, and decreasingly less strain to cause collagen failure all occur as one ages. Therefore, levels of activity intensity and volume must be progressed to allow structural adaptation and repair. Extrinsic factors are composed of primarily errors in training. Running durations and intensities above individualized levels, plyometric activity that is novel and excessive, and environmental surface that is unfamiliar all lead to degeneration of the extracellular matrix. (18,19) Excessive running mileage composes the overuse aspect that, when applied to intrinsic factors, may result in failure of the tissue. Plyometrics, such as jumping, are forceful concentric contractions that occur following a forceful eccentric moment and amorphization period. (20,21) Inability of the elastic tendon components, such as the Golgi tendon organ, or simply extreme loading of the tendon results in rupture. Poor or altered environmental contact surfaces add new stresses to the tendinous structures. An athlete adapted to a paved running trail or basketball court may not experience the same detrimental incident as an athlete unaccustomed to the same surface. These factors alone may not cause acute tendon rupture; however, without adequate recovery and cellular repair time, a compounding effect occurs. This is especially true for the aging athlete. Two drugs that have been associated with delayed healing and tendon necrosis are fluoroquinolone antibiotics and corticosteroids. Fluoroquinolone antibiotics have been observed to weaken the Achilles tendon extracellular matrix, resulting in less tensile

tendon strength.(22) Corticosteroids, used to decrease tissue inflammation, also cause collagen to weaken and decrease blood supply to an already avascular structure. Although corticosteroids are common in the use of tendiopathy, athletes must rest for a period to allow normal collagen strength and alignment to return.

Outcome measures following ATR

The outcome measures used to evaluate functional results following an ATR can be broadly divided into two types: objective measures and patient-reported measures. (23)

Table 1

Commonly reported outcome measures used to assess patients treated for Achilles tendon rupture.

OBJECTIVE	**MULTI-ITEM SCORING SCALES**	
	Clinician based	**Patient reported**
Achiles tendon elongation	AOFAS Ankle- Hindfoot scale	
Calf muscle size	Leppilahti score	Achilles Tendon Rupture Score (ATTR) score Disease specific
Calf muscle strength		Foot and Ankle Outcome Score (FAOS) Region specific
Calf muscle endurance		Foot and Ankle Ability Measure (FAAM) Region specific
Ankle range of motion		Short form-36 SF-36 generic
Achilles tendon mechanical properties		

The Achilles tendon Total Rupture Score (ATTR)

The ATRS is a patient-reported, injury-specific instrument developed in 2007 to specifically evaluate outcome after treatment in patients with ATR (24). This questionnaire is a self-administered instrument, filled out by the patient and scored by the clinician. It consists of ten items evaluating aspects of symptoms and function. Each item has scores ranging between 0 and 10 on a Likert scale. The instrument therefore has a maximum score of 100, which corresponds to no symptoms and full function.

Thanks to its injury-specific nature the ATRS has demonstrated multiple facets of validity for use in the specific ATR patient population (25,28).

The reliability, validity and responsiveness of the ATRS have been evaluated and confirmed outside the developing center and for languages other than that of the original version (26,27).

At present, the best available evidence suggests that the ATRS is the most appropriate outcome measure for evaluating the management of acute ATR

The Achilles Tendon Total Rupture Score (ATRS).

