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A Review of 105 Consecutive Uniport Endoscopic Plantar Fascial Release Procedures for the Treatment of Chronic Plantar Fasciitis

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ABSTRACT

Plantar fasciitis is a common cause of heel pain in the U.S. Army soldier, resulting in a significant loss of man hours. Given the heavy operations tempo of the U.S. military, successful treatment options need to be considered and used as quickly as possible. Plantar fasciitis can be successfully treated in up to 90% of patients using conservative measures. Operative intervention might need to be considered for those in whom conservative measures have failed. The present report is a review of 105 consecutive uniport endoscopic plantar fascial release procedures performed by the principal investigator during a 9-year period. The following data were collected and analyzed: gender, age, weight, height, body mass index, medical treatment facility, procedure laterality, preoperative pain levels, postoperative pain levels at 3 months, first ambulatory day in the controlled ankle motion boot, return to activity as tolerated, and complications. Three major points were of interest: evidence of improvement in chronic plantar fasciitis when treated with uniport endoscopic procedures; the patient attributes associated with self-reported pain levels 90 days postoperatively; and the patient attributes associated with the average time until patients were able to return to activities as tolerated in a controlled ankle motion boot. It was noted that 44.5% of those with a body mass index of 29.80 kg/m^2 or greater reported a postoperative pain level of 0; and 96.3% of those with a body mass index of 25.53 kg/m^2 or less reported postoperative pain levels of 0. The analyzed data were used to characterize the clinical outcomes of the procedure, identify changes in outcome with surgeon experience, and identify whether certain patient subgroups have better outcomes, allowing surgeons to identify which patient might be the best candidates for an endoscopic release procedure.

Plantar fasciitis is a common cause of heel pain in active duty soldiers in the U.S. Army and leads to a significant loss of fighting strength. Given the heavy operations tempo for our current military, successful management of this condition with a prompt return to duty is more critical than ever. Military surgeons generally follow the American Orthopaedic Foot and Ankle Society's (1) recommendations regarding diagnosis and treatment. Patients are initially treated conservatively with activity modification, nonsteroidal anti-inflammatory drugs, physical therapy, night splints, and orthotics. Corticosteroid injections (2) and extracorporeal shock wave therapy (3) are other nonoperative approaches to treatment. In up to 90% of cases, plantar fasciitis can be successfully treated using these conservative measures (4). If, however, the symptoms are not relieved with conservative measures after 6 to 12 months, operative intervention might be necessary. These operative decisions must be sensitive to the need to return soldiers to full activity as quickly as possible.

Plantar fasciotomy is currently the most common surgical treatment for refractory fasciitis (4). The traditional approach to plantar fascial release is an open surgical procedure, which can be associated with a prolonged recovery period, often requiring the patient to remain nonambulatory for a period of 4 to 6 weeks with a gradual return to full activity for an additional 8 weeks (5). Also, the plantar incision can lead to postoperative scarring that can, itself, cause chronic pain and limit function (4,5).

Increasingly, surgeons are adopting an endoscopic approach to plantar fascial release to avoid the complications associated with the

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open procedure; however, only limited studies have been conducted comparing the 2 procedures (6,7). Furthermore, no consensus has been reached on which of the various endoscopic approaches is best (1). Investigators have described uni- and multiport procedures both with and without insufflations (8–10). Beginning in 2001, the principal investigator (T.N.M.) adopted the use of a medial uniport plantar fascial approach without insufflation and anecdotally noted a marked reduction in postoperative pain levels and return-to-activity-as-tolerated times.

The purpose of the present study was to determine the effectiveness of a uniport endoscopic approach to plantar fascial release in the treatment of chronic plantar fasciitis by quantitatively comparing the preoperative and postoperative pain levels, ambulatory status, and time to return-to-activity-as-tolerated, while controlling for age, gender, height, weight, and body mass index (BMI). The present retrospective study is the largest, single-surgeon, case series reported for this procedure. If widely adopted, this procedure could significantly reduce the man-hours lost to this common condition in the military but could also be generalized to other patient populations.

