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A study of chronic tendon Achilles rupture and the different modalities of its repair

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Abstract

Background: Achilles tendon rupture is a common and primary cause of lower limb tendon injuries suffered during sports-related activities. The causes of Achilles tendon rupture include calf muscle and tendon overuse, steroid local injection in tendon, poor tendon quality, and various medical conditions. Historically, acute Achilles tendon rupture was treated conservatively. However, historical techniques are now associated with an increased risk of rerupture. **Aim and Objective:** To study of the reconstruction of chronic tendoachilles ruptures with the flexor hallucis longus and peroneus brevis. **Material and Method: 30** patients aged between 30 and 60 years underwent reconstruction of chronically ruptured tendon Achilles either with flexor hallucis longus or peroneus brevis. Ruptures are due to stumbling in fields, falling from stairs, and some being uneventful. All these patients attended the department of Orthopaedics OPD and tertiary care of SSIMS, Bhilai. The patients were admitted and surgically treated after appropriate counseling and consent. The results were compared with the Quigley scale and Leppilahti scores. **Results:** Rupture of the Achilles tendon is more common in middle-aged males. Delay in diagnosis is due to a lack of adequate knowledge by the treating physician and a lack of immediate disability for the patient. The Thompson test has high sensitivity and specificity in diagnosis. Complications such as superficial skin infections and wound dehiscence are more common in patients treated with peroneus Peroneus and Sensory disturbance on foot is post operative complication. C**onclusion:** Flexor hallucis longus is superior to Peroneus brevis because of its anatomical and technical advantages, less incidence of superficial infections, wound dehiscence, and sensory disturbance, and better weight-bearing times and functional recovery.

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Keywords: Tendo Achilles, Flexor Hallucis Longus, Peroneus Brevis.

Introduction

Injury to the tendon Achilles is relatively common in middle-aged people and athletes. [1,2] Pushing heavy objects with only the forefoot on the ground, bearing weight, sudden unexpected dorsiflexion [3] and violent dorsiflexion of the plantigrade foot. People of low socioeconomic backgrounds who walk barefoot on uneven ground with heavy weights are at risk of rupture due to stumbling. Administration of multiple steroids [4] for calcaneal tendinosis may lead to tendon degeneration and rupture due to an insignificant injury. Mucoid degeneration [5] of the tendon and inhibitory malfunction [6] are also the causes. The overall incidence of acute Achilles tendon ruptures has been steadily rising. The Achilles tendon is now the third most commonly injured tendon, with only the rotatory cuff tendons and the knee extensor mechanism more frequently injured among major tendons. [7-8] The most frequently affected group for acute Achilles tendon ruptures are male recreational athletes aged 30 to 49 years, with injuries occurring during sports participation. [9] Despite the relatively common occurrence of acute Achilles tendon ruptures and the typically healthy patient population, the ideal treatment is still debated. [10] A number of recent meta-analyses have attempted to stratify treatment modalities based on rates of rerupture, clinical function, and overall complications. [7]

Table no.1: Comparison of Tendons for Tendon Transfer in Treatment of Chronic Achilles Tendon Rupture[11]

Tendon	Strength relative to GSC	Advantage	Concern
Perroneus brevis	18 times weaker	In phase with GSC during normal gait Shared role as plantar flexor of ankle Relatively close proximity to Achilles tendon but in separate muscle compartment	Loss of eversion strength Lateral-to-medial pull after transfer to calcaneus, which does not reproduce inversion normally created by Achilles tendon Sural nerve damage during harvest
Flexor digitorum longus	27 times weaker	In phase with GSC during normal gait Shared role as plantar flexor of ankle Relatively close proximity to Achilles tendon	Weakened flexion of toes Lesser toe deformities Nerve or artery injury during harvest
Flexor hallucis longus	13 times weaker	In phase with GSC during normal gait. Shared role as plantar flexor of ankle Closest proximity to Achilles tendon	Loss of push-off strength during gait Clawed hallux deformity.Transfer metatarsalgia. Nerve or artery injury during harvest