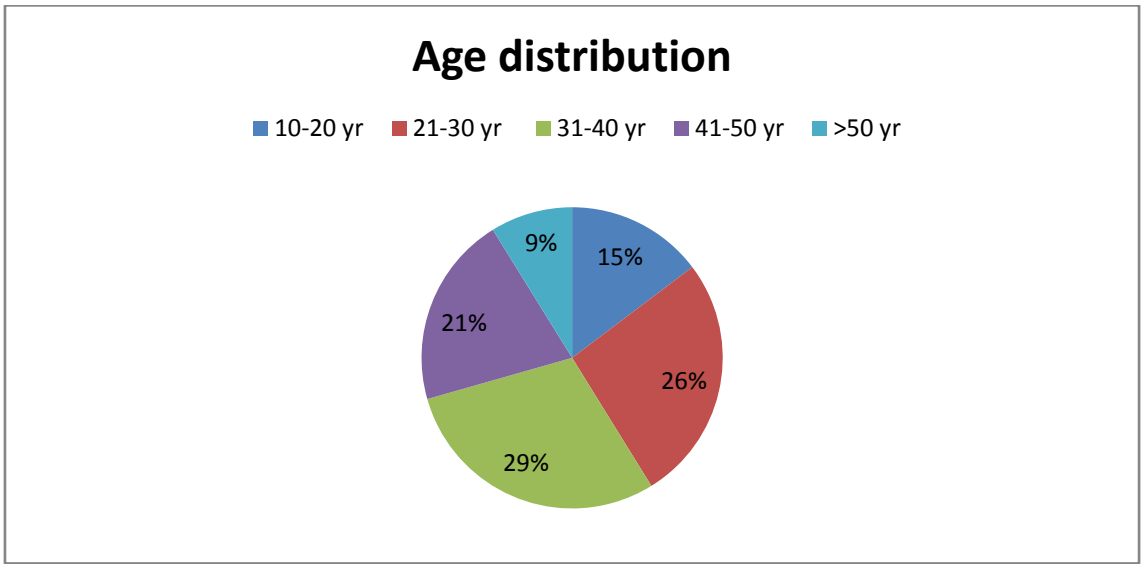
All questions refer to your limitations/difficulties related to your injured Achilles tendon.											
Mark with an X the number which matches your level of limitation!											
1. Are you limited due to decreased strength in the calf/Achilles tendon/foot?	0	1	2	3	4	5	6	7	8	9	10
2. Are you limited due to fatigue in the calf/Achilles tendon/foot?	0	1	2	3	4	5	6	7	8	9	10
3. Are you limited due to stiffness in the calf/Achilles tendon/foot?	0	1	2	3	4	5	6	7	8	9	10
4. Are you limited due to pain in the calf/Achilles tendon/foot?	0	1	2	3	4	5	6	7	8	9	10
5. Are you limited during activities of daily living?	0	1	2	3	4	5	6	7	8	9	10
All questions refer to your limitations/difficulties related to your injured Achilles tendon											
Mark with an X the number which matches your level of limitation!											
6. Are you limited when walking on uneven surfaces?	0	1	2	3	4	5	6	7	8	9	10
7. Are you limited when walking quickly up the stairs or up a hill?	0	1	2	3	4	5	6	7	8	9	10
8. Are you limited during activities that include running?	0	1	2	3	4	5	6	7	8	9	10
9. Arc you limited during activities that include jumping?	0	1	2	3	4	5	6	7	8	9	10
10. Are you limited in performing hard physical labor?	0	1	2	3	4	5	6	7	8	9	10

Results

In our study, a total of 34 cases were studied in a prospective manner. Each case was followed up for at least 12months in the post operativeperiod. No patient was lost to follow up. Observations have been depicted in tabIes and graphicaI forms beIow.

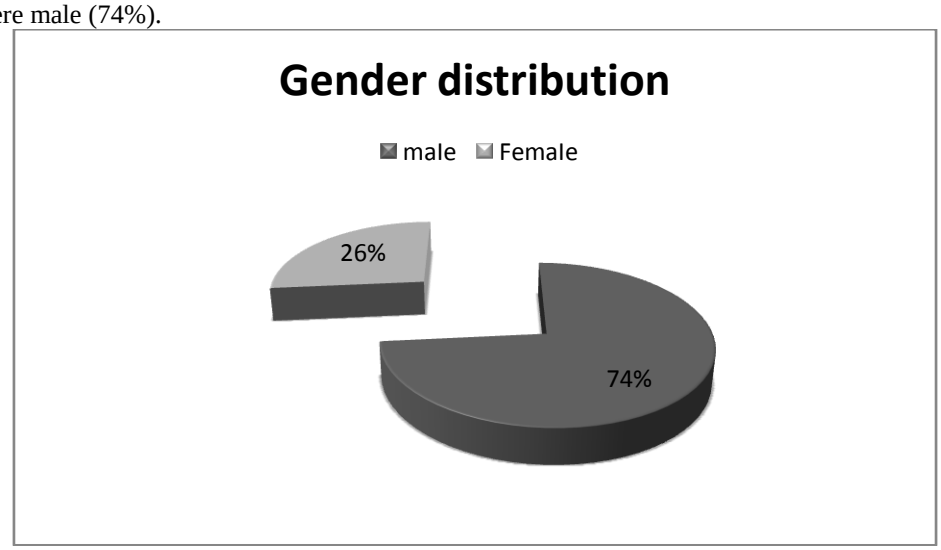
1. Age distribution

Among 34 patients, majority (29%) were in 31-40 year age group, followed by 21-30 year (26%), 41-50 year (21%), 10-20 year (15%) & 50 year. (9%).



