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Insertional Achilles Tendon Repair with Bioabsorbable Anchors and Suture

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SUMMARY
Sixty patients were systematically reviewed from the authors prior studies specifically for outcomes using bioabsorbable suture anchors who underwent repair of their Achilles insertion, with minimum two years post-index procedure. Fifty-five were chronic cases with and without calcific tendinosis and 5 were acute avulsions. Average age of the cohort was 51.5 ± 12.7 years. There were 38 males and 22 females. Thirty patients had their right limb operated on: 30 their left. Average return to activity was 6.9 ± 1.7 months. Average post-op VISA-A score was 94.4 ± 12.8, post-op RM score 1.3 ± 0.6, and calf atrophy 0.7 ± 1.0 cm calculated at the last post-op appointment. The ability to single leg heel raise was achieved in 45 patients: equal to the other limb 27. 95% of patients were able to return to full activity including sports. Two were Olympians. Complications were as follows: one DVT, one infection, three hypertrophic scars due to superficial suture and one subcutaneous suture reaction from a braided absorbable product. There were no re-ruptures, no suture granulomas/reactions from the Orthocord™ suture and no suture anchor failures. The repair typically involved one anchor superiorly at the Achilles insertion with a suture anchor and 2 partially absorbable suture with needles. Two additional anchors are placed inferiorly that were knotless. A total of 180 Healix™ Advance BR anchors were used, 62 were 5.5 mm Healix™ Advance BR with Orthocord and needles, 104 Healix™ Advance Knotless BR 5.5 mm, and 14 Healix™ Advance Knotless BR 4.75 mm. Using this repair technique for Achilles insertion repair has good outcome with low complication rate.

KEY WORDS
Bioabsorbable; soft tissue anchor; Achilles; suture; Haglunds Deformity.

INTRODUCTION

Insertional Achilles pathology accounts for up to 25% of cases of Achilles Tendinopathy (1). These are mostly chronic cases that "fail" non-surgical (aka "conservative") treatment which includes eccentric strengthening, heel cushions and shockwave therapy and occasionally immobilization (1). Acute avulsions can occur but are rarer than the typical mid-substance ruptures (2, 3).

Surgical treatment of this condition includes removal of prominence of the posterior calcaneus as well as enthesophytes. The resultant debridement of the tendon often requires re-attachment of the tendon. Prominence of the posterior superior lateral calcaneus has been termed "Haglund's" deformity. Early techniques for "Haglund's" deformity surgery consisted of a lateral incision, resection of the lateral superior portion of the calcaneus and did not involve re-attachment with soft-tissue anchors, which resulted in slow return to activity and chronic continued pain according to some studies in more than 50% of cases (1, 4-7). Since 1992, use of suture anchors has become a standard technique, especially after some have noted recurrence with the lateral "Haglund's" approach (1, 6, 7). Other authors have described their results with varying approaches and degrees of success (4-9). Recently, Saxena *et al.* published on 166 repairs via a posterior incisional approach using various suture anchors for chronic cases of insertional repair which is the largest series to date (8). In another recently submitted publication, 24 acute avul-

sions are reported on, again using suture anchors and posterior approaches (2). The purpose of this paper is to show outcomes of using bioabsorbable anchors and partially absorbable suture for Achilles insertional repair.

METHODS

The cohort of this study comprised of patients from the previous studies by Saxena *et al.* and Gaudin *et al.* with chronic and acute insertional repair (2, 8). Data from previously published studies encompassing Achilles insertional repair was collated to create a cohort of patients who had bioabsorbable anchors Healix™ Advance BR (DePuy Synthes Mitek, Raynham, MA USA) and partially absorbable suture Orthocord™ (DePuy Synthes Mitek, Raynham, MA USA). The Orthocord™ suture is 62% absorbable. This data was available via the appendix and tables presented in the published articles and did not require additional retrieval of data from the patients' medical records. These previous studies, (which have IRB approval IRBNet# 894358-12) had included patients from 2001 through 2018 and utilized a variety of anchors and suture. Other authors have shown braided non-absorbable suture has more complications (10, 11). Therefore, this study will highlight and evaluate patients who had bioabsorbable products. The procedures collated for this study were performed from 2013 through 2018 by the author. Patients were evaluated for return to activity (RTA), Roles and Maudsley scores (RM- "1" best, *i.e.* no pain nor limitations, "4" worst, *i.e.* pain at rest and unable to do desired activity), VISA-A scores ("100" being perfect, no pain nor limitations at all and a lower score indicating more symptoms and disability, "0" being worst), ability to single leg heel-raise, and complications such as infection, VTE (DVT/PE), suture reaction/granuloma, need for revision surgery, re-rupture, and implant failure. Statistics used were mean, standard deviation and Fisher's Exact test, with P-value set at ≤ 0.05.

