Patient Perceived Recovery and Outcomes after Bipolar Radiofrequency Coblation with Platelet Rich Plasma Injection for Refractory Plantar Fasciosis

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Statement of Purpose

Reported outcomes for refractory plantar fasciosis have focused on quantifying residual pain, and disability to determine recovery (Resolution). However, no prior investigation has evaluated whether other forms of recovery including behavioral adaptations (Readjustment), or cognitive coping (Redefinition) are possible. The purpose of this retrospective case series was to identify alternate forms of recovery following bipolar radiofrequency coblation with platelet rich plasma injection for refractory plantar fasciosis. Patient reported outcome measures were compared between patients who perceived themselves as recovered without/with residual deficits (Recovered-Resolved, Recovered-Not Resolved), vs. those not recovered. Holistic/procedure specific satisfaction, complications, and the re-operation/failure rate were recorded.

Introduction

Plantar fasciitis (PF) is the most common cause of plantar heel pain, with approximately 2 million people seeking treatment in the United States each year (1-4). Conservative treatment is initially recommended, and 90% of patient's experience symptom resolution (5-6). The remaining 10% develop refractory PF, characterized by microscopic tears of the aponeurosis in the absence of inflammation (7-11). While operative interventions addressing the mechanical perturbation(s) have been popularized (gastrocnemius recession, plantar fascial release, heel spur exostectomy), none directly address the altered hemodynamic state, and prolonged convalescence periods/complications persist. A percutaneous treatment capable of directly addressing the altered hemodynamic state by focal angiogenic stimulation to the degenerated, dysvascular aponeurosis may establish a biologic healing response, reducing the convalescence period/complication rate.

Bipolar radiofrequency coblation (BRC) was first introduced in the field of cardiology (12). The minimally invasive, non-heat driven process (40-70 degrees Celsius) stimulates electrolytes in a saline solution; creating a plasma gas capable of breaking down molecular bonds in damaged tissue (13). The resultant inflammatory response also stimulates an influx of healing proteins, and growth factors which initiate, and promote biologic healing. Small case series on BRC in refractory PF have demonstrated significant: pain relief, functional improvement, satisfaction, and reduced complications (11, 14-18). However, these studies account for only 146 patients with short-term follow up (<1 year). While BRC was initially met with great enthusiasm, and promising results for Achilles Tendonosis; varying results over longer follow-ups has since obviated any consensus regarding the procedures utility.

Platelet rich plasma (PRP) is a plasma concentrate of blood obtained from isolating, and concentrating platelets from an autogenous peripheral sample by differential centrifugation (19-21). The resulting plasma fraction contains platelets in supraphysiologic concentrations, two to ten times greater than baseline (21-22). More than 30 bioactive proteins are contained within platelets, many of which are essential for tissue healing and hemostasis (19). The alpha granules specifically contain cytokines, healing proteins, and growth factors in biologically determined ratios including: platelet derived growth factor (PDGF), vascular endothelial growth factor (VEGF), transforming growth factor beta (TGF-B), and insulin like growth factor (IGF). These factors initiate, and promote biologic healing through: angiogenesis, cell migration, cell proliferation, and matrix synthesis (20-28).

Within the medical community, investigations recently have focused on patient reported outcome measures (PROM's) for identifying post-operative recovery, operative success (29-36). However, investigations have demonstrated that recovery in some chronic foot and ankle conditions is not predicated on the complete resolution of all symptomatology (37-38). Patients capable of coping with any ongoing deficit(s) can still achieve recovery, despite persistent pain and disability. Pinsker et al. (37) first introduced Beaton's alternate recovery model (39) which consists of: Resolution, Readjustment, and Redefinition to the lower extremity. However, because PROMs rely on quantifying residual pain, and disability, they fail to assess the ability of patients to cope with any ongoing deficit(s); preventing them from capturing other forms of recovery.