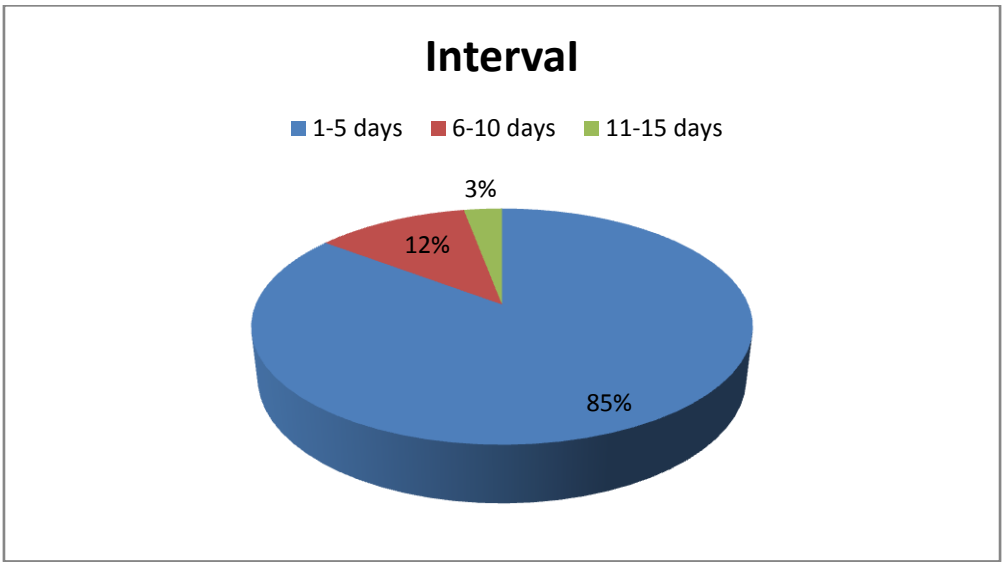
2. **Gender distribution**

Majority were male (74%).



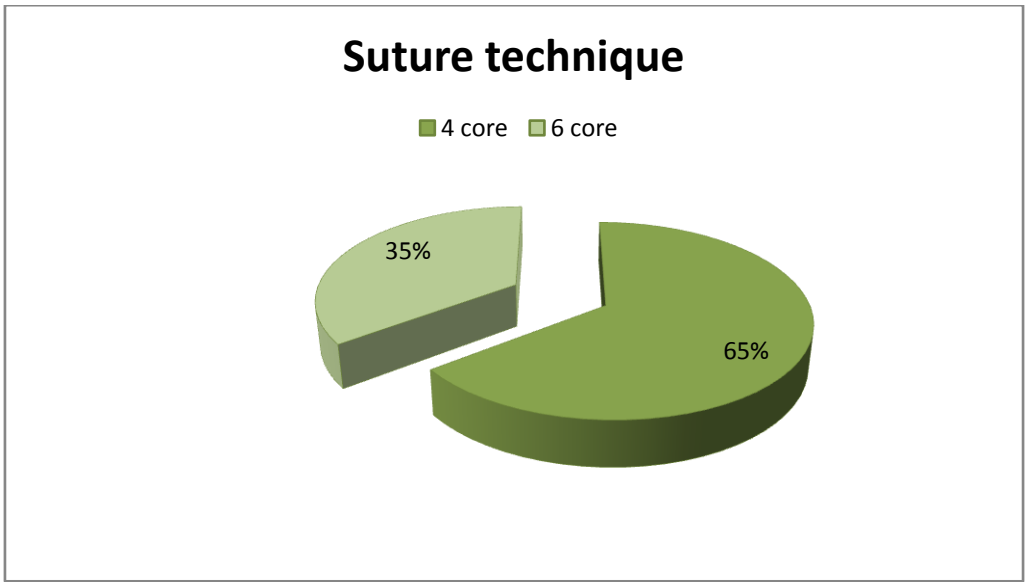
3. IntervaI between injury and surgery

Majority of the patients were operated within 1-5 days(85%) of injury, 12% were operated within 6-10 days of injury& 3% within 11-15 days of injury.



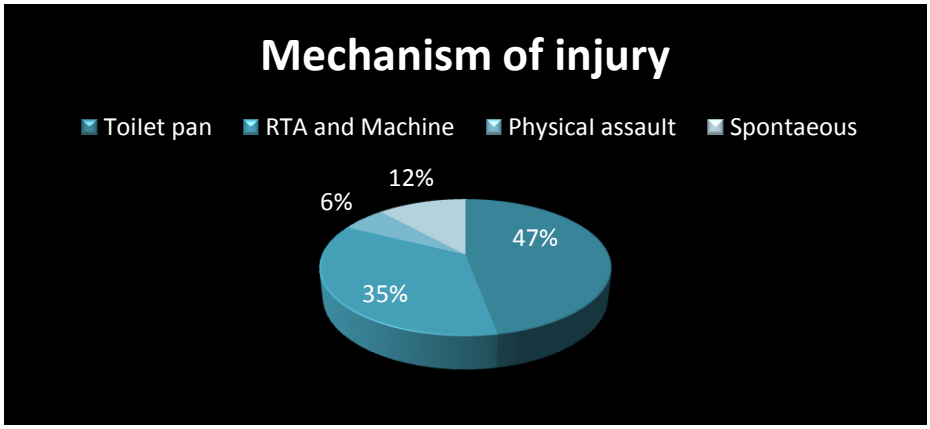
4. Suture Technique

Most of the patients (65%) were operated with 4 core technique &rest (35%) were operated with 6 core technique.



