

Surgical Treatment of Chronic Achilles Tendon Rupture

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Chronic Achilles tendon ruptures are often challenging to repair because of muscle and tendon atrophy, retraction, and short distal stumps. We undertook a retrospective investigation of 14 patients who were treated with the Ligament Advanced Reinforcement System (LARS) ligament for the treatment of chronic, neglected rupture of the Achilles tendon. The patients pursued a course of early functional rehabilitation, and postoperative outcome scores were obtained at 3, 6, and 12 months, based on the American Orthopaedic Foot and Ankle Society (AOFAS) ankle and hindfoot scoring system, and the Tegner Activity score. The minimum duration of follow-up was 36 months. After a minimum of 28 months postoperative, and up to 41 months postoperative, there was no observed incidence of rerupture or recurrent pain. The mean time to return to full activity was 18.3 ± 2.7 weeks, and >90% of the patients scored ≥ 80 points on the AOFAS scoring scale. Specifically, the mean AOFAS score increased from 48.64 ± 12.67 to 85.86 ± 6.6 after the operation, and this difference was statistically significant ($P = .001$). Furthermore, the Tegner activity scale score improved from 2.58 ± 0.31 to 1.73 ± 0.29 after the operation, and this difference was also statistically significant ($P = .001$). The results of this retrospective clinical study suggest that augmentation with the LARS ligament offers a satisfactory reconstructive option for the neglected Achilles tendon rupture. Level of Clinical Evidence: 4 (The Journal of Foot & Ankle Surgery 48(3):340–346, 2009)

Key Words: augmentation, LARS graft, neglected, polyester

Approximately 20% of all Achilles tendon ruptures are initially misdiagnosed (1, 2), and these make up approximately 40% of all surgically repaired Achilles tendons (3). Neglected Achilles tendon ruptures may be misdiagnosed because patients retain plantarflexion via the deep flexor muscles, or by fibrous in-growth and scarification of the defect (4). Chronic or neglected Achilles tendon ruptures are defined as those of greater than 4 weeks' duration without treatment (5). During this period of neglect, the tendon triceps surae atrophy and retract, and the gap defect fills with fibrous tissue (6–8). A number of operations have been described for the repair and augmentation of the ruptured Achilles tendon, including the use of tendon and fasciocutaneous flaps (4, 9, 10), tendon transfers that involve flexor hallucis longus and/or peroneus brevis (5, 11–13), free autogenous muscle and fascia lata flaps and grafts (14, 15), tendon and fascia lata allografts, and the use of allogeneic tissues (16, 17) and synthetic materials to reconstruct the

tendon (18). The use of autologous tissues, however, has been associated with increased surgical time, donor site morbidity, and an increased likelihood of sural nerve damage (4, 6, 9–13, 16, 19). Ideally, the material used to repair a neglected Achilles tendon should not require additional surgical dissection or harvest site morbidity, and the procedure should be relatively simple, restore normal functional capacity, and enable the patient to return to regular activities in a relatively short period of time. Recently, human dermal matrix has exhibited desirable suture retention properties, making this material an attractive prospective product for tendon augmentation (20–22). The purpose of this study was to retrospectively evaluate the clinical use of the Ligament Advanced Reinforcement System (LARS) graft (JK Orthomedic, Dollard-des-Ormeaux, Quebec, Canada), which is made of terephthalic polyethylene (polyester) fibers, as an augmentation material in the treatment of a series of neglected Achilles tendons ruptures (23, 24).