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The Achilles tendon is the most frequently torn ligament in the lower leg. [12] It is more prevalent in active young-to-middle-aged adults with an average age of 37–44 years. [13] Clinically, acute Achilles tendon rupture is frequently easy to diagnose and cure; yet, a large proportion of cases are still undetected due to factors such as a lack of therapy or a failure to provide adequate patient care at the time of injury. Typically, the Achilles tendon ruptures between 2 and 6 cm from its insertion into the calcaneal tuberosity. [14] This region is referred to as the watershed zone because of its decreased vascularity. [15] There is frequently a deficiency of tendinous tissue inside the paratenon at the defect location. Thick scar tissue fills the space between the proximal and distal tendon Achilles. [16] Due to tendon contraction, a lack of blood flow to the area, and gaps left following tendon damage, chronic Achilles tendon rupture becomes more difficult to repair than acute Achilles tendon rupture. Reduced plantar flexibility, restlessness, walking difficulty, persistent chronic pain, poor wound healing, and rerupture are consequences of chronic tears.[17] Various modalities of treatment include conservative management with splints and casts. [9] Operative treatment with gastrocnemius V-Y plasty, augmentation with plantaris tendon, peroneal tendons, flexor hallucis longus, and flexor digitorum longus. Other materials used include allografts and synthetic materials such as Dacron weave, carbon fiber, and Marlex mesh. In the present study, we use either flexor hallucis longus or peroneus brevis for re-augmentation of chronically ruptured tendo Achilles.

Material and method

The present is a prospective comparative study comprised of 30 patients with chronic rupture of the Achilles tendon in the Orthopedic Department, SSIMS, Bhilai, Chhattisgarh. All the cases were treated surgically by reconstructing the tendo Achilles with either the flexor hallucis longus or the peroneus brevis tendon.

Inclusion Criteria

- Patients of both sexes with a closed rupture of the Achilles tendon are at least 3 weeks old, and the patients are aged between 30 and 60 years.

Exclusion Criteria

- Prior history of surgery for the correction of tendon repair.
- Ruptures are associated with other generalized conditions.
- Ruptures associated with an open wound.

Sample Size

30 cases. 16 of the 30 patients were treated with flexor hallucis longus tendon transfer, and the remaining 14 patients were treated with peroneus brevis tendon transfer.

Tendo Achilles Rupture Reconstruction with Flexor Hallucis Longus Tendon Transfer (Modified Wapner Method)

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- The patient is positioned in a semi-lateral position towards the affected side, such that the body below the pelvis appears to be in a prone position. This helps in such a way that the posterior and medial parts of the foot face towards the ceiling. A sand bag is placed at the level of the ankle so that it holds the foot in plantar flexion.
- Through the posteriomedial approach, a direct incision is given all the way on to the Achilles tendon from a point 15 cm above the insertion of the tendo Achilles. The incision is extended until the paratenon is identified and split longitudinally.
- Ruptured ends are identified, and the distal 1 cm of the proximal part is debrided and sent for histopathological examination.
- The deep posterior compartment is opened, identified, confirmed, and separated.
- Through a separate incision at the level of the midfoot on the medial side, which is about 5 cm, the abductor hallucis is identified and retracted posteriorly to identify the flexor hallucis longus tendon. The tendon is cut immediately distal to the knot in Henry.
- The tendon is retracted into the posterior incision and secured to the tendo Achilles proximal part by interlacing it in the coronal plain and securing with 2.0 vicryl. The tendon exits at the distal tip of the proximal end.
- The tendon complex is secured with a 1.0 proline by Bunne. A tunnel is made in the calcaneus 1 cm. anterior to its insertion, exiting the sole at about 2 cm from the posterior border, by using a 4 mm drill bit.
- The tendon is passed into the tunnel of the calcaneus. The pull-out suture is secured with a button or a gauge roll. After wound closure, the ankle was immobilized in 100 plantar flexion.

Achilles Tendon Rupture Reconstruction with Peroneus Brevis Tendon Transfer

- Through the posterior approach, an incision is given over the distal portion of the leg, starting 8–12 cm from the insertion of the tendo Achilles. The incision is deepened until the paratenon is opened and split longitudinally.
- The ruptured ends are identified, and the distal 1 cm of the tendon is cut and sent to histopathological examination.
- The second incision is placed on the base of the fifth metatarsal such that it is at a right angle to the tendon of the peroneus brevis at its insertion. The peroneus muscle tendon is identified at the proximal incision by opening the lateral compartment at the lateral margin of the incision and confirmed by retracting and palpating it at its insertion.
- Peroneus brevis was cut at its distal end, and the tendon retracted to the proximal site. The tendon of Peroneus brevis is interlaced onto the proximal part of the ruptured Achilles tendon in the coronal plain and secured with 2.0 Vicryl.
- The tendon complex is anchored with a 1.0 proline by a Bunnel stitch. A bone awl tunnel is made in the calcaneus from a point just anterior to the Achilles tendon insertion to a point 2 cm from the posterior border of the foot.
- The peroneus tendon is passed through the tunnel and secured with a button or a gauge roll. After wound closure, the ankle was immobilized in 100 plantar flexion.