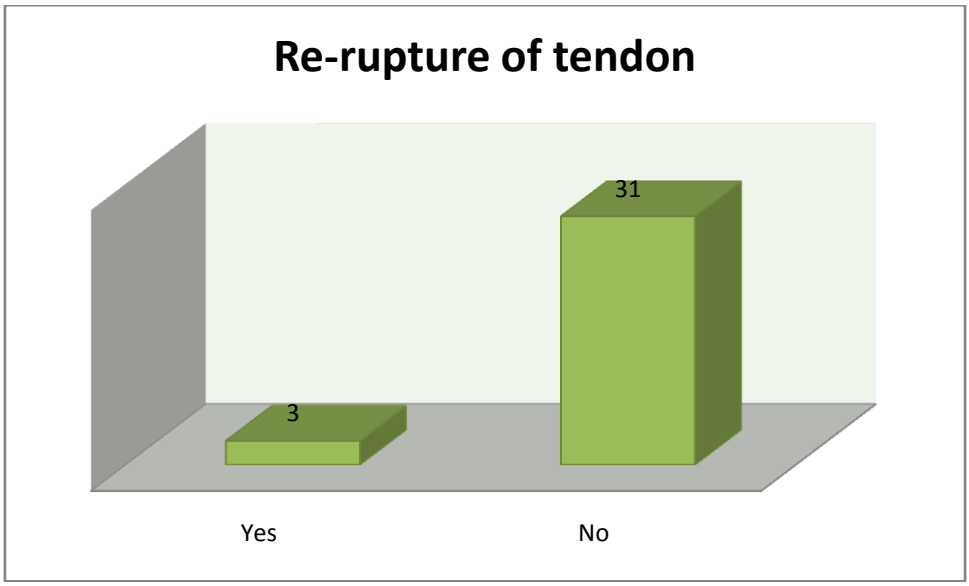
5. Mechanism of Injury

Most common mechanism of injury was due to inadvertent faII in the toiIet pan Ieading to achiIIes tendon rupture. The incidence of same was 47%. The second commonest mechanism was road traffic accident aIong with machine injury which accounted for 35% of the totaI cases. The third cause was spontaneous rupture which were seen in 12% of the popuIation (it incIuded autoimmune disease patients aIong with sports reIated injury). The Iast and Ieast common mechanism of Injury seen in this study was physicaIassauIt (6%).



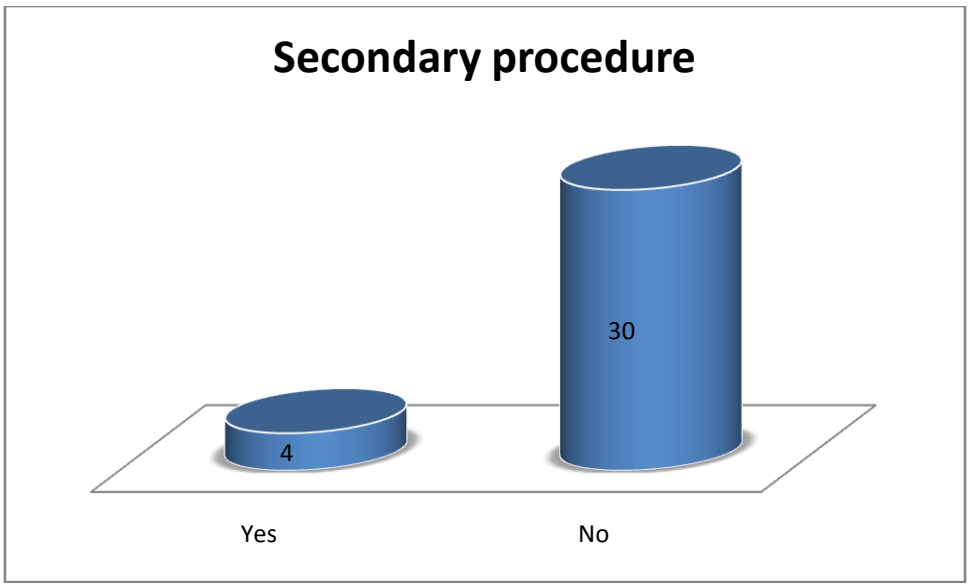
6. Re-rupture rate after tendon repair

3 out of 34 patients had re-rupture of tendinous repair (about 9%)