Patients and Methods

Between January 2002 and January 2005, every patient who underwent repair and LARS augmentation to reconstruct a chronic rupture of the Achilles tendon was identified, and information was abstracted from the medical records. To be considered for the operation, the patients had to present with enough disability that they could not stand on their

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FIGURE 1 Posterolateral incision made over the site of the Achilles tendon rupture.

tiptoes on the injured side, and they had to have reported absent or decreased spring action (propulsion) in their step. All of the patients underwent physical examination, assessment of the integrity of the Achilles tendon by means of the Thompson test (25), including gait observation, tiptoe stance, calf circumference measured 10 cm distal to the tibial tubercle and compared with the contralateral calf, as well as hindfoot motion and ankle and hindfoot stability and alignment. The American Orthopaedic Foot and Ankle Society (AOFAS) ankle and hindfoot scale score (26) was determined by means of questionnaire and physical examination, and the level of activity was measured by means of the Tegner score (27).

Operative Technique

With the patient prone and under general anesthesia and thigh tourniquet control, a posterolateral incision is made over the site of the Achilles tendon rupture (Fig 1). The posterior tuberosity of the calcaneus, as well as the ruptured ends of the Achilles tendon, are then exposed, and dissection is performed to release the tendon from adhesion and fibrosis (Fig 2), after which the ruptured tendon ends are freshened to macroscopically healthy tissue. A percutaneous drill hole of a size suitable for implantation of the LARS ligament (LAC 20-320 mm, code LII00205 frame) is then made from lateral to medial through the posterosuperior aspect of the body of the calcaneus (Fig 3), after which the synthetic ligament is then passed through the calcaneal drill hole, starting at the lateral side with a probe (Fig 4). The 2 ends are passed subcutaneously to penetrate the distal stump of the tendon and pulled out at the rupture site (Fig 5). A probe is then used to pass the lateral end of the synthetic ligament through the proximal portion of the tendon to create a Bunnell-type suture with the tendon ends approximated (Fig 6). The augmentation is tensioned so that the ankle is brought

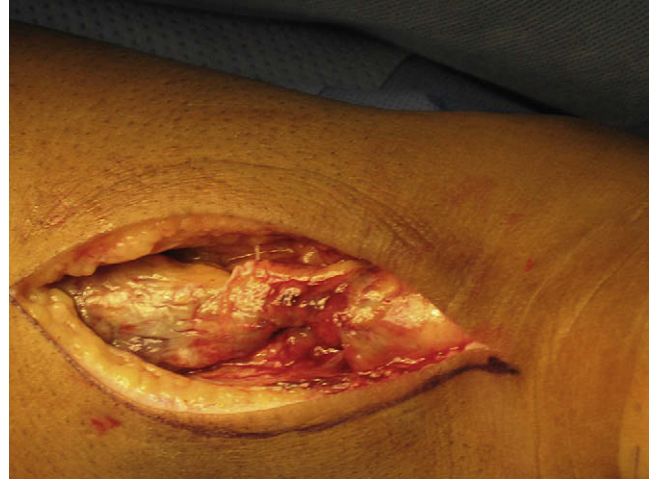


FIGURE 2 Exposure of the ends of the ruptured tendon.



FIGURE 3 A percutaneous drill hole made from lateral to medial through the posterosuperior aspect of the body of the calcaneus.

to a neutral position (Fig 7). The synthetic ligament is then sutured to itself and buried within the ends of the tendon, and the 2 ends of the ruptured tendo Achilles are approximated with the use of multiple interrupted sutures, after which the paratenon is closed (Fig 8). A below-knee cast in a plantigrade ankle position was placed (Fig 9) and maintained for 2 weeks. Then, a complete cast was applied for another 2 weeks, and partial weightbearing was allowed at 3 weeks. At 6 weeks, patients are allowed to be full weight-bearing.

Results

A total of 14 male patients were included in the case series, and the duration of follow-up ranged from 28 to 41 months.