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Postoperative Management and Follow-Up

- The drain is removed on the 2nd day, and sutures are placed on the 14th day.
- At the end of two weeks, a knee cast is applied in 100 equinus and continued till the end of six weeks.
- After 6 weeks, the cast is removed along with a pull-out suture, and the patient is advised to complete weight bearing at his comfort.
- Heel rise is given for another two weeks, along with physiotherapy (calf-strengthening exercises).
- Complete weight bearing is advised after 8 weeks of surgery for the comfort of the patient.

Follow-Up

Patients in both groups were followed up at 2, 4, and 6 months and were individually assessed clinically. The following criteria are used to assess the strength and stability of the ankle, along with the strength and power of plantar flexion.

The scoring systems that are adapted to assess the outcome are:

- Quigley Scale
- Leppilahti Score

RESULTS

The presentstudy examinedstudy examinedy 30 cases of chronic rupture ofthe Achillesthe Achilless tendon by surgical reconstruction with flexor hallucis longus and peroneus brevis. In groupA,A,A flexor hallucis longus isused,used,d and in groupB,B, peroneus brevis is used. 30 consecutive open repairs of acute Achilles tendon rupture performed by a single foot and ankle fellowship-trained surgeon in a tertiary care setting between 2022 and 2024. The study population consisted of 16 males and 14 females. The average age was 42.3 (range, 30-80) years.

Table 2. Sex Distribution

	Group 1	**Group 2**	**Total**
Male	8	8	16
Female	7	7	14

Table 3. Age Distribution

	Group 1	**Group 2**	**Total**
30–40 years	4	3	7
41–50 Years	8	7	15
More than 51 years	4	4	8
Total	16	14	30

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Table 4. Mode of Injury

	Group 1	Group 2	Total
Fall from Stairs	4	5	9
Stumbling in Fields	7	5	12
Unknown Injury	5	4	9
Total	16	14	30

Table 5. Side of Rupture

	Group 1	Group 2	Total
Right Side	8	7	15
Left Side	8	7	15
Total	16	14	30

Table 6. Time Gap from Injury to Surgery

	Group 1	Group 2	Total
3 to 5 weeks	7	7	14
More than 5 weeks	9	7	16
Total	16	14	30

Table 7. Gap in Ultrasound

	Group 1	Group 2	Total
2-3 CM	5	3	8
3-4 CM	9	10	19
More than 4 cm	2	1	3
Total	16	14	30

Table 8. Presentation and Associated Factors

	Group 1	Group 2	Total
Pain	8	2	10
Steroid Infiltration	3	3	6
Diabetes	3	6	9
Calf Weakness	2	2	5
Total	16	14	30

Table 9. Post-Operative Complications

	Group 1	Group 2	Total
Superficial skin infections	3	5	8

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Wound Dehiscence	3	3	6
Deep Infections Requiring Skin Flap Coverage	0	0	0
Rerupture	0	0	
Neurological Symptoms	0	4	4

Table 10. Quigley Scale

	Group 1	**Group 2**	**Total**
Excellent	8	3	11
Good	8	10	18
Fair	0	1	1
Poor	0	0	0
Total	16	14	30

Table 11. Leppilahti Score

	Group 1	**Group 2**	**Total**
91-100	8	4	12
81-90	4	8	12
71-80	4	2	6
<70	0	0	0
Total	16	14	30

Discussion

The purpose of treating a neglected tendon Achilles ruptures are intended to reduce the risk of rerupture, the most frequent side effect of non-operative treatment, and to restore the continuity of the tendon with adequate strength and healthy tissue without inflammation, allowing the patient to resume normal gait and endurance for walking and other everyday activities.