The purpose of this retrospective case series was to compare the PROMS of patients who perceived themselves as recovered without/with residual deficits (without deficits, Recovered-Resolved)(with deficits, Recovered-Not Resolved) vs. those not recovered following BRC with PRP injection. Secondary objectives included an assessment of outcome based on holistic/procedure specific satisfaction, complications, and re-operation/failure rate. A priori hypotheses was that Recovered-Resolved (RR) and Recovered-Not Resolved (RNR) patients would report better PROM scores compared to Not Recovered patients (NR); with >75% being very satisfied/satisfied (scoring 1-2), and willing to recommend/re-undergo the procedure again. Conversely, Not-Recovered (NR) patients would report lower PROM scores; with >75% not satisfied (scoring 0), and unwilling to recommend/re-undergo the procedure again. To the best of our knowledge, this study is the first to assess the outcomes of BRC with PRP injection for refractory PF, and the first to attempt to broaden our definition of "recovery" in these refractory cases by applying the "Resolution, Readjustment, Redefinition" concept of recovery.

Patients/Materials & Methods

Under Institutional Review Board (IRB) approval, a retrospective case series was conducted on all patients with refractory PF who underwent BRC with PRP injection by a single senior surgeon (S.M.S.) at our institution from July 2006 to July 2016. Patients were identified initially by the Current Procedural Terminology Code (28008), which was then cross-referenced with the International Classification Of Diseases, Ninth Revision, Diagnosis Code (728.71), and record to ensure accuracy. Patients with incomplete medical records, concomitant interventions, or less than one year follow up were excluded from the final analysis. The retrospective review, prospective data collection, and analysis was performed by resident FAS of varying post-graduate years.

From July 1, 2006 to July 1, 2016, 113 BRC and PRP injections (97 patients) were performed. Of the 97 patients identified, 12 were excluded for incomplete records, concomitant interventions, or follow up less than 1 year. Of the remaining 85 patients meeting the inclusion criteria, 42 (42/85, 49.4%) were lost to follow up (37/85, 43.5%) or refused to participate (5/85, 5.9%), leaving 43 of 85 eligible patients; representing a 50.6% response rate. These 43 patients underwent 52 procedures, with 9 patients (3 male, 6 female) undergoing BRC with PRP injection bilaterally; either as an index procedure (1 male, 3 female), or within 150 days of the contralateral extremity (2 male, 3 female). Thirty-three patients were female (33/43, 76.7%) and 10 patients were male (10/43, 23.3%) with a mean age of 59.4 years (range, 31 to 79 years), and mean follow up duration of 57.1 months (range, 12.1 to 118 months).

Following the retrospective review, prospective follow up was conducted via a telephone survey to obtain: PPR, PROM's, "holistic"/"procedure specific" satisfaction, complications, and the reoperation/failure rate. PPR was first assessed by asking the patient to choose the statement that best described their current state of recovery, as described prior (37-38). Patients who selected the statement "I am better with no residual symptoms" were classified as Recovered-Resolved (RR), "I am better with some residual symptoms or limitations that I can cope with" were classified as Recovered-Not Resolved (RNR), and "I am not better" were classified as Not Recovered (NR). PROM's were then assessed utilizing a modified FFI, and VAS for pain. "Holistic" satisfaction was accessed utilizing a semi-quantitative scale (2-very satisfied, 1-satisfied, 0 not satisfied), followed by "procedure specific" satisfaction based on the willingness to recommend the procedure. A priori hypotheses were that RR and RNR patients would report better PROM scores compared to NR; with >75% reporting holistic/procedure specific satisfaction. Conversely, NR patients would report lower PROM scores; with >75% reporting no holistic/procedure specific satisfaction. Complications, and re-operation's were recorded, and the failure rate determined. Univariate descriptive statistics for demographic variables were generated for the entire sample, and then stratified by recovery group. Values are expressed as counts (percentage), and means (standard deviation) as appropriate. Fisher exact tests and Kruskal Wallis tests were used to compare categorical, and continuous variables respectively. Spearman correlation was used to assess relationships between holistic/procedure specific satisfaction, and the PROMS (FFI, VAS). Two sided p-values of <0.05 were considered statistically significant.