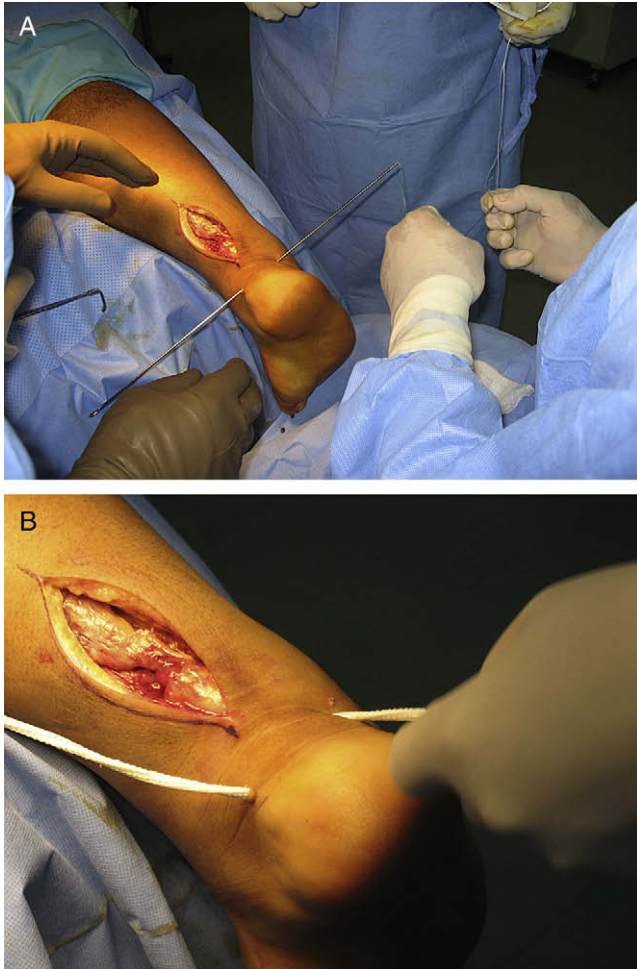


FIGURE 4 Placement of the synthetic ligament through the calcalear drill hole, starting at the lateral side with a probe (A) so that the prosthesis is secured in the distal segment of the ruptured Achilles tendon (B).



FIGURE 5 The 2 ends are passed subcutaneously to penetrate the distal stump of the tendon (A) and pulled out at the rupture site (B).

The overall mean age was 41.57 ± 3.08 years, and the median time from injury to operation was 15 ± 15 weeks. The mechanism of the injury was sports related and acute in 6 (42.86%) patients, was chronic tendonitis in 4 (28.57%) patients, and, in the remaining 4 (28.57%) patients, there was no history of an acute sport injury or chronic tendonitis; rather, the rupture occurred with sudden movements sustained while descending stairs or jumping short distances. In the sports-related cases, the Achilles ruptures were related to soccer, basketball, football, and handball. Clinically, a defect was palpated at the site of the ruptured tendon in all of the cases, and every patient walked with a limp and displayed a positive Thompson test (25). Table 1 depicts the prevalence of preoperative pain, stiffness, and swelling. It is interesting to observe that none of the patients had moderate or severe symptoms as a result of the chronically ruptured Achilles tendon, whereas 2 (14.29%) had

mild pain, 2 (14.29%) had mild swelling, and 1 (7.14%) had mild stiffness. Table 2 further describes the dataset, including the outcomes of interest. The mean time to partial weightbearing was 25.93 ± 6.15 days, and full weightbearing was allowed at a mean of 5.93 ± 1 weeks. The mean time to return to work was 8 ± 1.24 weeks, and patients returned to their sporting activities after a mean of 22 ± 8.5 weeks (results not shown in Table 2). Twelve (85.7%) patients were able to stand on their tiptoes on the involved leg once the cast was removed. The other 2 (14.3%) patients were able to stand on the involved leg while the uninvolved leg was off the ground, but were hesitant to stand on the tiptoes. The mean calf circumference of the involved leg measured 32.88 ± 1.86 cm compared with 35.09 ± 1.88 cm on the unaffected side, and this difference was statistically significant ($P = .001$). The overall mean range of motion revealed a loss of dorsiflexion of $-8^\circ \pm 5^\circ$ in comparison with that of the contralateral ankle. Full range