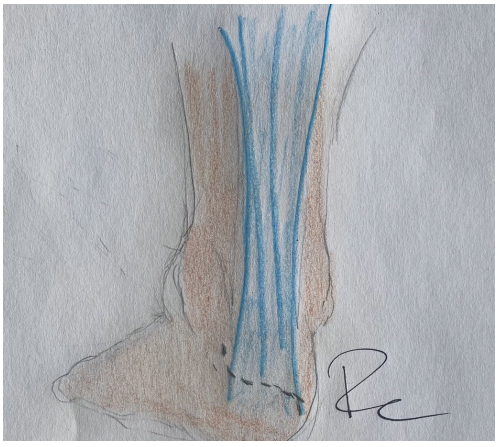

Figure 1. Incision from supero-medial to infero-lateral.

Surgical technique for Achilles insertional repair

The procedure utilized is as described in the studies by Saxena *et al.* and Gaudin *et al.* (2, 8). Patients are placed prone and most patients do not have general anesthesia. Local anesthesia with 2% lidocaine and 0.5% bupivacaine (approximately 20 mLs), along with intravenous sedation without tourniquet is often used. The anterior aspect of the lower leg is placed on pillows so the foot can be manipulated into dorsiflexion. After IV antibiotics (usually 2 gm of cefazolin), standard prepping and draping is performed. A curvilinear incision is made at the posterior heel at the Achilles tendon insertion region from superior-medial to inferior-lateral (**figure 1**).
A full thickness flap is maintained as sharp and blunt dissection is performed down to a level of the tendon insertion. Degenerated, ruptured tissue, bursa and possible calcifica-

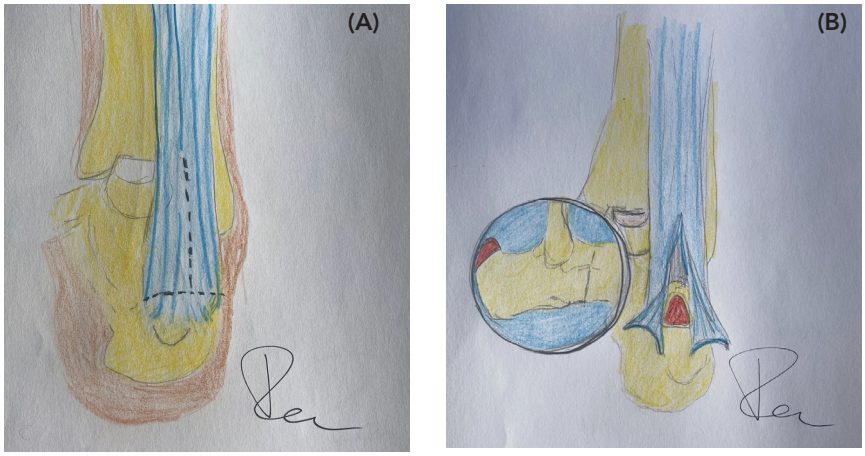

Figure 2. (A) Inverted-T approach to Achilles tendon insertion and retro-calcaneal space. **(B)** Resection of retro-calcaneal prominence.

tions should be inspected for and removed at this time. An inverted "T" approach is used to gain access to the retrocalcaneal space (**figure 2**).

A curved osteotome is used to excise the insertional calcification, if present. Remodeling of the posterior and superior aspects of the calcaneus should next be performed utilizing a curved osteotome, rongeur and reciprocating rasp, ensuring that no sharp, uneven edges, bony impingements nor erosions are present. Intraoperative fluoroscopy can be used to ensure proper excision of all abnormal calcification and adequate remodeling of posterior heel with lateral and axial views (**figure 3**).

