What Do You Do With The Achilles if You Have No Fancy Toys?

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KEYWORDS

• Achilles tendon • Flexor hallucis longus • Semitendinosus tendon • Bony anchorage • Chronic Achilles rupture

KEY POINTS

- Surgical management of Achilles disorders warrants thorough excision of the degenerated tendon and removal of all impinging bone. Resulting defects can be bridged by various methods like tendon mobilization, V-Y advancement, central turn-down, or tendon transfer.
- Although the flexor hallucis longus is the most commonly used tendon for transfer, large defects in cases of chronic Achilles ruptures may be bridged by use of a distant donor tendon, such as the semitendinosus tendon.
- Bony anchorage of a lengthened or transferred tendon into the calcaneus can be done either with suture anchors or with interference screws.
- In developing countries, such costly implants may not always be available or affordable. This necessitates the adoption of innovative ways to anchor tendons into calcaneus.

INTRODUCTION

The surgical management of insertional and noninsertional Achilles disorders are comprised of 2 key steps. Step 1 is the thorough excision of all necrotic and degenerated tendon and removal of all impinging bony prominences.[1,2] This may result in a tendon defect, which is bridged with various procedures depending upon the size of the defect.[1–3] Defects up to 2 cm can easily be bridged by Achilles tendon mobilization and by pulling the tendon down with the help of traction sutures placed

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in the tendon end (picture 5). Defects up to 2 to 5 cm can be bridged by a V-Y advancement or a central turn down procedure. Defects beyond 5 cm require a tendon transfer, which can be local or distant. The flexor hallucis longus tendon is the most commonly used local tendon transfer. Autogenous semitendinosus is also used as a distant transfer for large defects when allografts are not available.[4]

Step 2 is the bony anchorage of a lengthened/augmented original or transferred tendon to calcaneus. Traditionally this is done either with the use of suture anchors or an interference screw.[5,6] These implants may not be available in developing countries. If available, they may not always be affordable to most of the patients.[7] This requires the use of innovative ways to carry out bony anchorage of tendon.[7] The authors describe their innovative techniques to deal with bony anchorage of tendons without the use of expensive implants.

INDICATIONS

All surgically managed noninsertional and insertional Achilles disorders and chronic Achilles rupture cases (6 weeks after injury) requiring either reattachment of a lengthened Achilles tendon to the calcaneus or requiring attachment of transferred tendons like the flexor hallucis longus (FHL) and semitendinosus to the calcaneus are indications for these procedures. For chronic Achilles ruptures, only patients who complain of significant weakness in daily activities are candidates for surgery. The common feature for all these cases is the lack of availability of expensive implants for bony anchorage of tendon.

CONTRAINDICATIONS

Cases with peripheral vascular disease, peripheral neuropathy, and poor soft tissue envelope are contraindications for these procedures.[2,8] For the chronic Achilles rupture group, patients older than 60 years of age and diabetics are considered as surgical contraindications.[4]

PREOPERATIVE PLANNING

Before surgery, the extent of tendon degeneration is evaluated clinically and radiologically. On radiographs, the presence of an insertional spur and the prominence of a posterosuperior angle of the calcaneus (Haglund deformity) can be diagnosed. Use of ultrasound and MRI also helps in identification of possible extent of tendon degeneration.[1,3,8] A rough estimate is made about the size of tendon defect to remain at the end of tendon debridement and bone removal. A plan is made to bridge the tendon defect and for bony anchorage of the tendon to calcaneus.

SURGICAL PROCEDURE

Surgical procedures will differ depending upon the clinical situations, like treatment of Achilles disorders with reattachment of original or augmented tendon, with local FHL transfer or with distant semitendinosus transfer.

Bone Tunnel-Assisted Bony Anchorage of Achilles Tendon to Calcaneus (for Defects up to 2 or 2–5 cm)

Position

The patient is positioned prone with both the ankles hanging out of operative table. Both of the lower limbs are prepared and draped (**Fig. 1**). This positioning helps in

Fig. 1. Prone operative position of patient with preparation of both the lower limbs. Both the ankles are brought out of the table for easy maneuvering of the ankle.

maneuvering of the affected ankle. It also helps in assessment of tendon tension.[1,3] The limb is exsanguinated, and a thigh tourniquet is inflated.