Patients and Methods

The principal investigator (T.N.M.) conducted a retrospective review of 105 consecutive uniport endoscopic plantar fascial release procedures performed in 96 patients, from April 2001 to October 2009 at 4 different sites. The study population consisted of active-duty U.S. Army soldiers who presented with symptoms of chronic plantar fasciitis of at least 6 months' duration. The patients were examined by the principal investigator (T.N.M.) clinically and radiographically and questioned regarding previous treatment or procedures. The patients in whom 6 months of conservative treatment, consisting of physical therapy, a trial of custom orthotic inserts, activity modification, and plantar fascial corticosteroid injections, had failed were considered for the present study. Those patients did not meet these inclusion criteria or who presented with Baxter's neuritis were excluded from the present study. The study candidates were offered both the endoscopic and open procedure. Those who elected to undergo endoscopic surgical treatment then underwent the informed consent process and agreed to the procedure.

All procedures were performed by the principal investigator with the AM™ Surgical Soft Tissue Release System instrument set (Wright Medical Technology, Arlington, TN) (11) using a medial uniport surgical approach without insufflation. This set consists of a fascial elevator, obturator, cannula, rasp, measuring device, and disposable blade. The patient is placed in the supine position, anesthetized, and a 0.5-cm vertical incision is made approximately 6.5 cm from the posterior aspect of the calcaneus on the medial non-weightbearing aspect of the foot. The incision location should be immediately distal to the weightbearing area of the calcaneus, ensuring that it is in a non-weightbearing site. The incision is deepened using blunt dissection, and the EPF elevator is then inserted through the incision, crossing the foot from medially to laterally, ensuring that the elevator is plantar to the plantar fascial band. Once across the foot, the elevator is rotated 180° and, on removal, used to strum the plantar fascial bands to ensure the elevator is plantar to the band. The obturator is then placed into the cannula, and both are inserted along the path created by the elevator. The obturator is then removed, and the cannula is left in place. Open across the top, the cannula allows visualization of the operative field. The rasp is then inserted through the cannula and used to remove adipose tissue so that the plantar fascial band can be identified. The endoscopic camera is then used using a 30° arthroscope to identify the plantar fascial band. Once the band is identified, the measuring device is attached to the arthroscope, allowing for a visualized measurement of the plantar fascial band. A measurement is taken, corresponding to the medial two thirds of the band. The measuring device is then removed, and the blade is attached to the arthroscope. The previous measurement is used to adjust the cutting distance of the blade. The foot is placed in dorsiflexion, and the blade or arthroscope is inserted into the cannula, with the blade transecting the medial two thirds of the plantar fascial band. After band transection, the arthroscope is reinserted so that the intrinsic muscles that are dorsal to the band can be visualized. This visualization ensures that the band has been transected. The instrumentation is then removed, and the incision site is closed with 1 suture using 3-0 nylon.

Postoperatively, patients were placed in a controlled ankle motion (CAM) boot and allowed to bear weight as tolerated. The patients were transitioned from the CAM boot to normal shoe gear as tolerated and instructed to use either a CAM boot or night splint when sleeping for the first 30 days. The sutures were removed at 2 weeks postoperatively and patients allowed to progress to activity as tolerated.

At the 90-day follow-up visit, data regarding the preoperative pain level, postoperative pain level, first day of ambulation in the CAM boot, and first day of ambulation as tolerated were collected using a patient questionnaire. A numerical pain scale of 0 to 10 was used to report the preoperative and postoperative pain levels, with 0, indicating the absence of pain; 1 to 3, mild pain; 4 to 6, moderate pain; and 7 to 10, severe pain. Demographic and biometric data were collected from the patient charts by the principal investigator during the postoperative recovery phase.

Table 1
Distribution of patients (N = 105 procedures in 96 patients)

Attribute	Patients (n)
First ambulatory day in CAM boot	
1	33 (31.4)
2	55 (52.4)
3 or 4	17 (16.2)
Weight group (lb)	
118–169	23 (21.9)
170–184	25 (23.8)
185–212	30 (28.6)
≥213	27 (25.7)
Gender	
Female	21 (20.0)
Male	84 (80.0)
Facility	
1	13 (12.4)
2	23 (21.9)
3	57 (54.3)
4	12 (11.4)
Age group (y)	
20–34	43 (40.9)
35–44	51 (48.6)
≥45	11 (10.5)
BMI group (kg/m^2)	
20.00–25.53	27 (25.7)
25.54–27.72	25 (23.8)
27.73–29.79	26 (24.8)
≥29.80	27 (25.7)
Laterality	
Left foot	50 (47.6)
Right foot	55 (52.4)
Surgery order group	
First 25 procedures	25 (23.8)
Middle 55 procedures	55 (52.4)
Last 25 procedures	25 (23.8)

Abbreviations: BMI, body mass index; CAM, controlled ankle motion.
Data in parentheses are percentages.