Bone wax should be applied to the posterior calcaneus in all areas remodeled except where Achilles tenodesis is desired. Following this, the Achilles tendon is repaired and then tenodesed using three 5.5 Healix™ Advance BR (DePuy Synthes Mitek, Raynham, MA USA) bio-composite anchors: one with needles with #2 Orthocord™ (DePuy Synthes Mitek, Raynham, MA USA) suture superiorly and two knotless Healix™ Advance Knotless anchors (either 5.5 or 4.75 mm) inferiorly. The "stay suture" in the knotless anchors is removed as it is not utilized. The central portion of the tendon is first repaired with one suture strand. Then the second strand is used to tenodese the tendon onto the anatomical footprint of the Achilles insertion (**figure 4**). Intraoperative fluoroscopy can be used to ensure proper positioning of the anchors. The expansion can next be repaired using the remnant #2 Orthocord™ suture from the anchor, "burying" the knots. The foot is dorsiflexed to verify "cheese wiring" does not occur (which is more common with non-absorbable suture) (12). These can be avoided by crossing and locking one set of sutures during the repair (**figure 5**). Other similarly sized anchors with Dynacord™ (DePuy Synthes Mitek, Raynham, MA USA) can be used.

Once secure fixation (tenodesis) is verified, additional repair of periosteum and subcutaneous tissue is performed using 2-0 braided absorbable suture. Skin is re-approximated with 3-0 nylon.

After completion of the procedures, the extremity is then placed in a below-knee cast boot with heel wedges approximately two cm thick, to keep the foot in an equinus position. Post-operatively, the patients are non-weightbearing for four weeks (two weeks in below-knee gravity equinus cast, then two weeks in below-knee cast boot with 2 cm of heel

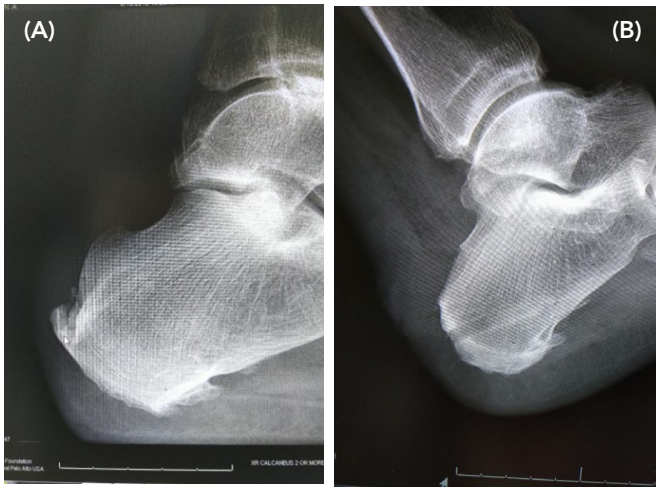

Figure 3. (A) Pre-operative X-ray. **(B)** Post-operative X-ray showing removal of retrocalcaneal prominence and calcific tendinosis.

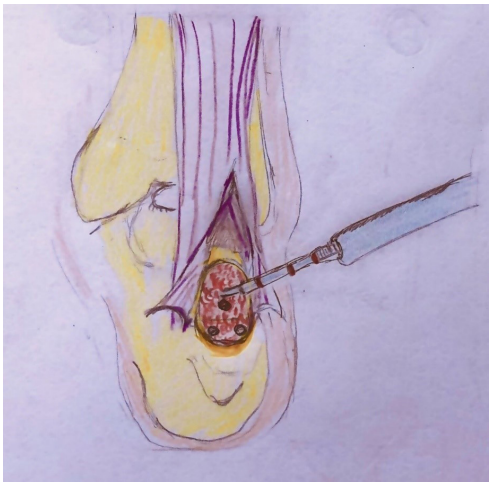

Figure 4. Drill holes for anchor placement.