Approach

A straight midline posterior incision extends upwards from Achilles insertion up to 7 cm (Fig. 2). The incision may be extended more proximally depending upon the preoperative evaluation of the extent of tendon pathology. Distally, the incision is extended to such a level that complete visualization of tendon insertion and the insertional spur is obtained. The skin and tendon sheath are incised together without creating any plane between them. Distal dissection must be beyond the tendon insertion. The Achilles is vertically split in the midline up to its insertion. The tendon is released both medially and laterally at its insertion to result in a medial and lateral tendon flap.

Bone removal

The insertional bony spur is sharply excised or removed. A self-retaining retractor is placed inside the split tendon, which exposes the retrocalcaneal bursa and the posterosuperior calcaneus prominence (Haglund deformity). The bursa is completely excised. The Haglund deformity is excised with the use of a straight osteotome, taking care to avoid entering a subtalar joint. The clinical picture at this juncture must look without any offending bony projections (Fig. 3).At this juncture, image check is done to confirm the adequacy of bone removal (Fig. 4).

Tendon excision

The tendon is inspected and palpated for areas of degeneration. Thorough excision of all necrotic tendon and calcifications is carried out until healthy-looking tendon is found. The assessment of the tendon defect is done at this juncture.

Management of defect up to 2 cm

In a case with a defect up to 2 cm, with 2 vertically split tendon flaps, a number 2 Ethibond suture is passed from the distal end of the medial tendon flap. The suture goes upwards in a crisscross manner to suture both medial and lateral tendon flaps together. The suture is then brought down and out to exit from the opposite lateral tendon flap. Standing at the end of the table, an assistant gives continuous tension through the sutures for 5 minutes. This removes all of the slack in the tendon and will close the defect. If required, to gain more length, proximal mobilization

Fig. 2. Posterior vertical midline approach.

of the tendon from its sheath can be done. With the closure of the defect, the 2 tendon flaps with sutures at their ends are ready to be anchored to the bone (Fig. 5) The bony anchorage of tendon can be done in different ways, as will be described.

Management of defect up to 2 to 5 cm

V-Y advancement is planned for bridging such a defect. The incision in the skin and tendon sheath needs to be extended upwards up to the musculotendinous junction. The limbs of the V incision in the gastrocnemius fascia are planned and marked as

Fig. 3. Clinical picture at the end of bone resection.

double the size of the defect (Fig. 6). While carrying out the incision in the gastrocnemius fascia, care is taken to prevent injury to the underlying muscle belly. Tag sutures are passed through the end of the tendon flap. Standing at the end of the table, an assistant gives continuous traction over the tag sutures for 5 minutes. This maneuver gains required length and closes the defect. If required, to gain more length, proximal mobilization of tendon from its sheath can be done. Once the defect is closed, the proximal V incisions in the tendon sheath are closed to make it Y (Fig. 7A, B). Tag sutures are replaced with Bunnell sutures with the use of number 2 Ethibond. With sutures out at the distal end of tendon stump, the tendon is ready to be anchored to bone (Fig. 8). The bony anchorage of tendon can be done in different ways, as will be described.

Bony anchorage

Bony anchorage of the tendon is done with the formation of 2 parallel bone tunnels in the calcaneus at its original Achilles insertion site. The distance between the 2 bone

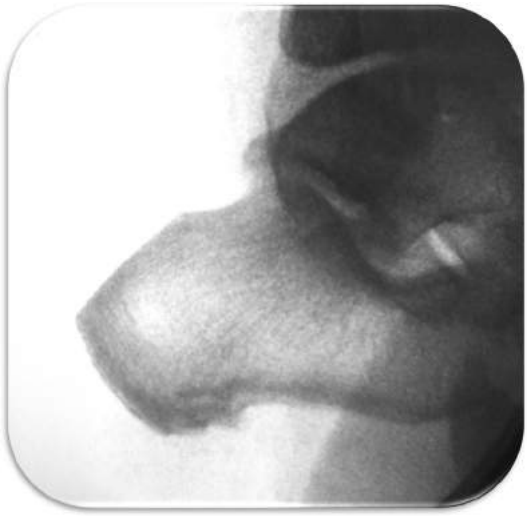

Fig. 4. Intraoperative radiological projection at the end of bone resection.