The following data were analyzed: gender, age, weight, height, BMI, hospital, procedure laterality, preoperative pain levels, postoperative pain levels at 90 days, first ambulatory day in the CAM boot, interval to return-to-activity-as-tolerated, and operative complications. The 3 major points of interest were as follows:

1. Evidence of improvement in chronic plantar fasciitis when treated with a uniport endoscopic procedure
2. Patient attributes associated with self-reported pain levels at 90 days postoperatively
3. Patient attributes associated with average interval until patients were able to return to activities as tolerated in a CAM boot

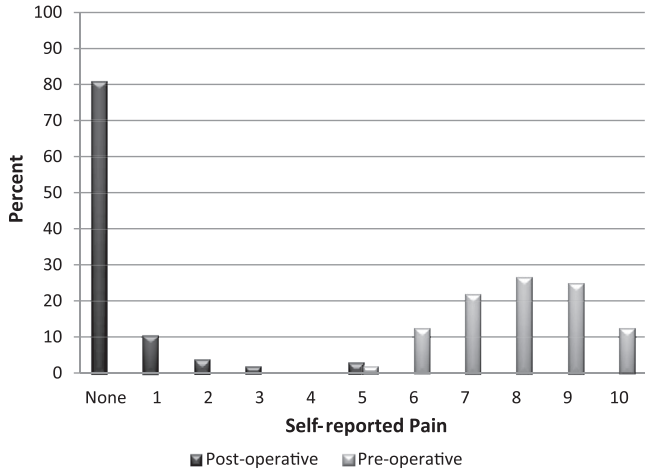

Fig. 1. Distribution of preoperative and postoperative self-reported pain (N = 105 procedures in 96 patients).

Table 2
Distribution of preoperative and postoperative self-reported pain (N = 105 procedures in 96 patients)

Pain Scale	Preoperative Pain (%)	Postoperative Pain (%)
None	0.0	80.9
1	0.0	10.5
2	0.0	3.8
3	0.0	1.9
4	0.0	0.0
5	1.9	2.9
6	12.4	0.0
7	21.9	0.0
8	26.7	0.0
9	24.7	0.0
10	12.4	0.0
Total	100.0	100.0

The distribution of preoperative and postoperative self-reported pain was compared using an exact test of the Pearson correlation. The clinical and demographic attributes were compared with the level of postoperative pain using a gamma statistic and tested using Fisher's exact test. The mean number of days to return-to-activity-as-tolerated in a CAM boot was compared against the various patient attributes using analysis of variance. Trend analysis was performed by fitting a linear model relating the mean to the attribute groups, coded as consecutive integers, weighting inversely proportional to the variance of each mean and then testing whether the slope was different from 0. All statistical analyses were completed using SAS, version 9.1 (SAS Institute, Cary, NC). The institutional review board at Womack Army Medical Center approved the present study.

Results

The demographic and biometric data for the study population are summarized in Table 1. The 105-patient group was predominately male (80% male versus 20% female), reflecting the gender ratio of the U.S. military overall. The procedures were nearly equally distributed with respect to laterality. The patient age range was 20 to 61 years (average 36). For the purposes of data analysis, the patients were separated into age groups of 20 to 34, 35 to 44, and 45 years or older. Similarly, weight and BMI analysis groups were created, dividing the study population into quartiles. The patients were also grouped by the interval to ambulation. Finally, the patients were categorized by site and the order in which the procedures were performed.

Figure 1 illustrates the strong reduction in self-reported pain 90 days after uniport endoscopic plantar fascial release. Preoperatively, the pain scores ranged from 5 to 10 and were symmetrically distributed around a mean of 7.97. The mean postoperative pain level was 0.38, and more than 80% of patients reported no pain at all. This represented a clinically and statistically significant ($p < .0001$) reduction in self-reported pain. The relationship between the preoperative and postoperative pain levels is given in Table 2. Greater preoperative pain levels were associated with persistent, but reduced, levels of postoperative pain (Tables 3 and 4). This was quantified by a Pearson correlation between pre- and postoperative self-reported pain of 0.20, significantly different from 0 (exact 2-sided $p = .0379$), and indicative of a positive relationship between the pain reported at the 2 points.