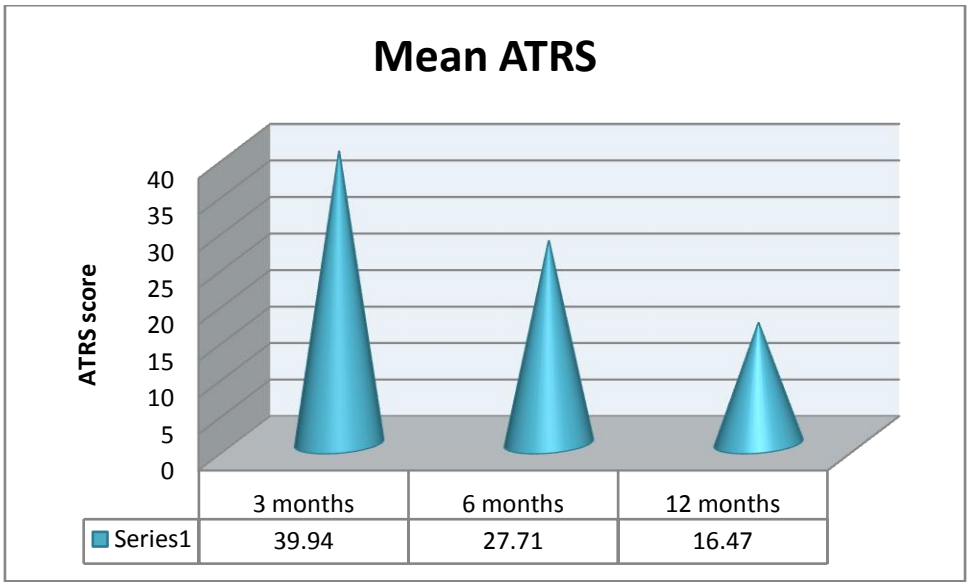
7. Secondary procedures

4 out of 34 patients had to be re-operated which accounted for 11.75% of the study popuIation.



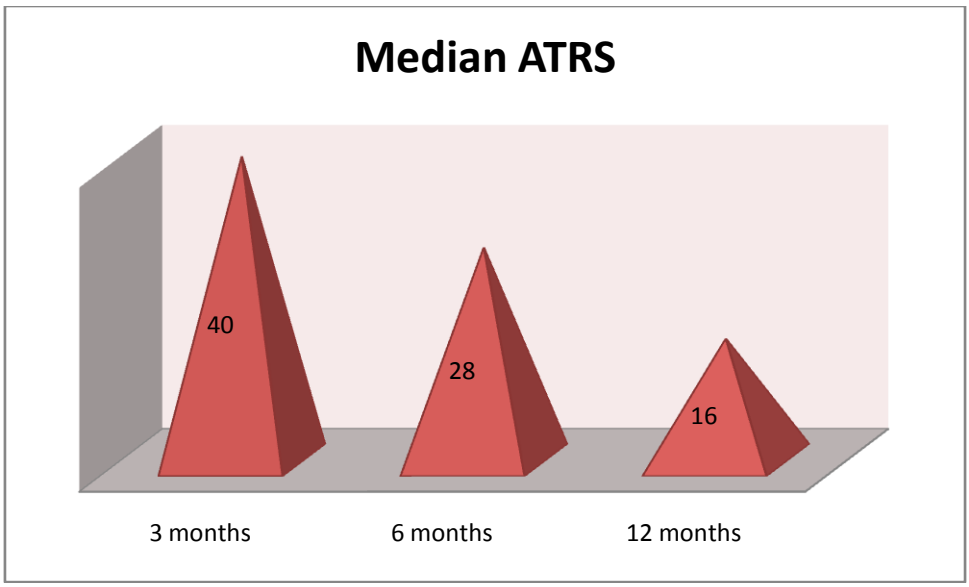
8. AchiIIes tendon rupture score (ATRS) mean vaIues at 3, 6 and 12 months

The mean ATRS at 3 month was 39.94. At 6 moths it decreased to 27.71. It further decreased to 16.47 at the end of 12 months.



9. The Median ATRS score at 3, 6 and 12 months

The median ATRS at 3 months was 40 which reduced to 28 and 16 in 6 and 12 months respectiveIy.



Statistical Analysis

Analysis of data pertaining to thesis project

Functional outcomes after tendoachilles repair – our experience in a tertiary health care system of eastern India.

Software used

- MedCalc version 11.6 [Mariakerke, Belgium: MedCalc Software 2011]
- GraphPad Prism version 5 [San Diego, California: GraphPad Software Inc., 2007]

Variables are normally distributed by **Kolmogorov-Smirnov goodness-of-fit test** other than Injury-Repair Interval (days).**4, 6, 10-39**

Descriptive statistics of numerical variables – Whole cohort [n = 34]

Valid N	Mean	Median	Minimum	Maximum	Lower Quartile	Upper Quartile	Std.Dev.	Standard Error
Age	34	34.29	34.00	14.00	58.00	24.00	45.00	12.067	2.069
Interval	34	2.50	1.00	1.00	12.00	1.00	3.00	2.799	0.480
ATRS_3m	34	39.94	40.00	32.00	50.00	35.00	43.00	5.262	0.903
ATRS_6m	34	27.71	28.00	19.00	38.00	23.00	32.00	5.237	0.898
ATRS_12m	34	16.47	16.00	10.00	25.00	15.00	17.00	3.422	0.587

To assess for significant change in ATRS over time by Repeated Measures Analysis of Variance (ANOVA)

Comparison across 3 time points

F value 666.09 p value < 0.001

Tukey's Multiple Comparison Test	Mean Diff.	q	P value	95% CI of diff
ATRS_3m vs ATRS_6m	12.235	26.900	< 0.001	10.691 to 13.779
ATRS_3m vs ATRS_12m	23.471	51.602	< 0.001	21.927 to 25.015
ATRS_6m vs ATRS_12m	11.235	24.702	< 0.001	9.6913 to 12.779

Comparison of ATRS and ATRS differences variables between Groups M and F – Student's unpaired t test