Fig. 5. Sutures brought out from both of the Achilles tendon flaps for bony anchorage.

Fig. 6. Limbs of V are marked in gastrocnemius aponeurosis as double the size of the defect to be bridged.

tunnels is at least 2 cm to prevent breakage of intervening bone (Fig. 9). The bone tunnels are created with 2 parallel 1.8 mm k-wires. The K-wires are driven in a posterior-to-anterior direction. The K-wires are directed in such a manner that anteriorly they exit through the superior surface of calcaneus (Fig. 10). This formulates a strong bone bite between the entry and exit for a strong bony anchorage. K-wires are

Fig. 7. Sutures brought out from Achilles tendon following V-Y advancement for bony anchorage.

replaced with number 18 hypodermic needles, passed from posterior to anterior in direction. Sutures are threaded out posteriorly through the hypodermic needles. The sutures are pulled tight and are tied with each other over the posterior calcaneus with the ankle in neutral position (Fig. 11A, B).

Closure

After lavage, the sheath is closed with absorbable sutures. The skin automatically gets approximated once the sheath is closed and is sutured with nylon. A below-knee plaster slab in a neutral position is given for 4 weeks.

Bone Tunnel Assisted Bony Anchorage of Flexor Hallucis Longus to Calcaneus (for Defect More than 5 cm)

Position

The patient is positioned prone with both of the ankles hanging off of the table for easy maneuvering of the limbs. Both the lower limbs are prepared and draped. A tourniquet is inflated after exsanguination of the limb.

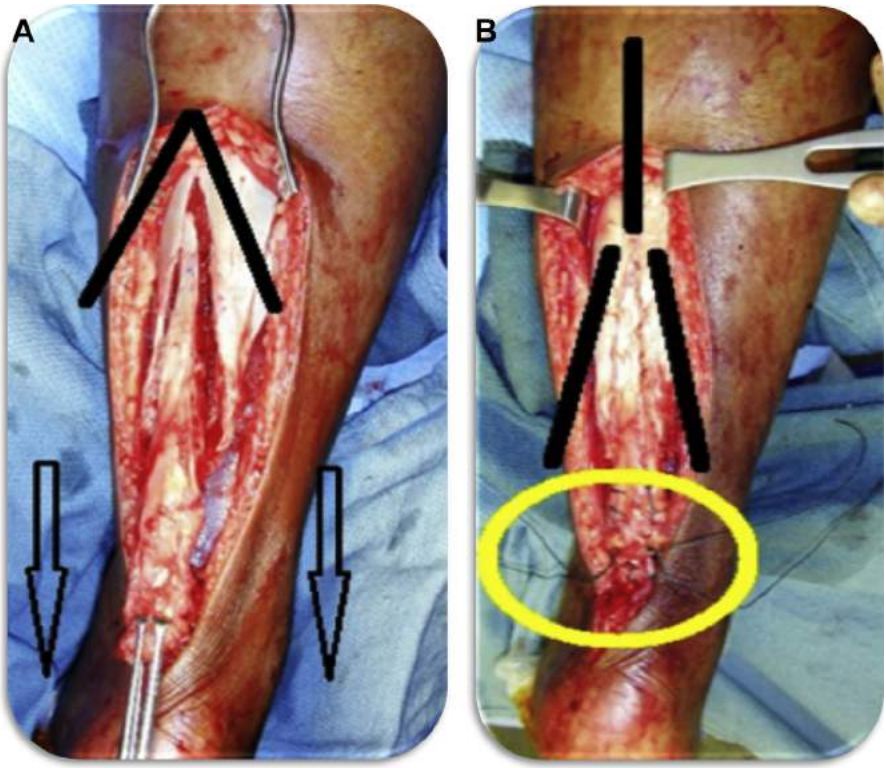

Fig. 8. (*A*) Gastrocnemius fascial V incision being pulled, at closure of defect (*B*) it becomes Y.