In the present study, we have surgically treated 30 patients with tendo Achilles rupture with either flexor hallucis longus (group A) or peroneus brevis (group B) tendon transfer. 16 patients were in group A, and 14 patients were in group B. These 14 were female (46.66) and 16 were male (53.44). of this, 8/16 (50%) were female in group A, and 7/14 (50%) were female in group B. Achilles tendon tears are more common in athletes because they are more commonly involved in sports and recreational activities. Ruptures of Achilles tendon tears are seen in middle-aged males unconditioned for sports activities.

Our study found that the side of the injury is equal on both sides, i.e., 15 were on the left side and 15 were on the left side. The mode of injury in our study is most commonly stumbling in the fields (12 cases, i.e., 40%), as the majority of patients are

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farmers and agricultural laborers. Other causes include falls from steps (9 cases, i.e., 30), which may cause sudden violent dorsiflexion of the ankle, leading to the uprise of the tendo Achilles. Remaining cases do not have a history of falls or any such incident that may lead to the uprise of the tendon Achilles. Almost 50% of the patients (8 in group A and 8 in group B) had a history of pain in the posterior region of the ankle before the rupture. 30 of the patients (3 in group A and 3 in group B) have a history of steroid infiltration for ankle pain, which has been cited as a cause for the rupture of the chilles tendon. Steroid infiltration is associated with decreased wound healing capacity and decreased local immunity. It also decreases the thickness and quality of the skin at the infiltration site. Other comorbidities, like diabetes, were present in 30 of the cases. In almost all cases, 90% have fissures in the sole of the foot.

Inglis has classified the timing as early, if within 3 weeks after rupture, and late, if over 3 weeks. [6] Gabel et al. described that an Achilles tendon rupture is considered chronic if there is a 4-week interval between the rupture and repair. [18] Criteria suggested by Turco that positively influence the outcome of the reconstruction include the suturing of the shredded tendon, prevention of lengthening of the tendon, debridement of the ischemic ends of the tendon, elimination of excessive equinus, secure fixation, and elimination of the cast disease. [19] These guidelines are followed in the reconstruction of the tendons in both groups.

The following are the advantages of flexor hallucis longus over peroneus brevis: [20-21]

- Flexor hallucis longus tendon is the second strongest tendon acting to plantar flex the ankle.
- The axis of contraction of the flexor hallucis longus is in line with that of the Achilles tendon.
- Flexor hallucis longus fires in line with that of the gastrocnemius-soleus complex.
- Flexor hallucis longus is in anatomical proximity to the Achilles tendon.
- Digitations present between flexor hallucis longus and flexor digitorum longus help retain flexion of the first distal interphalangeal joint.

In the non-athletic patient, the clinical deficit resulting from the harvest of the flexor hallucis longus seems to be remarkably limited. Most patients in the published series are over 50 years old. It is unclear if loss of hallucial push-off would be more noticeable in a younger population to whom the ability to sprint or jump is more highly valued.

Coull et al. analyzed morbidity following flexor hallucis transfer. A trend toward decreased loading of the hallux on the operative side was noted on force plate pressure measurement, and a clinically apparent decrement in the flexion strength of the hallux was noted on a physical exam. Nevertheless, clinical symptoms were essentially absent, and no transfer metatarsalgia was present. This result has been borne out in other follow-up studies of the procedure; the success of the surgery may well outweigh any perceived deficits with the toe.

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The average time for complete weight bearing in group A is 7 weeks, and that in group B is 8.5 weeks. Almost (90%) of the patients in group A can bear their complete weight by 7 weeks and comfortably walk without discomfort by 8 weeks. In the case of group B, only 60% of patients can walk comfortably by 8 weeks. Major complications such as reruptures and deep wound infections have not been encountered. 15% of cases from Group A (3) and 18.75% from Group B (3/14) have the complication of superficial wound infection, which has been treated with parenteral antibiotics. 18.75% of group A and 21.42% of the cases in group B have complications of wound dehiscence and sensory disturbance in 28.57% (n = 4) of the cases in group B. 71.43 of the patients in group A can stand on tiptoes by the end of 12 weeks and brisk walk by the end of 18 weeks. For 2 patients in Group A, it took 22 weeks to stand on tiptoes and 24 weeks to walk briskly. In group B, only 60% of the patients can stand on tiptoes by the end of 12 weeks, and only 50% of patients can briskly walk by the end of 18 weeks. Three patients in group B cannot stand on tiptoes even after 22 weeks.