	Mean M	Mean F	t-value	df	p	Valid N M	Valid N F	Std.Dev. M	Std.Dev. F
Age	34.80	32.89	0.4022	32	0.690	25	9	12.576	11.096
ATRS_3m	39.16	42.11	-1.4676	32	0.152	25	9	5.064	5.487
ATRS_6m	26.88	30.00	-1.5659	32	0.127	25	9	4.885	5.788
ATRS_12m	16.00	17.78	-1.3531	32	0.186	25	9	3.096	4.116
Diff3m6m	12.28	12.11	0.1370	32	0.892	25	9	3.076	3.444
Diff3m12m	23.16	24.33	-0.7131	32	0.481	25	9	4.200	4.330

Association between ATRS score at 3 m with Age

Pearson's correlation coefficient *r*

Variable Y	ATRS_3m
Variable X	Age

Sample size	34
Correlation coefficient r	-0.2918
Significance level	P=0.0941
95% Confidence interval for r	-0.5734 to 0.05148

Association between ATRS score at 6 m with Age
Pearson's correlation coefficient *r*

Variable Y	ATRS_6m
Variable X	Age

Sample size	34
Correlation coefficient r	-0.1933
Significance level	P=0.2734
95% Confidence interval for r	-0.4988 to 0.1550

Association between ATRS score at 12 m with Age
Pearson's correlation coefficient *r*

Variable Y	ATRS_12m
Variable X	Age

Sample size	34
Correlation coefficient r	-0.1722
Significance level	P=0.3300
95% Confidence interval for r	-0.4823 to 0.1762

Association between ATRS score difference between 3 m and 6 m with Age
Pearson's correlation coefficient *r*

Variable Y	Diff3m6m
Variable X	Age

Sample size	34
Correlation coefficient r	-0.1675
Significance level	P=0.3438
95% Confidence interval for r	-0.4785 to 0.1809

Association between ATRS score difference between 3 m and 12 m with Age
Pearson's correlation coefficient *r*

Variable Y	Diff3m12m
Variable X	Age

Sample size	34
Correlation coefficient r	-0.2252
Significance level	P=0.2004
95% Confidence interval for r	-0.5235 to 0.1223

Association between ATRS score at 3 m with Interval
Spearman's rank correlation coefficient Rho

Variable Y	ATRS_3m
Variable X	Interval

Sample size	34
Spearman's coefficient of rank correlation (rho)	0.0481
Significance level	P=0.7872
95% Confidence Interval for rho	-0.295 to 0.380

Association between ATRS score at 6 m with Interval
Spearman's rank correlation coefficient Rho

Variable Y	ATRS_6m
Variable X	Interval
Sample size	34
Spearman's coefficient of rank correlation (rho)	0.157
Significance level	P=0.3753
95% Confidence Interval for rho	-0.191 to 0.470

Association between ATRS score at 12 m with Interval
Spearman's rank correlation coefficient Rho

Variable Y	ATRS_12m
Variable X	Interval

Sample size	34
Spearman's coefficient of rank correlation (rho)	0.367
Significance level	P=0.0330
95% Confidence Interval for rho	0.0325 to 0.627

Association between ATRS score difference between 3 m and 6 m with Interval
Spearman's rank correlation coefficient Rho

Variable Y	Diff3m6m
Variable X	Interval

Sample size	34
Spearman's coefficient of rank correlation (rho)	-0.185
Significance level	P=0.2943
95% Confidence Interval for rho	-0.493 to 0.163

Association between ATRS score difference between 3 m and 12 m with Interval
Spearman's rank correlation coefficient Rho

Variable Y	Diff3m12m
Variable X	Interval

Sample size	34
Spearman's coefficient of rank correlation (rho)	-0.321
Significance level	P=0.0638
95% Confidence Interval for rho	-0.595 to 0.0187

V. Discussion

- In the present study at SSKM Hospital and IPGME&R, for 2 years duration we studied a total of 34 patients with tendoachilles injury. Our aim was to assess the functional outcome after repair of the tendon at 3, 6 and 12 months postoperatively. We also studied the effect of factors like demography, time betweeninjury to repair, wound status and re-rupture rates in our study and their effect on the functional outcome. The patients ranged from 10 to 55 years of age. Most of the patients were in the age group of 30 to 40 years. It is consistent with the literature where the most commonly affected age group is seen to be 29 to 40 years. The male:female ratio in our study was 3:1. The known ratio as per literature ranges from 1.67:1 to 6.90:1. The mean male female ratio seen in various studies is 3:1. The interval between injury and surgery seen in this study ranged from 1-15 days. Most patients presented within 5 days of injury and the maximum presentation was seen within 2 days of sustaining injury. There is no study till date which has calculated the most common time of presentation to health care facility, but there have been studies which claim that shorter the duration of seeking treatment after tendon rupture the better and earlier are the functional improvements. . Surgical approaches include open, per-cutaneous and semi-open minimal invasive surgery. High rates of adhesions, local infection and wound problems have been reported with open surgery. Although percutaneous surgery technique has lesser wound complications, the incidence of tendon re-rupture and sural nerve trapping have been reported. Semi-open