Exposure

Exposure is carried out with a straight posterior incision that extends upwards from the Achilles insertion up to 7 cm proximally. The skin and sheath are incised together without creating a plane between the two. The lower extent of the incision and dissection must expose the Achilles insertion and insertional spur fully.

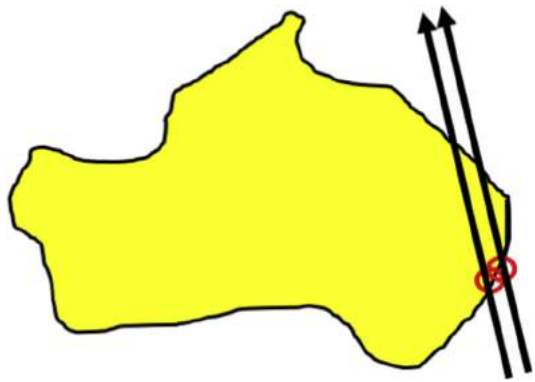

Fig. 9. Diagrammatic representation showing side view of location and direction of vertical bone tunnels in calcaneus.

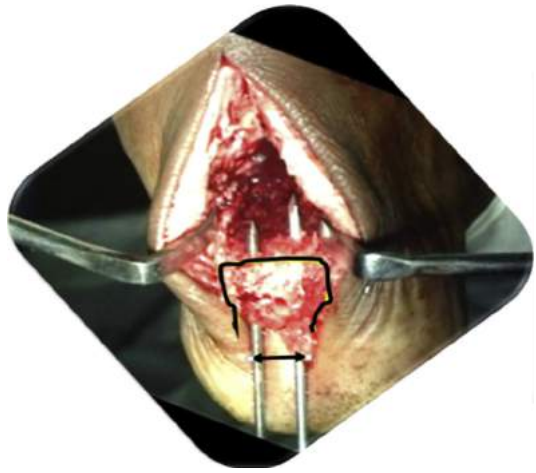

Fig. 10. Intraoperative picture showing direction and spacing of 2 vertical bone tunnels in calcaneus.

Excision of bone and tendon

The procedures are the same as those previously described for insertional and non-insertional Achilles disorders. All degenerated and calcified tendon areas, together with all impinging bone, are thoroughly excised. If the resultant tendon defect is more than 5 cm, a transfer of the flexor hallucis longus is planned. The authors prefer a short harvest of the FHL.

Flexor hallucis longus harvest

The Achilles stump is retracted proximally to expose the fascia of the posterior compartment. The muscle belly of the FHL underlying this fascia is identified. A vertical cut in the fascia is made to expose the FHL muscle belly and is traced distally up to the tendon. The tendon is gently hooked out with mixture forceps (Fig. 12).

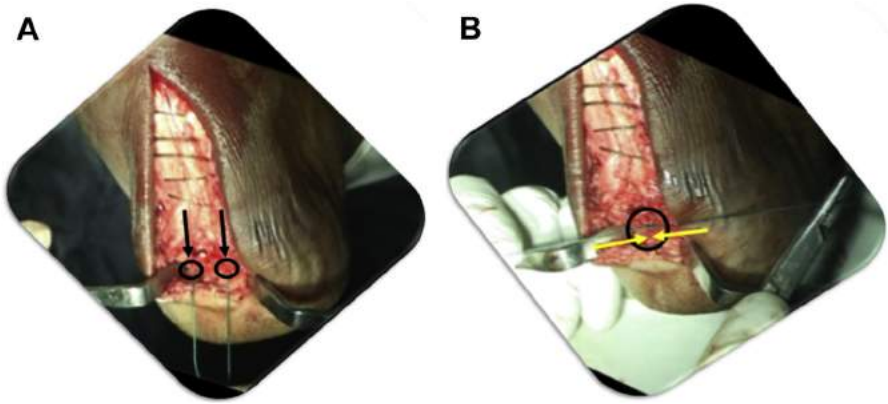

Fig. 11. (*A*) Passage of sutures through the bone tunnels for anchorage of vertically slit Achilles tendon. (*B*) Final bone tunnel anchorage of the Achilles tendon.