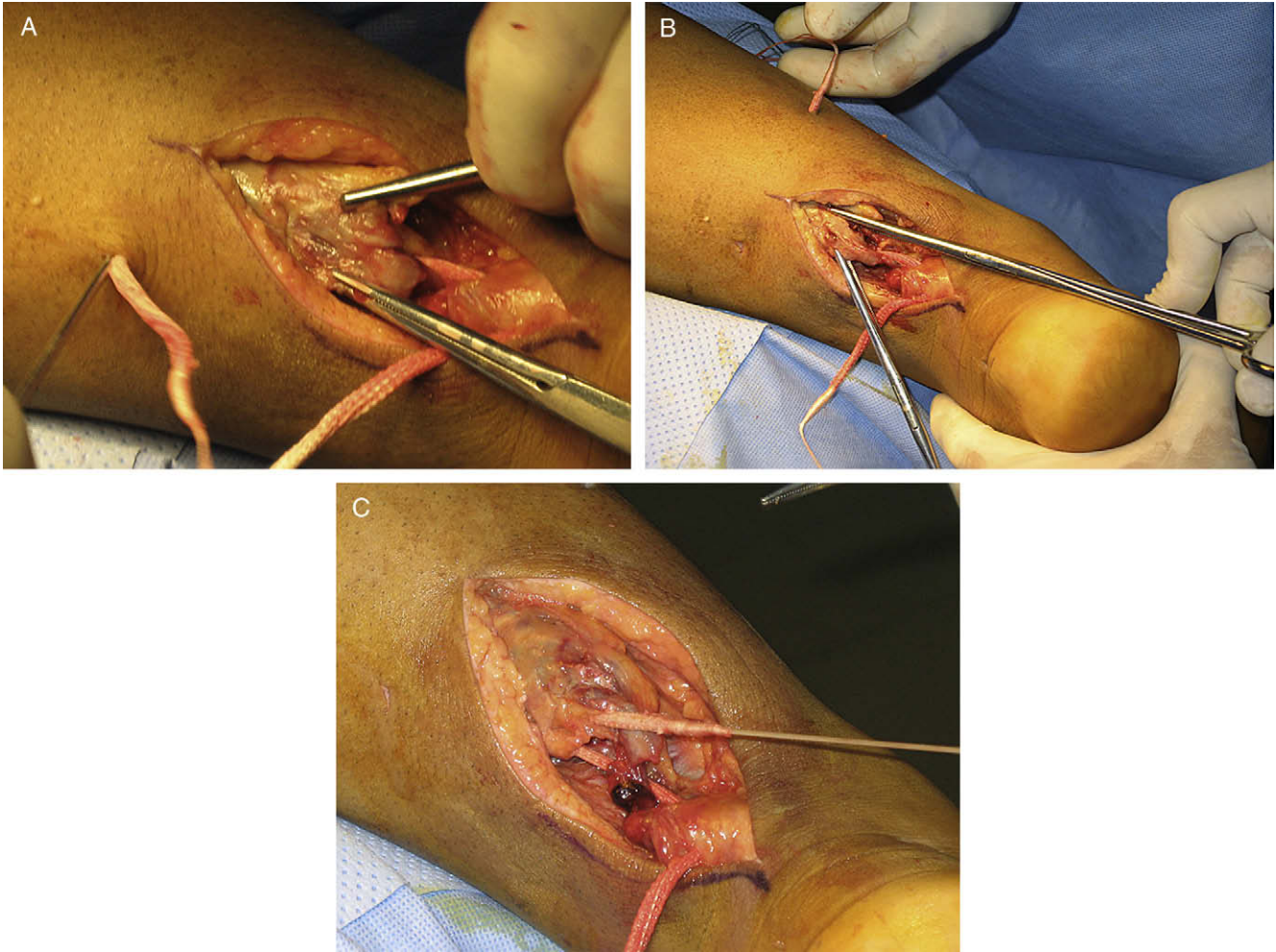


FIGURE 6 A probe is used to pass the lateral end of the synthetic ligament through the proximal portion of the tendon (**A** and **B**), and to create a Bunnell-type suture with the tendon ends approximated (**C**).