Results

	Recovered-Resolved (RR) (n = 29)	Recovered-Not Resolved (RNR) (n = 10)	Not Recovered (NR) (n = 4)	Total Sample (n = 43)	P-value
Patient Demographics					
Male, n(%)	8 (27.6)	1 (10)	1 (25)	10 (23)	
Female, n(%)	21 (72.4)	9 (90)	3 (75)	33 (77)	*0.53*
Age (y), mean(range)	60.6 (39 - 76)	58.1 (50 - 66)	54 (31 - 66)	59.4 (31-79)	*0.56*
Follow-up (m), mean(range)	54.7 (12.1 - 118)	69.6 (33 - 107)	42.8 (25 - 65)	57.05 (12.1 - 118)	*0.12*
Total procedures, n (%)	33	11	8	52	
Right	13 (45)	6 (60)	0 (0)	19 (44)	
Left	12 (41)	3 (30)	0 (0)	15 (35)	
Bilateral	4 (14)	1 (10)	4 (100)	9 (21)	***0.009****
Patient Reported Outcome Measures					
Modified FFI score, mean(SD)	2.77 ± 4.56	19.29 ± 0.7	56.91 ± 15.32	11.65 ± 18.03	***<0.00****
VAS score, mean(SD)	0.3 ± 0.72	3.1 ± 1.66	6.0 ± 2.94	1.51 ± 2.24	***<0.00****
Holistic Satisfaction					
Very Satisfied, n (%)	24 (82.7)	3 (30)	0 (0)	27 (62.8)	***<0.00****
Satisfied, n (%)	5 (17.3)	7 (70)	0 (0)	12 (27.9)	***<0.00****
No Satisfaction, n (%)	0 (0)	0 (0)	4 (100)	4 (9.3)	***<0.00****
Procedure Specific Satisfaction					
Recommend/Re-undergo, n (%)	29 (100)	9 (90)	0 (0)	38 (88)	***<0.00****
Complications					
Residual pain, n (%)	0 (0)	5 (50)	4 (100)	9 (21)	
Plantar fibroma, n (%)	0 (0)	1 (10)	0 (0)	1 (2.3)	
Re-operation, n (%)	0 (0)	0 (0)	4 (100)	4 (9.3)	***<0.00****