Fig. 12. Posterior fascia is cut, and tendon of flexor hallucis longus is hooked out.

Identification of the tendon is assisted by simultaneous movements of the great toe.[3] The tendon is freed from all the sides starting proximally and going as distally as possible to gain maximum length. With the maximal plantar flexion of the great toe and the ankle, and with maximum pull over the tendon by an assistant, the tendon is released as distally as possible. The knife cut is directed from medial to lateral to prevent injury to surrounding neurovascular structures. Holding sutures through the harvested FHL tendon may be applied for easy maneuverability of the tendon (**Fig. 13**). The tendon is now ready for bony anchorage.

Bony anchorage of flexor hallucis longus tendon

Bony anchorage of the FHL tendon is done with the help of 2 parallel and transverse bone tunnels drilled through the calcaneus. Bone tunnels are created with the help of 2 1.8 mm k-wires that are drilled transversely through the calcaneus starting medially and exiting laterally. The distance between the anterior and posterior bone tunnels is kept at minimum of 2 cm (**Fig. 14**). Bone tunnels are positioned in such a manner that good bone bite is maintained all around the tunnels to prevent bone breakage at suturing (**Fig. 15**). A hypodermic needle number 18 replaces the k-wire in the posterior most tunnel (**Fig. 16**). The suture ends are, turn by

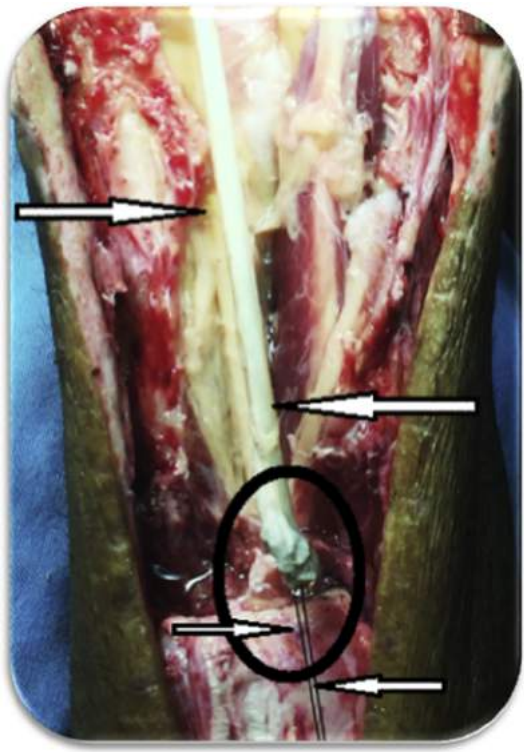

Fig. 13. Holding sutures tied at the end of the tendon of flexor halluces longus to pull the tendon.

turn, threaded with the help of the hypodermic needle to exit medially and laterally. The medial and lateral arm of the sutures are tied with each other in the center with tension. The ankle is in neutral position during tendon tensioning. With the help of the hypodermic needle number 18, a number 2 Ethibond is threaded transversely through the anterior tunnel. Sutures are passed through the tendon and tied to each other in the center. These sutures lie anterior to already anchored tendon. Resultant transfer now has a solid double anchorage with good tendon tension (Fig. 17). The proximal Achilles stump is pulled and sutured with the muscle belly of the FHL with 2 absorbable sutures on both sides. This provides strength and additional blood supply to the transfer.[1–3]

Closure

After lavage, the sheath is closed with absorbable sutures. The skin gets approximated once the sheath is closed and sutured with nylon. A below-knee plaster slab in a neutral position is given for 4 weeks.

Bone Tunnel-Assisted Bony Anchorage of Semitendinosus to Calcaneus (for Defects More than 5 cm)

Position

The patient is positioned prone, and both of the lower limbs are prepared and draped.