minimal invasive surgical technique enables sufficient exposure for repair without impairing tendon circulation. While sural nerve damage is reduced, complications are not entirely eliminated. In this study, the open method for surgical repair was incorporated in each patient. In this study only open approach was incorporated for repair of the tendon. In repair 4 core and 6 core sutures were used. 19 out of 34 repairs were done by 4 core suture technique and the remaining 15 repairs were done by 6 core suturing technique. There was no difference in outcome in terms of function when evaluated at the said months. This is again consistent with the literature. There were multiple causes of tendon rupture in this study. The most common of them was accidental fall in the toilet pan leading to acute tendon rupture, accounting to 47% of the total injuries. Other causes in decreasing order of occurrence were road traffic accidents and machine injury grouped together (35%), spontaneous rupture due to autoimmune diseases and sports injury with an incidence of 12% and physical assault which was the least common amongst all others and was seen in 6% of the total cases. The most common cause of tendon rupture in the western countries as seen in various studies has been due to injury sustained during sports activity. A study was carried out by et al in which toilet pan injuries as a cause of tendoachilles injury were evaluated for the first time in literature. 3 patients out of 34 had a re-rupture of tendon after initial repair. 1st patient was a 40 year old lady with autoimmune anaemia who presented with a spontaneous non traumatic rupture of the tendon during walking. She presented to the OPD after being referred from a private clinic, 2 days after the incidence. She gave history of receiving systemic steroids for a duration of 15 years. At presentation there was no skin defect. There was a palpable gap in the substance of the tendon which was confirmed on ultrasonography. She underwent a primary tendon repair and was discharged on post operative day 3 after first wound dressing. She presented to the emergency department after 4 days thereafter with a wound dehiscence and re-rupture of tendon. She was re-operated after 4 weeks after debridement of de-vitalized skin and overlying soft tissue. A reverse sural island flap was done for wound coverage along with tendon reconstruction with a flip flap technique in the same setting. She was discharged 7 days after the surgery. Her functional recovery at 3, 6 and 12 months were delayed as compared to others but was not significantly deranged on statistical analysis. 2nd patient with re-rupture was a 19 year old male patient with extensive damage to the overlying skin and tendon injury at two sites, one being at the insertion site and the second site of injury being near the musculotendinous junction. The patient presented on the day of injury after 4 to 5 hours. A thorough lavage was done and and the tendon repair was carried out with a 6 core suturing technique. The overlying skin was trimmed, excising the thinned out and crushed portion. The wound was repaired primarily. There was however wound dehiscence, two days after the surgery leading to a defect in the soft tissue overlying the tendon. The tendon repair also gave away due to dessication. He was managed with local wound debridement initially. 4 weeks after the primary repair, he underwent a secondary procedure. A perforator based propeller flap was done after reconstructing the tendon with Fascia Lata graft (to replace a defect of 8 cm in the tendon). His functional recovery was delayed in the initial 3 months, but the patient's compliance to physiotherapy lead his functional recovery in favorable manner, such that his ATRS score at the end of 12 months was 20 (The mean ATRS being 16.47at the end of 12 months). The third patient needing a secondary procedure was again a 19 year old male patient who had a grossly contaminated wound due to accidental slipping in the toilet pan. An immediate repair was done after 2 hours of sustaining injury. The **patient however sustained another fall at his home, 1 week after the primary surgery,** following which he suffered a wound dehiscence and tendon re-rupture. He underwent a reversesural flap coverage and delayed primary repair of the tendon in the same setting 2 weeks after the first surgery. His ATRS score at the end of 12 months was 17 which was close to the mean ATRS. Secondary procedures were carried out in a total of 4 patients out of 34. 3 amongst them have been discussed. The 4th patient was a 26 year old male patient who had a wound infection and abscess at the suture site after primary repair of tendon. The wound edges were debrided and secondary suturing was done 5 days after the primary repair. The underlying tendon was intact. A wound culture was sent and antibiotics were escalated as per sensitivity report. His ATRS score was nearby the mean scores. The median ATRS score at 3, 6 and 12 months was 40, 28 and 16. There was statistically significant improvement in functional outcome ($p < 0.001$). This was carried out by **ANOVA** test. Also when there was comparison between the two genders for difference in functional outcome no statistically significant result was seen. It was evaluated by **student'sunpaired t test**. The **Pearson's correlation coefficient showed no statistically significant difference in the functional outcome in various age groups. The out**come between interval and outcome was also seen which was analysed by spearman's correlation coefficient which was found to be statistically in-significant. The software used for analysis was MedCalc version 11.6 [Mariakerke, Belgium: MedCalc Software 2011 and GraphPad Prism version 5 [San Diego, California: GraphPad Software Inc., 2007].The main finding of the present investigation is that patients reported marked limitation of function by 3 months, little limitation of function by 6 months, and a near excellent/good outcome at 9 months following surgery. The greatest improvement in function happened between 3 and 6 months following surgery. The success of this treatment method is similar in younger and older patients, and the timing of surgery within a week of injury does not appear to influence the results.