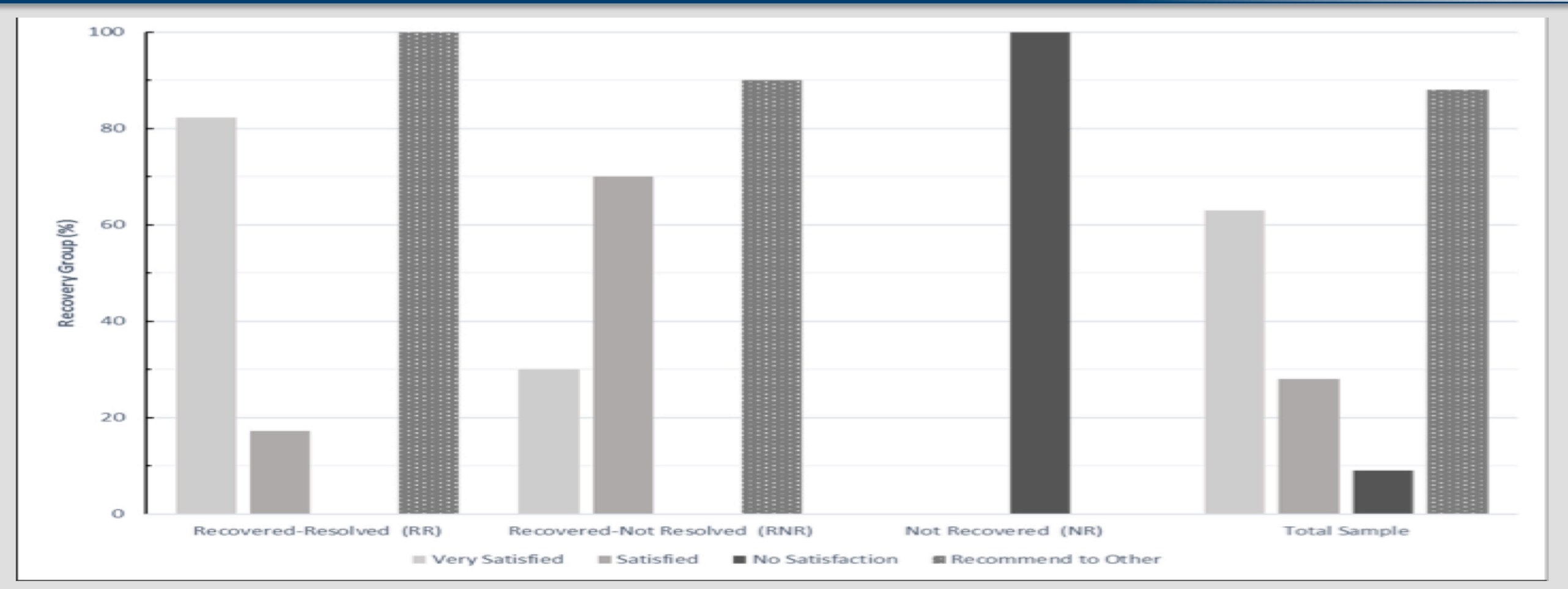
*p-value <0.05

Recovery Group Identification and Trends:

Overall, 67.4% (29/43) of patients perceived themselves as Recovered-Resolved (RR), 23.3% (10/43) as Recovered- Not Resolved (RNR), and 9.3% (4/43) as Not Recovered (NR). Between groups, no significant differences were identified with respect to: gender, age, or follow up duration. A trend toward identification with the RR group was observed for males (8/10, 80%), but the sample size precluded testing for statistical differences between sexes. Four of the 5 patients (4/5, 80%) who underwent staged BRC with PRP injection identified as RR (4/29, 13.8%); while the remaining patient identified as NR (1/4, 25%). In contrast, 3 of the 4 patients (3/4, 75%) who underwent bilateral BRC with PRP injection as an index procedure identified as NR (3/4, 75%), while the remaining patient identified as RNR (1/10, 10%). These findings demonstrate a trend for identification with NR group for patients who underwent bilateral interventions as an index procedure (3/4, 75%) vs. staged intervention (1/5, 20%). While these findings may be interrupted to suggest worse outcomes when management is not staged, the sample sizes were to small to determine statistical differences between these subgroups (Table 1).

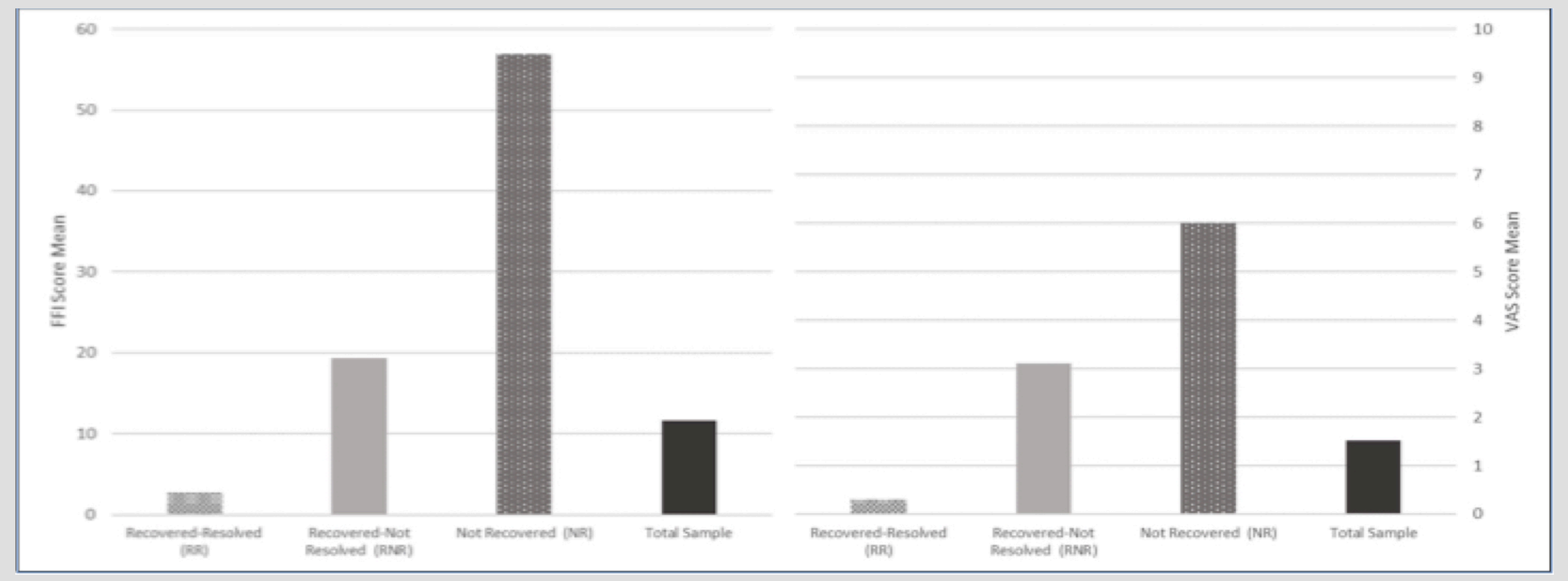
Holistic And Procedure Specific Satisfaction:

In the RR group, all were very satisfied (24/29, 82.3%) or satisfied (5/29, 17.2%), and all (29/29, 100%) would recommend/re-undergo the procedure again. Similarly in RNR group, patients were either very satisfied (3/10, 30%) or satisfied (7/10, 70%), and all but 1 patient (9/10, 90%) would recommend/re-undergo the procedure again. The NR group (4/4, 100%) reported both holistic, and procedure specific dissatisfaction (Table). The priori hypothesis for recovery groups was met.



Functional Status And Pain:

A logical gradient was identified with RR patients reporting the lowest residual pain scores (VAS 0.3, SD 0.72), and less functional limitation (FFI 2.77, SD 4.56). RNR patients reported significantly higher residual pain (VAS 3.1, SD 1.66), and functional limitation (FFI 19.29, SD 0.72). Despite this, RNR patients still identified themselves as "recovered"; suggesting there is a residual deficit level with which patients can cope. The NR group reported the highest residual pain scores (VAS 6, SD 2.94), and most functional limitation (FFI 56.91, SD 15.32). Between recovery groups, the PROM's were statistically significant; providing credibility to the proposed recovery theory for refractory PF (Table). A strong correlation between PROMS (FFI, VAS) and "holistic" patient satisfaction (r=0.63, p<0.00/ r=0.7, p<0.00) was identified; and a moderate correlation between the PROMS and "procedure specific" satisfaction (r=0.56, p<0.00/ r=0.51, p<0.00).



Complications, Reoperations, and Failure Rate:

Nine patients (9/43, 20.9%) reported continued heel pain of varying severity, and 1 (1/43, 2.3%) developed an asymptomatic plantar fibroma at the operative site. Five (5/9, 55.6%) of the 9 patients who continue to experience heel pain, and the patient developing the fibroma identified in the RNR group. These patients did not feel the residual pain limited/restricted their daily lives to any significant extent, nor prevented their recovery. The remaining 4 (4/9, 44.4%) with persistent pain identified as NR, and felt the residual pain severely limited/restricted their activities of daily living. Thus, only 4 of the original 43 patients (4/43, 9.3%) in our cohort continue to have pain that prevents their recovery. The re-operation rate was 7% (3/43), and occurred in 3 of the 4 patients (3/4, 75%) who identified as NR (4/43, 9.3%); all of whom underwent bilateral BRC with PRP injection as an index procedure. The overall failure rate of combined BRC with PRP injection was 9.3% (4/43) at a mean of 57.1 months post-op.