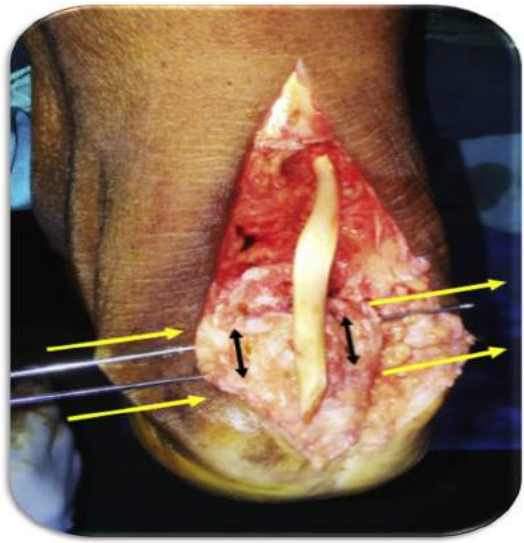

Fig. 14. Intraoperative picture showing top view of calcaneus with 2 transverse bone tunnels with direction and spacing of k-wires.

Incision & preparation

A vertical midline incision centering over the palpable gap is taken and deepened with sharp dissection (Fig. 18). Thorough debridement of the tendon ends, and intervening fibrous tissue is done. The gap between the 2 tendon ends is measured in neutral position of ankle. If the defect is more than 5 cm, the semitendinosus tendon is harvested from the same leg and used for reconstruction.

Graft harvest

For harvesting the semitendinosus tendon, the knee is flexed, and a 3 to 4 cm incision medial to the tibial tuberosity is taken (Fig. 19A, B). The tendon is prepared using

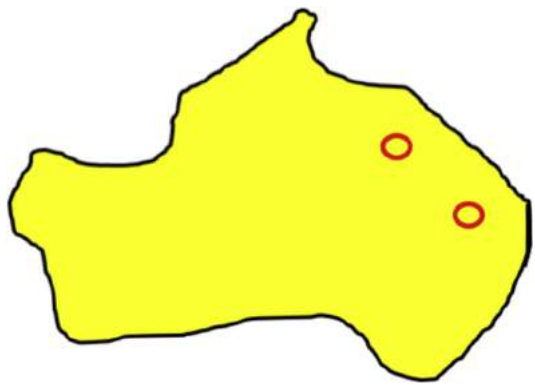

Fig. 15. Diagrammatic representation showing side view of calcaneus with location and spacing of transverse bone tunnels.

Fig. 16. Intraoperative picture showing short harvest of flexor hallucis longus tendon with 2 hypodermic needles passed through transverse bone tunnels in calcaneus.

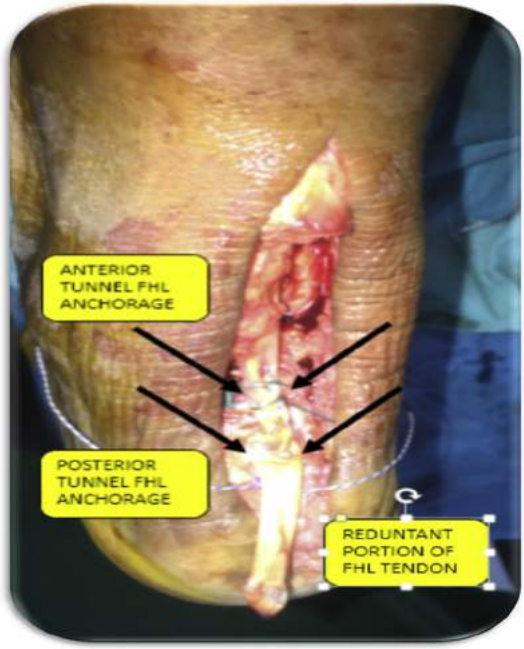

Fig. 17. Flexor hallucis longus transfer fixed with sutures through posterior and anterior transverse bone tunnels in calcaneus.