Table 3
Comparison of preoperative and postoperative self-reported pain (N = 105 procedures in 96 patients)

Preoperative Pain Scale	Postoperative Pain Scale*					
	None	1	2	3	5	Total
5	2 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)
6	12 (92.3)	0 (0.0)	1 (7.7)	0 (0.0)	0 (0.0)	13 (100.0)
7	19 (82.6)	3 (13.0)	0 (0.0)	0 (0.0)	1 (4.4)	23 (100.0)
8	22 (78.6)	4 (14.3)	2 (7.1)	0 (0.0)	0 (0.0)	28 (100.0)
9	22 (84.6)	3 (11.5)	0 (0.0)	1 (3.9)	0 (0.0)	26 (100.0)
10	8 (61.5)	1 (7.7)	1 (7.7)	1 (7.7)	2 (15.4)	13 (100.0)
Total	85 (80.9)	11 (10.5)	4 (3.8)	2 (1.9)	3 (2.9)	105 (100.0)

Data presented as n (%).
* Postoperative pain scale level 4 not reported by any patient.

Table 4
Relationship between postoperative self-reported pain and various attributes (N = 105 procedures in 96 patients)

Attribute	*p* Value*	Gamma
First ambulatory day in CAM boot	.4053	−0.02
Age group	.2425	−0.02
Weight group	.0037	0.70
BMI group	.0001	0.79
Gender	.6219	0.21
Surgery order group	.2296	0.12
Laterality	.5734	−0.08
Facility	.7595	0.37

Abbreviations: BMI, body mass index; CAM, controlled ankle motion.
* Fisher's exact test.

The relationship between postoperative pain and various clinical and biometric attributes were evaluated using Fisher's exact test. The weight and BMI were the only biometric variables among the 8 attributes considered that showed a statistically significant correlation with postoperative pain ($p = .0037$ and $p = .0001$, respectively; Table 5). The gamma statistic is a measurement of correlation strength between the clinical variable and its outcome and ranges from −1 for a perfect inverse association to +1, indicative of a perfect agreement. The gamma statistic for the weight and BMI group by postoperative pain was 0.70 and 0.79, respectively, indicating that increased weight and BMI were associated with greater self-reported pain. Although most patients (91.3% and 96.3%) in the lowest weight and BMI groups reported no postoperative pain at all, approximately one half of the patients (48.1% and 55.5%) in the greatest weight and BMI groups reported at least some postoperative pain. The only other attributes with gamma statistics suggestive of an association with postoperative pain were gender and site (0.21 and 0.37, respectively); however, the correlation was not statistically significant ($p = .6219$ and $p = .7595$, respectively). Earlier ambulation in a CAM boot was not associated with lower levels of postoperative pain.

Another important outcome measure is the number of days until the return to activity as tolerated in a CAM boot. Most patients (81.9%) were ambulatory within 14 days, and all patients had returned to activity-as-tolerated by 15 days. Only age ($p = .0281$) and gender ($p = .0068$) showed any statistically significant association with this outcome measure (Table 6). Patients 45 years old or older had a slightly lower average return to activity time than the younger patients (Table 6). Also, male patients had a slightly lower average return time than female patients. Although not statistically

Table 5
Postoperative self-reported pain by weight group and BMI group (N = 105 procedures in 96 patients)

Attribute	Postoperative Pain Scale*					
	None	1	2	3	5	Total
Weight group (lb)						
118–169	21 (91.3)	2 (8.7)	0 (0.0)	0 (0.0)	0 (0.0)	23 (100.0)
170–184	25 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	25 (100.0)
185–212	25 (83.4)	3 (10.0)	1 (3.3)	0 (0.0)	1 (3.3)	30 (100.0)
≥213	14 (51.9)	6 (22.2)	3 (11.1)	2 (7.4)	2 (7.4)	27 (100.0)
BMI group (kg/m^2)						
20.00–25.53	26 (96.3)	1 (3.7)	0 (0.0)	0 (0.0)	0 (0.0)	27 (100.0)
25.54–27.72	24 (96.0)	1 (4.0)	0 (0.0)	0 (0.0)	0 (0.0)	25 (100.0)
27.73–29.79	23 (88.6)	1 (3.8)	1 (3.8)	0 (0.0)	1 (3.8)	26 (100.0)
≥29.80	12 (44.5)	8 (29.6)	3 (11.1)	2 (7.4)	2 (7.4)	27 (100.0)
Total	85 (80.9)	11 (10.5)	4 (3.8)	2 (1.9)	3 (2.9)	105 (100.0)

Abbreviation: BMI, body mass index.
Data presented as n (%).
* Postoperative pain scale level 4 not reported by any patient.