Discussion

To the best of our knowledge, this study is the first to assess the outcomes of BRC with PRP injection for refractory PF, and the first to broaden our traditional definition of "recovery" in this patient cohort. PPR was grouped into: Recovered-Resolved (67.4%), Recovered-Not Resolved (23.3%), and Not-Recovered (9.3%). Between recovery groups, the PROM's demonstrated statistical significance; providing credibility to the proposed recovery theory. As expected, RNR and NR patients reported poorer PROM scores, with lower "holistic" and "procedure specific" satisfaction compared to RR patients. However, within the RNR group, patients still perceived themselves as recovered despite their residual deficit(s) at a mean of 69.6 months (range, 33 to 107 months). Saliently, both RR and RNR patients reported similarly high levels of holistic (90.7%; 39/43), and procedure specific satisfaction (88.4%; 38/43). Had these outcomes been accessed with traditional PROMs alone; alternate forms of recovery could not have been identified. Admittedly, recovery in chronic foot and ankle conditions has been under-investigated, and is likely a much more complex, multifactorial process not always predicated on the resolution of all symptomatology. Other factors in chronic musculoskeletal conditions such as anxiety, and depression are known to affect patient's perception of pain, disability, satisfaction, and perhaps perceived recovery (40-41). Physician-patient communication has been identified as a strong predictor of post-operative patient satisfaction, and may influence PPR. For this reason, we recommend FAS emphasize improvement, rather than resolution when setting patient expectations, and discussing the postoperative course for refractory PF patients undergoing BRC with PRP injection

Alternate forms of recovery have been well described, and recently applied to the lower extremity for chronic conditions where complete symptom resolution is not always possible (37-38). In these conditions, most patients perceive a satisfactory outcome if able to reach an improved residual deficit level with which they can cope (37). These alternative recovery theory(s) have been slow to migrate to orthopedic subspecialties, in part due to the pendulum shift from physician recorded clinical indicators (PRCI's) to PROM's (38). While PROM's provide direct, patient centric data regarding an intervention; too many measures evaluating similar conditions are currently in use, and compounding the difficulty in comparing operative interventions (46). In our investigation we utilized the modified FFI to access patients residual deficit level, mainly for it's user friendliness, and ease of use with our protocol. Since its introduction, the FFI has become one of the widest utilized and studied, validated foot specific instruments for measuring pain, and disability (46). However, like other PROMS; the FFI relies primarily on measuring a patient's residual symptoms/limitations to determine whether resolution has occurred. Weather a patient is cable of coping with an improved residual deficit is not considered, preventing it from capturing other forms of recovery.

In conclusion, BRC with PRP injection is a viable percutaneous procedure affording a reduced convalescence period, and low complication rate. While our results should be interpreted as positive; additional research is warranted to delineate the optimum technique/protocol, as well as stratify perceived recovery/outcomes between specific subgroups. While the complete resolution of symptomatology may not occur in all refractory cases, the improvement post-operatively will allow the majority of patients to perceive themselves as recovered. FAS should be cognizant of the inherent limitations of traditional outcome measures, and our traditional definition of "recovery" should be broadened when interrupting outcomes in these refractory cases. Physician-patient communication has been identified as a strong predictor of patient satisfaction, and may influence PPR. Moving forward, it is prudent FAS emphasize improvement, rather than resolution when setting patient expectations, and discussing the postoperative course for patients with refractory PF undergoing BRC with PRP injection.