Fig. 18. Vertical midline incision taken for bridging the defect in tendoachilles with semitendinosus tendon.

number 2 Ethibond. Attention is given to prepare the ends of the graft that will facilitate the passage of graft through the tunnel in the calcaneus.

Bony anchorage

A transverse tunnel in the calcaneus is drilled over a guide wire, which is directed from medial to lateral (Fig. 20) at about 1.5 cm below the point of insertion of Achilles tendon (Fig. 21). A 4.5 mm cannulated drill is used over the guide wire, and then the

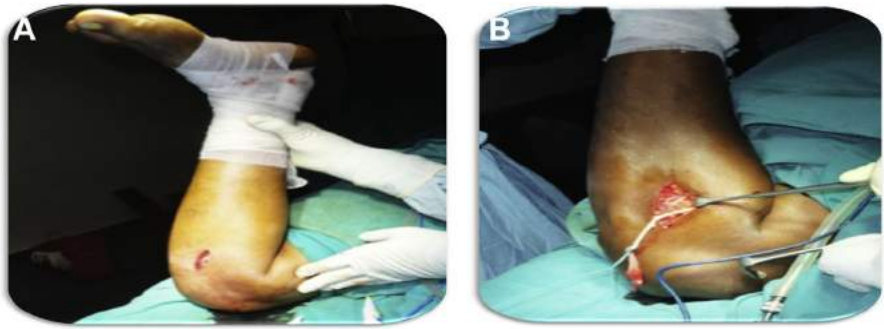

Fig. 19. (*A*) Incision medial to tibial tuberosity for harvest of semitendinosus. (*B*) Semitendinosus graft harvested through with knee in flexion with patient in prone position.

Fig. 20. Transverse tunnel in calcaneum drilled with 4.5 mm cannulated drill over a guidewire passed from medial to lateral side, 1.5 cm below the attachment of the Achilles tendon.

Fig. 21. Lateral radiograph of the ankle joint showing position of the calcaneal tunnel for passage of semitendinosus tendon transfer.

Fig. 22. The semitendinosus graft passed through calcaneus and then taken upward to pass through the proximal end of Achilles.

graft is passed through the tunnel. Proximally, the graft is passed through the debrided tendon end and then sutured to itself (Fig. 22). The suturing of graft to itself and Achilles tendon side to side will avoid the sliding of the tendon in the tunnel (Fig. 23). This technique has resulted in satisfactory postoperative results (Fig. 24).

POSTOPERATIVE CARE

A below-knee plaster slab in a neutral position is given for 4 weeks. Sutures are removed at the end of 10 days. Nonweight-bearing mobilization of ankle is started after removal of the plaster splint. Mobilization and strengthening exercises follow. The patient starts ambulation over a period of the next 2 weeks after gaining adequate strength and range of motion.

COMPLICATIONS AND MANAGEMENT

Specific to the bony anchorage of the tendon, the most common complication is the breakage or fracture of intervening bone or bone tunnel. This is better prevented than managed. Spacing between the 2 tunnels and the location of the tunnels must be so that there is a good intervening and surrounding bone. If the tunnel breaks, the option of creating another tunnel by the side of the same tunnel remains. Failure with transverse tunnel can also be managed with use of additional vertical tunnel and vice versa. A hypersensitivity reaction to Ethibond suture material resulting in a sinus formation is common. It usually settles down once the offending suture is removed under local anesthesia.

Fig. 23. The graft is sutured to itself and with the Achilles side to side.

Fig. 24. The postoperative clinical picture showing final result.

SUMMARY

Reattachment of either the original tendon or a transferred tendon does not always necessitate use of fancy implants like interference screws or suture anchors. Given a case where these implants are not available, bony anchorage of tendons can easily be done with the use of bone tunnels. Bone tunnels could be transverse or vertical depending upon the case. Tunnels drilled parallel with adequate surrounding bone would be success denominator. Two tunnels give better anchorage strength. Bone tunnel anchorage of tendon is user-friendly, cost-effective, and safe with reproducible good end results. The technique is a boon for developing countries, where fancy gadgets are either not available or not affordable.

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