The Quigley scale was introduced by Thomas B. Quigley in his journal in 1980 to objectively measure the success of surgical repair of tendo-achilles ruptures. The components he considered were calf muscle atrophy, range of motion at the ankle joint, and the difference in toe raises. He compared the results with those of the unaffected leg. In the present study, we have 50% (n = 8) of the patients with excellent results in group A and only 28.57% (n = 4) in group B. All the patients with excellent results in both groups were less than 50 years old and non-diabetic. We have good results (57.14% (n = 8) in group A and 62.5% (n = 10) in group B. We have gotten fair results in 7.14% (n = 1) of cases in group B and none in group A. The patient with fair results is an elderly patient with diabetes. The Leppilahti score provides a comprehensive assessment of outcome after tendon transfer for neglected rupture of tendo Achilles as it takes into consideration both subjective and objective criteria. In the present study, a Leppilahti score of 91–100 (excellent) is achieved by 57.14% (n = 8) in group A and (n = 4) in group B. This is because all the patients in group A with scores more than 90 are below 50 years of age and have had regular follow-up. None of them has a gap greater than 4 cm intraoperatively. They all have healthy and bulbous tendon ends. Both cases in group B with Leppialhti scores greater than 90 are less than 50 years of age, and the intraoperative gap is less than 4 cm. Leppialhti scores between 80 and 90 (good) are seen in 25% (n = 4) in group A and 57.14% (n = 8) in group B. Leppilahti scores 71–80 (fair) are seen in 25% (n = 4) in group A and 14.28% (n = 2) in group B. Both cases in group A are older than 55 years, and one of them is diabetic, while the other is suffering from chronic kidney disease. In group B, all the patients are diabetics and older than 50 years. So the outcome of reconstruction of a neglected rupture of the tendon Achilles is poor in the elderly and diabetics. With the Leppialhti score, we can conclude that flexor hallucis longus has better outcomes both objectively and subjectively. Age and diabetes are the predisposing factors for the complications. All the cases with diabetes have the complication of superficial wound infection in group A, and 4 out of 6 cases with diabetes had superficial skin infections. These complications can be avoided by preoperative glycaemic control, avoiding the incision over the subcutaneous skin over the Achilles tendon, and avoiding excessive equinus of the ankle in the post-operative period.

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In a similar study done by Meghan E. Bishop et al., wound-healing complications have been cited as a concern when treating patients operatively. He found that when solely looking at healing complications prolonging the patients' overall recovery, a significantly lower rate of complications existed compared to that reported in the literature. **[22]** Siddigari DR et al. found that Flexor hallucis longus is superior to Peroneus brevis because of its anatomical and technical advantages, less incidence of superficial infections, wound dehiscence, and sensory disturbance, and better weight-bearing times and functional recovery. [23] The Devarshi Rastogi et al. study found that a reverse gastrocnemius turndown flap with FHL tendon is a well-tolerated and effective treatment for chronic TA rupture. [24]

Few studies have attempted to solely stratify wound complications after the operative treatment of Achilles tendon injuries. Bruggeman et al. reported an overall complication rate of 10.4%, with deep infections occurring in 3% of patients. [25] Saxena et al. reported similar complication rates of 10%, with 3.2% of patients requiring a second surgery to treat incisional complications. [26] These reports study a heterogeneous patient population with a number of presenting pathologies and varying physiologic states of well-being. Chronic ruptures of the tendo Achillis are uncommon but potentially debilitating. The choice of management is partly guided by the size of the tendon defect, with the optimal management being surgical. There are many different techniques that can be used to repair or reconstruct the rupture. Comparison of different techniques is difficult because relevant studies tend to be retrospective and small. Every patient is different and can present with varied comorbidity, a varied time of presentation, and different lengths of Achilles tendon retraction gap. Management should be tailored to the individual. Tissue engineering technology shows promise but is in its infancy, and its application in clinical studies is probably still far away. Further research and clinical trials are needed to evaluate its efficacy in humans.

CONCLUSION

Rupture of the Achilles tendon is more common in middle-aged males than in females because males are more commonly involved in recreational, athletic, and strenuous activities. Rupture occurs more commonly in unconditioned individuals for particular sports or athletic activities. Common complications include superficial skin infections, wound dehiscence, and scar hypertrophy. Flexor hallucis longus seems to be advantageous over peroneus brevis for augmentation because of the anatomical and technical advantages, less incidence of superficial skin infections, wound dehiscence, and sensory disturbance, and better weight-bearing times and functional recovery.

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