References

1) Neufeld SK, Cerrato R. Plantar fasciitis: evaluation and treatment. J Am Acad Orthop Surg.16:338-346, 2008.
2) Rushing CJ, Rogers DE, Spinner SM: A Case Report of Heel Pain Mimicking Plantar Fasciitis and Osteosarcoma: A Unique Presentation of A Nora's Lesion. The Journal of Foot and Ankle Surgery 56: 670-673, 2017.
3) Irving DB, Cook JL, Young MA, Menz HB: Impact of chronic plantar heel pain on health-related quality of life. J Am Podiatr Med Assoc. 98:283–9, 2008.
4) Tong KB, Furia J: Economic burden of plantar fasciitis treatment in the United States. Am J Orthop. 39:227–31, 2010.
5) Thomas JL, Christensen JC, Kravitz SR, et al: The diagnosis and treatment of heel pain: a clinical practice guideline revision 2010. The Journal of Foot and Ankle Surgery 49:S1-S19, 2010.
6) Johnson RE, Hass K, Lindow K, Shields R: Plantar fasciitis: what is the diagnosis and treatment? Orthop Nurs. 33(4):198-204, 2014.
7) Boabighi A, Kuhlmann JN, Luboinski J, Landjerit B: Aponeuroses and superficial fascia. Mechanical and structural properties. Bull Assoc Anat. 77:3–7, 1993.
8) Miller LE, Latt DL: Chronic Plantar Fasciitis is Mediated by Local Hemodynamics: Implications for Emerging Therapies. N Am J Med Sci. 7(1):1-5, 2017.
9). Lemont H, Ammirati KM, Usen N. Plantar fasciitis: a degenerative process (fasciosis) without inflammation. J Am Podiatr Med Assoc. 93:234–237, 2003.
10). Tasto JP: The use of bipolar radiofrequency microtenotomy in the treatment of chronic tendinosis of the foot and ankle. Techniques in Foot & Ankle Surgery 5 (2):110–116, 2006.
11) Sorensen MD, Hyper CF, Philibon TM: Percutaneous Bipolar Radiofrequency Coblation for Recalcitrant Proximal Plantar Fasciosis. The Journal of Foot and Ankle Surgery 50:165-170, 2011.
12) Oesterle SN: Laser percutaneous myocardial revascularization. Am J Cardiol 83:46– 52, 1999.
13) Shibuya N, Thorud JC, Humpers JM, Devall JM, Jupiter DC: Is Percutnaeous Radiogruqency Coblation for Treatment of Achilles Tendinosis Safe and Effective?. The Journal of Foot and Ankle Surgery 51:767-771, 2012.
14) Sollitto RJ, Plotkin EL, Klein PG, Mullin P: Early clinical results of the use of radiofrequency lesioning in the treatment of plantar fasciitis. The Journal of Foot and Ankle Surgery 36:215–9, 1997.
15) Weil L Jr, Glover JP, Weil LS: A new minimally invasive technique for treating plantar fasciosis using bipolar radiofrequency: a prospective analysis. Foot Ankle Spec 1(1):13–18, 2008.
16) Sean NY, Singh I, Wai CK: Radiofrequency microtenotomy for the treatment of plantar fasciitis shows good early results. Foot Ankle Surg. 16:174–7, 2010.
17) Hormozi J, Lee S, Hong DK: Minimal invasive percutaneous bipolar radiofrequency for plantar fasciotomy: A retrospective study. The Journal of Foot and Ankle Surgery 50:283–6, 2011.
18) Tay KS, Ng YC, Singh IR, Chong KW: Open technique is more effective than percutaneous technique for TOPAZ radiofrequency coblation for plantar fasciitis. Foot Ankle Surg.18:287–92, 2012.
19) Schliephake H: Bone growth factors in maxillofacial skeletal reconstruction. Int J Oral Maxillofac Surg. 31:469–84, 2002.
20). Marx RE: Platelet-rich plasma: evidence to support its use. J Oral Maxillofac Surg. 62:489-496, 2004.
21) Halpern BC, Chaudhury S, Rodeo SA: The Role Platelet-Rich Plasma in Inducing musculoskeletal Tissue Healing. Hospital for Special Surgery (8):137-145, 2012.
22) Monto, RR: Platelet-Rich Plasma Efficacy Versus Corticosteroid Injection Treatment for Chronic Severe Plantar Fasciitis. Foot and Ankle International 35(4) 313-318, 2014.
23) Barrett S, Erredge S. Growth factors for chronic plantar fasciitis. Podiatry Today 17:37-42, 2004.
24) Ragab EM, Othman AM: Platelet rich plasma for treatment of chronic plantar fasciitis. Arch Orthop Trauma Surg. 132:1065–1070, 2012.
25) Martinelli N, Marinozzi A, Carni S, Trovato U, Bianchi A, Denaro V: Platelet-rich plasma injections for chronic plantar fasciitis. Int Orthop. 37:839–42, 2013.