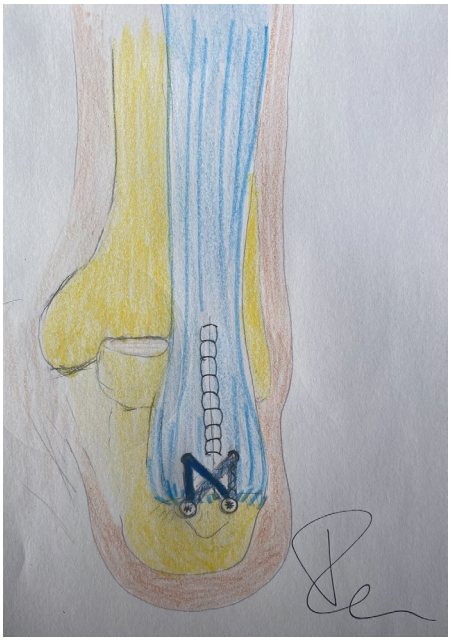

Figure 5. Suture technique for tenodesis.

wedges), followed by an additional period of six weeks of weightbearing in a CAM boot with progressive lowering of the heel wedges such that, by 10 weeks post-operative, a 5 mm wedge is being utilized. Ankle range-of-motion exercises can be performed at three weeks after cast and suture removal, avoiding dorsiflexion beyond neutral. Physical therapy begins at ten weeks post-operative, avoiding stretching of the Achilles tendon and eccentric loading until concentric strength is achieved (13). Return to impact sport activities is not initiated until at least five months post-operative, though stationary biking with the heel on the pedal, even with the boot or cast is allowed as soon as patients are pain-free.

RESULTS

The cohort consisted of 55 patients with chronic Achilles insertion repair and five with acute Achilles avulsion re-attachment. The average age of the entire cohort was 51.5 ± 12.7 years. There were 38 males and 22 females. Average BMI was 28.9 ± 5.7. Three patients had cortico-steroid injections pre-op included two with avulsions (p = 0.016). Thirty patients had some form of shockwave prior to surgery. Patients treated from 2009-16 had radial shockwave (pressure wave - "RSW") at 2.4 Bar, 2500 pulses for three sessions, and those treated from June 2016-December 2018, had similar shockwave sessions with the addition of focused ESWT at 0.15 mJ/mm², also for three sessions with 500 pulse "ramp-up" and then 2000 pulses at the target energy level. There were 30 procedures performed on the right and left limb each for a total of 60 procedures. Twenty-eight of the patients had calcific Achilles tendinosis, 27 retrocalcaneal exostoses, three avulsions with calcific tendinosis, and two avulsions without calcific tendinosis (**table I**). Average chart review was 42.3 ± 18.9 months from the index procedure. The last post-operative follow-up visit was 8.5 ± 4.7 months. Average RTA was 6.9 ± 1.7 months. Three patients were professional athletes including two Olympians. Pre-op RM score was 4.0 ± 0.0; post-op RM score was 1.5 ± 0.6. Post-op VISA-A average score was 94.4 ± 12.8. Average calf atrophy measured 10 centimeters distal to the tibial tuberosity was 0.7 ± 1.0 cm at the last post-op visit. Single leg heel raise was achieved in 45 patients by the last post-op visit and equal calf circumference to the other side in 27 patients. Three avulsion patients had decreased desired activity level (DDA), but none of the chronic repair patients did (**table II**). Complications were as follows: one DVT, one infection, one suture reaction (from braided absorbable material) and three hypertrophic scars due to superficial suture. No suture granulomas were noted from the Orthocord™ material at the time of submission. There were no re-ruptures, no revisions from the index surgery, though two had prior procedures elsewhere. There were no anchor or suture failures (**table III**).

Fifty-two patients had their tenodesis performed with the Healix™ Advance BR 5.5 mm with Orthocord™ and needles and Healix™ Advance Knotless BR 5.5 mm anchors; seven patients had their construct comprised of the Healix™ Advance BR 5.5 mm with Orthocord™ and needles and Healix™ Advance Knotless BR 4.75 mm anchors. One patient had their tenodesis performed with two GII anchors (with #2 Orthocord™) and one Healix™ Advance Knotless BR 5.5 mm anchor. The total number of anchors was as follows: Healix™ Advance BR 5.5 mm (n = 62), Healix™ Advance Knotless BR 5.5 mm (n = 104), Healix™ Advance Knotless BR 4.75 mm (n = 14) and two GII™ anchors.