of motion was achieved in 7 (50%) of the patients. Five (37.7%) patients displayed a loss of 3° to 5° of dorsiflexion, whereas 2 (14.2%) patients lost >5° of dorsiflexion. Only 1 patient had a postoperative complication, and this consisted of a superficial wound infection, which was treated conservatively. At the time of the last follow-up, there had been no cases of rerupture, and no symptoms of sural nerve damage had been reported. The average AOFAS hindfoot score was more than 90 (93-95) for three patients (21.4%). Eight patients (57%) achieved scores between 80 and 90, and 3 patients (21.4%) had a score between 70 and 80. The mean preoperative AOFAS score for the group was 48.64 ± 12.67 , whereas the postoperative score was 85.86 ± 6.6 , and this difference was statistically significant ($P = .001$). The mean preoperative Tegner score for the group was 2.58 ± 0.31 , whereas the postoperative score was 1.73 ± 0.29 , and this difference was also statistically significant ($P = .001$).

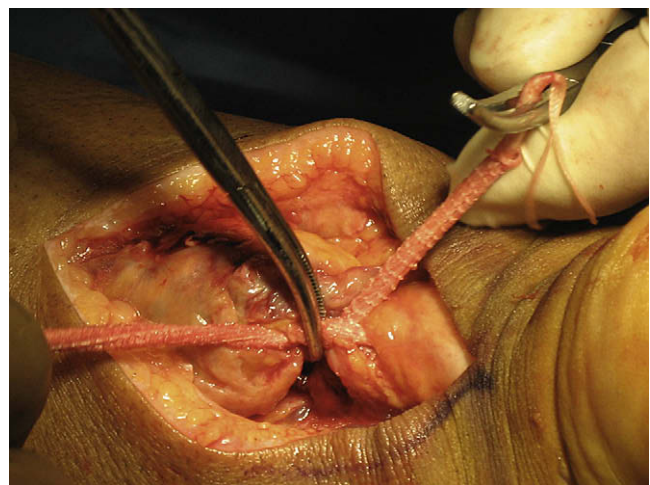


FIGURE 7 The augmentation is tensioned so that the ankle is brought to a neutral position.