Table 6
Mean interval to return to activities as tolerated in CAM boot (N = 105 procedures in 96 patients)

Attribute	Interval (d)
Overall	14.10 ± 0.62
Age group (y)	
20–34	14.16 ± 0.53
35–44	14.16 ± 0.46
≥45	13.64 ± 1.21
Gender	
Female	14.43 ± 0.51
Male	14.02 ± 0.62
Weight group (lb)	
118–169	14.30 ± 0.47
170–184	14.16 ± 0.69
185–212	14.07 ± 0.37
≥213	13.93 ± 0.83
BMI group (kg/m^2)	
20.00–25.53	14.33 ± 0.55
25.54–27.72	14.12 ± 0.60
27.73–29.79	14.00 ± 0.28
≥29.80	13.96 ± 0.85

Abbreviation: BMI, body mass index.
Data presented as mean ± standard deviation.

significant, an unexpected downward trend was noted in the mean days to the return to activity-as-tolerated by weight and BMI. As with postoperative pain, earlier ambulation in a CAM boot was not associated with an earlier return to activity as tolerated (Tables 7 and 8).

Discussion

To our knowledge, the present report describes the outcomes of uniport EPF in the largest, single-surgeon cohort, published to date. The present review has demonstrated that the uniport approach to plantar fascial release is a simple surgical technique that gives most patients immediate relief from pain, allows for a rapid return to activity as tolerated, and is associated with few, if any, postoperative complications. More than 80% of patients reported complete relief of their pain and were able to return to activity as tolerated within 2 weeks. When compared anecdotally to the traditional open procedure, the endoscopic approach gives superior results in these important outcome measures, similar to those reported by others. In a smaller case series report involving 17 patients who underwent uniport endoscopic release, Boyle and Slater (8) reported that 82.4% of subjects had mild to no pain postoperatively. Similarly, Brekke and Green (7) reported a mean reduction in pain of 71.5% with a dual-portal endoscopic procedure.

Although all patients reported reduced pain, the data suggested that some patients are better candidates for this procedure than others. The patients in our study with mild-to-moderate preoperative pain were more likely to experience immediate and complete relief of their pain compared with patients with more severe disease. Bazaz and Ferkel (12) reported similar findings, noting that patients with more severe symptoms or symptoms of longer duration who underwent endoscopic release had less favorable results. In contrast, although the study by Bazaz and Ferkel (12) also found that obesity did not affect the outcome, the patients in our study in the lower weight and BMI groups reported greater postoperative pain relief than the patients in the greater weight and BMI groups. Only 44.5% of those with a BMI of 29.80 kg/m^2 or greater reported a postoperative pain level of 0, but almost all (96.3%) of those with a BMI of 25.53 kg/m^2 or less reported no postoperative pain. Although not statistically significant, an association was also noted between male gender and decreased postoperative pain.

Table 7
Distribution of patients by interval to return to activities as tolerated in CAM boot (N = 105 procedures in 96 patients)

Interval	Patients (%)
10 d	1 (1.0)
12 d	1 (1.0)
13 d	2 (1.9)
14 d	82 (78.0)
15 d	19 (18.1)

Abbreviation: CAM, controlled ankle motion.

Table 8
Comparison of mean interval to return to activities as tolerated in CAM boot (N = 105 procedures in 96 patients)

Attribute	*p* Value*
First ambulatory day in CAM boot	.2285
Age group	.0281
Weight group	.1749
BMI group	.1174
Gender	.0068
Surgery order group	.8773
Laterality	.6979
Facility	.8204
Preoperative self-reported pain	.9296
Postoperative self-reported pain	.4590

Abbreviations: BMI, body mass index; CAM, controlled ankle motion.
* Analysis of variance for equality of mean.

With regard to function, most patients were able to return to activity as tolerated within 2 weeks. The clinical and biometric variables that predicted persistent postoperative pain did not necessarily lead to a delayed return of function. The only variable in our study that was associated with both reduced postoperative pain and a speedier return of function was male gender. Other studies have found conflicting results regarding the role of gender. Saxena (9) noted a longer return-to-activity period for female patients, and Bazaz and Ferkel (12) reported less favorable results for male patients. In the latter study, however, the investigators noted that the male patients were more likely to be seeking workman's compensation.