DISCUSSION

The results from this study show that bioabsorbable anchors with partially absorbable suture has good results. The results are similar, if not better than other recent studies (2, 5-9). The current cohort comprised patients from larger studies of insertional and avulsion of Achilles tendinopathy repair. In

Table I. Achilles insertional tendinopathy data.

Categories	Patient data	Percent (%)
Total number of patients	60	100
Female	22	37
Male	38	63
Age (average in yrs.)	51.5	
Side of surgery LEFT	30	50
Side of surgery RIGHT	30	50
BMI (Mean)	29.1	
Chronic cases (with and without calcific tendinosis)	55	91
Acute cases (Acute avulsions)	5	9

Table II. Functional scores.

	Average return to activity (months)	VISA-a Score (post-op)	RM Score (post-op)	Calf atrophy (cm) (at last post-op appt.)	Single-leg heel raise (equal to other limb)
Total	6.9	94.4	1.3	0.7	45
Standard deviation	1.7	12.8	0.6	1.0	

Table III. Complications.

	DVT	Infection	Suture Infection	Re-Rupture	Suture Granuloma/ Reactions from Orthocord™	Suture and no suture anchor failures	Other Complications
Total (60 patients)	1	1	1	0	0	0	0
Percent (%)	1.7	1.7	1.7	0	0	0	0

those studies, there were less complications when using bioabsorbable materials, both anchors and suture, as compared to non-absorbable materials (2, 8). There were no differences between males and females as to age, RTA and heel raise ability. Average calf atrophy was less than 1 cm in this cohort, and all the patients were able to return to their activities who had chronic insertional repair. This yields a 100% RTA for the chronic patients and overall 95% for the entire cohort.

In the study specifically on avulsions by Gaudin *et al.*, the one case of repair on a recurrent avulsion was with a braided multi-strand, long chain ultra-high-molecular-weight-polyethylene (UHMWPE) and polyester suture as "cheese-wiring" occurred (2, 12). In a large study of acute Achilles rupture repair by Hsu *et al.*, this same suture was associated with a 2% incidence of foreign body granuloma and deep infection, which was all the cases in their series (10). In another recently published study on acute Achilles rupture repair by Saxena *et al.* evaluated 188 cases, braided non-absorbable suture was associated with more wound complications (14). Other authors have described effects of different suture in the animal model with Achilles (15). Because of this, authors recommend avoidance of braided non-absorbable suture when possible for Achilles tendon surgery (2, 8, 14).

In the largest series of chronic insertional repair that was just published by Saxena *et al.*, patients with bioabsorbable anchors and suture had less complications (8). In that study, 96% of patients returned to activity on average of seven months post-surgery with identical technique and post-operative care. Their results as expected, are similar to this current study, since the cohorts were abstracted from the same data sets.

Achilles insertional tendinopathy can be associated with metabolic disease and therefore can be addressed "indirectly" (16). Some authors recommend avoiding tendon debridement and calcification excision, and perform calcaneal osteotomy instead. This has been recently described in two papers (17, 18).

Evaluation of 60 Achilles insertional repair surgeries using 180 bioabsorbable suture anchors result in good outcomes in the short to medium-term. There were no re-ruptures, anchor or suture failure, nor suture granulomas. The surgical technique using Healix™ Advance BR anchors with #2 Orthocord™ should be considered for Achilles insertional repair due to a high percentage of return to activity and low complication rate.

CONCLUSIONS

The study showed that using this repair technique for Achilles insertion repair with bioabsorabable anchors and suture Healix™ Advance BR anchors and 5.5 mm Healix™ Advance BR with Orthocord and needles, 104 Healix™ Advance Knotless BR 5.5 mm, and 14 Healix™ Advance Knotless BR 4.75 mm. Anchors have good outcome with low complication rate.

FUNDINGS

The study was funded by Depuy Synthes Mitek, which was not involved in the design, data acquisition, statistics and preparation of this manuscript.

DATA AVAILABILITY

Data are available under reasonable request to the corresponding author.

CONTRIBUTIONS

RLC: writing, editing, drawings. AS: writing, data analysis, editing.

CONFLICT OF INTERESTS

Ricarda Luise Gaudin declares that she has no conflict of interests. Amol Saxena receives consulting fees from Depuy Synthes Mitek.

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