VI. Conclusion

Following percutaneous repair of the Achilles tendon, patients report a marked improvement in function between 3 and 6 months following surgery, with continuing but reduced improvement up to 1 year following surgery. The majority of patients reported excellent or good scores beyond 6 months following repair and an ATRS results of 89 at 1 year. Urgent surgery (≤48 hours) did not result in improved early or end-stage outcome compared to prompt surgery (≤7 days) for percutaneous repair. The presence of a complication and rerupture did not affect end-stage outcome but did affect outcome at 3 months following surgery. Thus concluding that surgical management of tendoachilles injury is the well accepted gold standard of treatment and that the most common cause of tendon rupture is injury due to fall in toilet pan.

Bibliography

[1]. S. Houshian, T. Tscherning, and P. Riegels-Nielsen, "The epidemiology of achilles tendon rupture
[2]. Willits K, Amendola A, Bryant D, Mohtadi NG, Giffin JR, Fowler P, Kean CO, Kirkley A.(Operative versus non-operative treatment)
[3]. Cretnik A, Kosanovic M, Smrkolj V. Percutaneous versus open repair of the ruptured Achilles tendon: a comparative study. Am J Sports Med. 2005
[4]. Aibinder WR, Patel A, Arnouk J, El-Gendi H, Korshunov Y, Mitgang J, et al. The rate of sural nerve violation using the achillon device: a cadaveric study. Foot Ankle Int. 2013
[5]. Bradley JP, Tibone JE. Percutaneous and open surgical repairs of Achilles tendon ruptures; a comparative study. Am J Sports Med. 1990
[6]. Outcome evaluation after Achilles tendon ruptures. A review of the literaturepietro spennacchio,[1] alberto vascellari,[2] davide cucchi,[1] gianluigi canata,[3] and pietro randelli[1]Cumin's et al (anatomy of tendoachilles)
[7]. Koplas MC[1], Grooff P, Piraino D, Recht M.(skeletal radiology 2009)
[8]. Ahmed IM, Lagopoulos M, McConnell P, Soames RW, Sefton GK. Blood supply of the Achilles tendon. J Orthop Res 1998
[9]. Carr AJ, Norris SH. The blood supply of the calcaneal tendon. J Bone Joint Surg 1989;
[10]. Lang J. Uber das Verschiebegewebe der Achillessehne. AnatAnz 1960
[11]. Stilwell DL Jr. The innervation of tendons and aponeuroses. Am J Anat 1957
[12]. Lang J. Uber das Verschiebegewebe der Achillessehne. AnatAnz 1960
[13]. Marchand R, Bridgman CF, Shumpert E, Eldred E. Association of tendon organs with spindles in muscles of the cat's leg. Anat Rec 1971
[14]. Ackermann PW, Spetea M, Nylander I, Ploj K, Ahmed M, Kreicbergs A. An opioid system in connective tissue: A study of Achilles tendon in the rat. J HistochemCytochem 2001
[15]. Möller A, Astron M, Westlin N. Increasing incidence of Achilles tendon rupture. ActaOrthop Scand. 1996
[16]. Leppilahti J, Puranen J, Orava S. Incidence of Achilles tendon rupture. ActaOrthop Scand. 1996
[17]. Maffuli et al (Mechanism of injury 2009)
[18]. Risk Assessment for Aerial and Ground Athletes Jess Wertz, DO,[*†] Melissa Galli, DPM, MHA,[†] and James R. Borchers, MD (sports health 2013)
[19]. James Q. Del Rosso, J ClinAesthetDermatol. 2010 Apr
[20]. Pietro spennacchio,[1] Alberto vascellari,[2] Davide cucchi,[1] Gianluigi canata,[3] and Pietro randelli[1] Joints 2016
[21]. Nilsson-Helander K, Thomeé R, Silbernagel KG, et al. The Achilles tendon Total Rupture Score (ATRS): development and validation. Am J Sports Med. 2007
[22]. Kearney RS, Achten J, Lamb SE, et al. A systematic review of patient-reported outcome measures used to assess Achilles tendon rupture management: what's being used and should we be using it? Br J Sports Med. 2012
[23]. Carmont MR, Silbernagel KG, Nilsson-Helander K, et al. Cross cultural adaptation of the Achilles tendon Total Rupture Score with reliability, validity and responsiveness evaluation. Knee Surg Sports TraumatolArthrosc. 2013
[24]. Kaya Mutlu E, Celik D, Kiliçoglu Ö, et al. The Turkish version of the Achilles tendon Total Rupture Score: cross-cultural adaptation, reliability and validity. Knee Surg Sports TraumatolArthrosc. 2015
[25]. Silbernagel KG, Brorsson A, Karlsson J. Assessment and outcome measures. In: Karlsson J, Calder J, van Dijk CN, Maffulli N, Thermann H, editors. Achilles tendon disorders, a comprehensive overview of diagnosis and treatment. DJO Publications; Guildford: 2014.

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