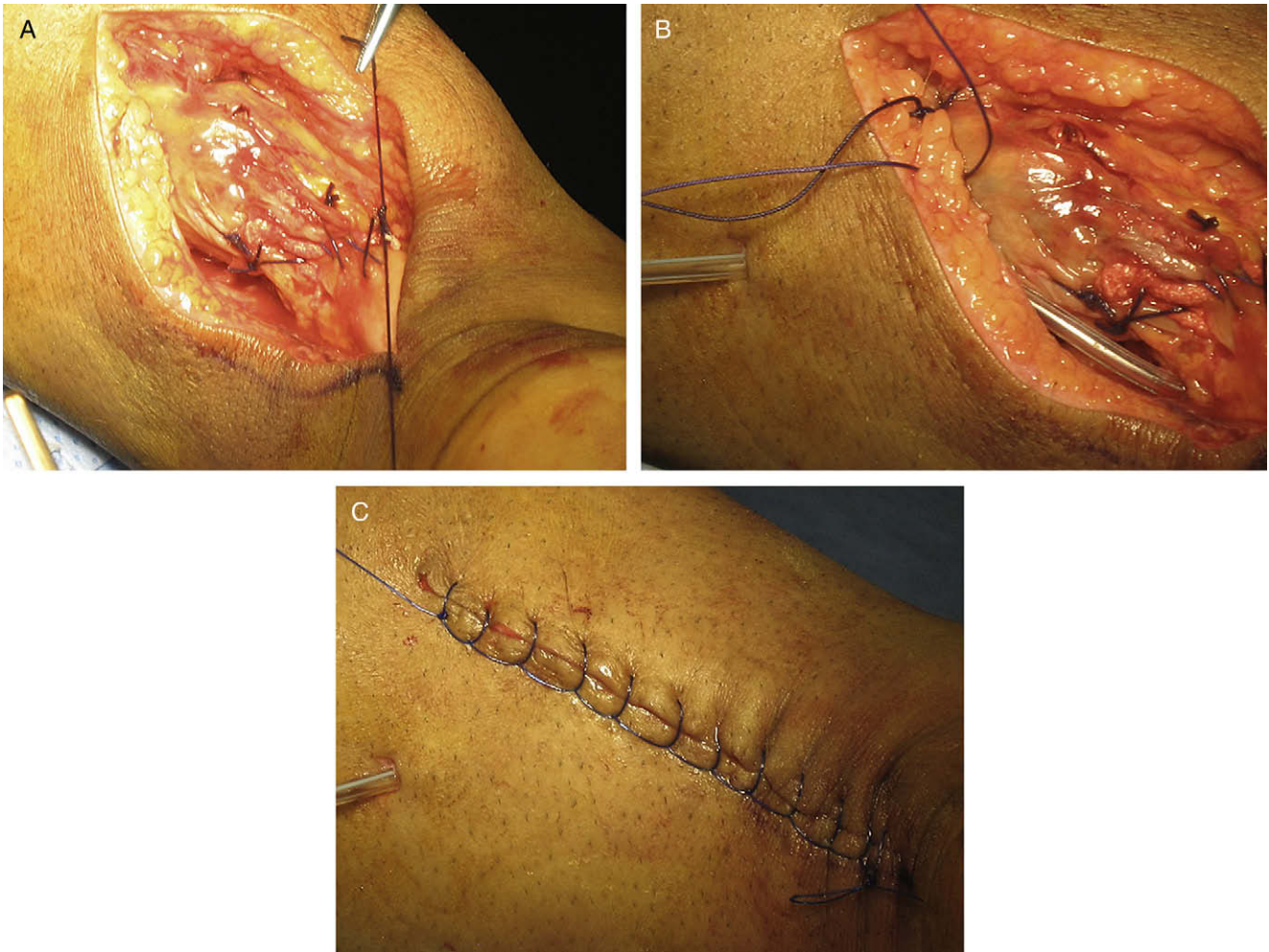


FIGURE 8 The synthetic ligament is sutured to itself and buried within the ends of the tendon, and the 2 ends of the ruptured tendo Achilles are approximated with the use of multiple interrupted sutures (A), after which the paratenon (B) and then the skin (C) are closed.



FIGURE 9 A below-knee cast in a plantigrade ankle position is applied.

TABLE 1 Prevalence of preoperative pain, stiffness, and swelling (N = 14 male patients)

	Pain	Swelling	Stiffness
None	12 (85.71%)	10 (71.43%)	10 (71.43%)
Mild	2 (14.29%)	2 (14.29%)	1 (7.14%)
Moderate	0	0	0
Severe	0	0	0

Discussion

The results of this study of neglected Achilles tendon injuries augmented with LARS ligament are promising. In our previous report, the use of a two-in-one procedure (28) resulted in complications, which were avoided with this method. The demographics of the series of patients described in this report are not consistent with those described by Lee

TABLE 2 Dataset and results (N = 14 male patients)