Although increased weight and BMI were associated with persistent pain postoperatively, an unexpected downward trend was noted between heavier weight and the number of days to a return to activity as tolerated, suggesting that heavier patients had a speedier return of function than their normal weight counterparts. Although not statistically significant, this trend was supported by the results from the study by Bazaz and Ferkel (12) and challenges the findings from Saxena (9) that the more athletic patients were quickly able to return to sporting activities, although those with BMIs greater than 27 kg/m^2 had significantly less favorable results. This difference might have resulted from the greater motivation of the athletes in the study by Saxena (9) to return to their sport. Similarly, patients aged 45 years or older in our study were able to return to duty more quickly than their younger counterparts, perhaps owing to the greater compliance with postoperative recommendations anecdotally observed among older patients.

No complications were noted during the observation period. Even without insufflation, the uniport approach allowed for excellent visualization of the plantar fascial band both before and after transection, minimizing scar formation. The use of a medial approach (Figs. 2 and 3) minimized the risk of sural nerve complications and is highly reproducible.

Although in most cases, plantar fasciitis can be successfully treated using nonoperative therapies, a surgical option could still be required in recalcitrant cases. The results we have presented have confirmed the suggestions of previous studies, namely, that single-port endoscopic plantar fascial release provides the patient the fastest return to

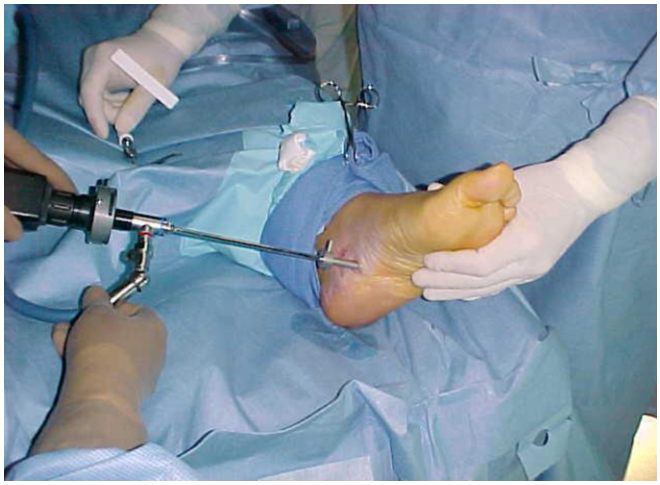

Fig. 2. Proper endoscopic placement.

normal activity with the least risk of surgical complications compared with other operative techniques.

As with all retrospective cohort studies, we recognize the methodologic shortcomings that could threaten the validity of our conclusions. With the exception of the subjective patient outcomes, all other measurements were made by the treating surgeon. However, our main interest was in pain reduction, and this measurement was determined from the patients' subjective assessments of their pre- and postoperative heel pain. In addition, we did not consider the effects of multiple factors such as smoking status, the presence of ankle equines, and activity level. Furthermore, we did not undertake a sensitivity analysis to explore the influence that such unmeasured variables would have had on the results. Also, the study population was an active military one; thus, the patients were physically active, generally less overweight than the general population, and worked in an environment that actively encourages a return to activity as soon as possible. These factors could have an influence on the generalizability of the results to other patient populations. Nonetheless, we believe that the outcomes that were measured are important and could be considered in the surgical decision-making process.

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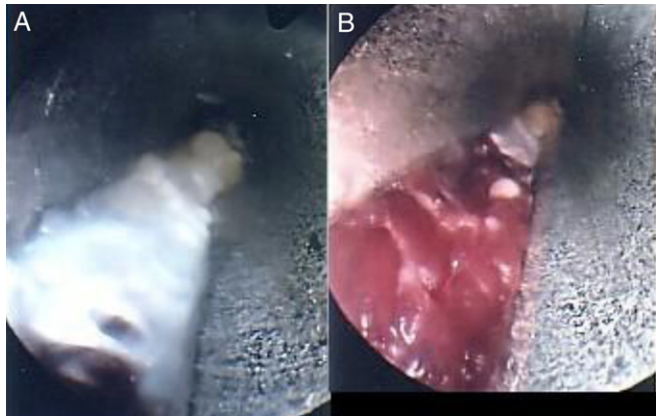

Fig. 3. Intraoperative view showing (*A*) plantar fascial band and (*B*) underlying intrinsic muscle belly.

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