26) Angthong C, Khadsongkram A, Angthong W: Outcomes and Quality of Life after Platelet-rich Plasma Therapy in Patients with Recalcitrant Hindfoot and Ankle Diseases: A Preliminary Report of 12 Patients. The Journal of Foot and Ankle Surgery 52:475-480, 2013.
27) Franceschi F,Papalia R, Franceschetti E, Paciotti M, Maffulli N, Denaro V: Platelet-rich plasma injections for chronic plantar fasciopathy: a systematic review. British Medical Bulletin 112:83-95, 2014.
28) Karimzadeh A, Raeissadat A, Fam E, Sedighipour L, Babael A: Autologous whole blood versus corticosteroid local injection in treatment of plantar fasciitis: A randomized, controlled multicenter clinical trial. Clin Rheumatol. 36(3):661-669, 2017.
29) Monteagudo M, Maceira E, Garcia-Virto V, Canosa R: Chronic plantar fasciitis: plantar fasciotomy versus gastrocnemius recession. Int Orthop. 37(9):1845-50, 2013.
30) Barrett SL, Day SV, Brown MG: Endoscopic plantar fasciotomy: preliminary study with cadaveric specimens. J Foot Surg 30:170–172, 1991.
31) Jerosch J, Schunck J, Liebsch D, Filler T: Indication, surgical technique and results of endoscopic fascial release in plantar fasciitis (EF RPF). Knee Surg Sports Traumatol Arthrosc 12:471–477, 2004.
32) Tomczak R, Haverstock B: A retrospective comparison of endoscopic plantar fasciotomy to open plantar fasciotomy with heel spur resection for chronic plantar fasciitis/heel spur syndrome. J Foot Ankle Surg 34:305–311,1995.
33) Cottom JM, Maker JM, Richardson P, Baker JS: Endoscopic debridement for treatment of chronic plantar fasciitis: an innovative technique and prospective study of 46 consecutive patients. J Foot Ankle Surg 55:748–752, 2016.
34) Saxena A: Uniportal endoscopic plantar fasciotomy: a prospective study on athletic patients. Foot Ankle Int 25:882–889, 2004.
35) Lundeen O, Aziz S, Burks J, Rose J. Endoscopic plantar fasciotomy: a retrospective analysis of results in 53 patients. J Foot Ankle Surg 39:208–217, 2000.
36) Davies MS, Weiss GA, Saxby TS. Plantar fasciitis: how successful is surgical intervention? Foot Ankle Int. 20 (12): 803–807,1999.
37) Pinsker I, Inrig T, Daniels TR, Warmington K, Beaton DE: Resolution and Patient-Perceived Recovery Following Ankle Arthroplasty and Arthrodesis. Foot Ankle Int. 37(12): 1269-1276, 2016.
38) Rushing CJ: Patient Perceived Recovery and Outcomes after First Metatarsophalangeal Joint Implant Arthroplasty. The Journal of Foot and Ankle Surgery: *Manuscript Under Review*
39) Beaton DE, Tarasuk V, Katz JN, Wright JG, Bombardier C: "Are you better?" A qualitative study of the meaning of recovery. Arthritis Rheum. 45(3):270-279, 2001.
40) Bair MJ, Wu J, Damush TM, Sutherland JM, Kroenke K: Association of depression and anxiety alone and in combination with chronic musculoskeletal pain in primary care patients. Psychosom Med. 70(8):890-897, 2008.
41) Ryosuke N, Satoshi Y, Seiji K, Aya S, Yohei Y, Ryuichiro A, Takahisa S, Seiji O: Association of Anxiety and Depression with Pain and Quality of Life In Patients With Chronic Foot and Ankle Diseases. Foot Ankle Int. 2017.
42) Marx RE: Platelet-rich plasma (PRP): What Is PRP and What Is Not PRP? Implant Dent.10:225–8, 2001.
43) Scherer SS, Tobalem M, Vigato E, Heit Y, Modarressi A, Hinz B, Pittet B, Pietramaggiori G: Nonactivated versus thrombin-activated platelets on wound healing and fibroblast-to-myofibroblast differentiation in vivo and in vitro. Plast Reconstr Surg. 129(1):46-54, 2012.
44) Castillo TN, Pouliot MA, Kim HJ, Dragoo JL: Comparison of growth factor and platelet concentration from commercial platelet-rich plasma separation systems. Am J Sports Med. 39(2):266-71, 2011.
45) Arnoczky SP, Caballero O, Yeni Y: Platelet-rich Plasma To Augment Connective Tissue Healing: Making Sense of It All. The Journal of the American Academy of Orthopaedic Surgeons 18(7):445-448, 2010.
46) Budiman-Mak E, Conrad KJ, Mazza J, Stuck RM: A review of the foot function index and the foot function index revised. Journal of Foot and Ankle Research 6(5), 2013.

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