Patient	Age (y)	Partial weightbearing (d)	Full weightbearing (wk)	Return to work (k)	Contralateral calf circumference (cm)	Ipsilateral calf circumference (cm)	AOFAS score preop	AOFAS score postop	Tegner score preop	Tegner score postop
1	40	28	5	6	40	37.6	52	94	3	2
2	43	28	7	8	32.5	31.2	44	95	2.6	1.8
3	50	15	5	6	34.8	33.1	32	70	3.5	1.5
4	43	28	5	8	34.5	33.5	64	89	2.5	1.4
5	41	30	6	7	34.2	30	28	80	2.5	2.1
6	42	28	7	8	35.6	32.8	58	80	2.4	1.6
7	40	30	6	9	33.3	32.6	45	82	2.5	1.5
8	44	32	5	8	35.5	32	64	88	2.4	2.3
9	40	28	5	10	33	31	56	89	2.5	1.5
10	38	15	6	8	36	34.2	58	85	2.5	1.4
11	41	32	8	9	37.2	33.5	64	84	2.4	1.6
12	41	28	7	10	34.5	31.3	43	86	2.5	1.8
13	37	26	6	7	35.2	33.2	32	87	2.4	1.6
14	42	15	5	8	35	34.3	41	93	2.4	2.1
Mean	41.57	25.93	5.93	8	35.09	32.88	48.64	85.86	2.58	1.73
SD	3.08	6.15	1	1.24	1.88	1.86	12.67	6.6	0.31	0.29
*P value	—	—	—	—	.001	.001	.001	.001	.001	.001

*Wilcoxon signed rank test.

et al (22) and Leppilähti et al (29), who described groups of patients with higher average ages, which we believe may have been linked to a less athletic population. The length of time before return to work and sports activities in our series was shorter than results reported in previously published studies. Saxena and Cheung (30) described 5 patients treated with turn-down flaps with and without flexor hallucis longus tendon reinforcement, and described a return-to-activity duration of 34 ± 16.6 weeks. In a series of 11 patients treated with freshening of the fibrous scar, Porter et al (19) reported an average time to return to sports activity of 5 to 8 months (range, 2.5-9 months). Interestingly, in the series described by Lee et al (22), the return-to-activity time ranged from 15.2 to 17 weeks, which was less than that observed in our series. In the series described by Lee and colleagues, the rapid return to activity was attributed to the use of an acellular human dermal matrix to augment the repair.

In regard to rerupture of the Achilles tendon after surgical reconstruction, rates as low as 1.4% to 3% (30, 31) and as high as 17% (32, 33) have been reported. In our series of patients, we observed no evidence of rerupture over a follow-up duration that extended from 28 to 41 months. We believe that the absence of any cases of rerupture attests to the satisfactory strength of the repair with the LARS synthetic ligament. In regard to the AOFAS score, a number of prior publications related scores that ranged from 70 to 95 points after reconstruction of the Achilles tendon (21, 22, 34). In the series of patients described in this report, 3 (21.43%) patients scored >90 points and 8 (57.14%) displayed a mean score of 86.2 ± 5.65 . In regard to the duration of post-operative immobilization, Jennings and Sefton (35) reported

good results in 16 patients that were treated with a short duration of splintage after polyester tape augmentation of the repair of the Achilles tendon. In another report (17), minimal postoperative splintage was used after repair by means of frozen allograft, with satisfactory results. In our series, patients were casted for a maximum of 4 weeks, and most of our patients returned to full weightbearing in a relatively short period of time (5.93 ± 1 weeks).

As with most retrospective case series, a number of methodological limitations exist that could threaten the validity of conclusions. For instance, our group of patients was relatively young and athletic, and our results may not be generalizable to a cohort of older and less active patients. Moreover, we did not assess the resistance of our results to the potential influence of a hypothetical, unmeasured, confounding variable, so we do not know if a risk factor, such as body mass index or comorbid conditions, would have changed our results. Advantages of this investigation include the fact that we used outcome measurements that focused on activity and the subjective feelings of the patients, and these outcomes were registered by the patients rather than the surgeon.

In conclusion, the clinical results observed in this case series suggest that using a polyester synthetic ligament to augment Achilles tendon ruptures provides desirable outcomes without the loss of function or the need for additional surgical exposure required for the execution of more traditional flap or tendon transfer procedures. This technique appears to be effective with a relatively short period of post-operative immobilization of the ankle, and is associated with an early recovery of function and satisfactory return to activities without rerupture.

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