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Factors Associated With Poor Patient-Reported Outcomes in Isolated Gastrocnemius Recession for Heel Pain

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Abstract

Background: Gastrocnemius recession is commonly performed for a variety of pathologies of the foot and ankle, yet studies characterizing risk factors associated with patient-reported outcomes are limited. In this cohort study, patient outcomes were compared against the general population for PROMIS scores with correlation analysis comparing demographics and comorbidities. Our primary goal in this study is to identify risk factors associated with poor patient-reported outcomes following isolated gastrocnemius recession for patients with plantar fasciitis or insertional Achilles tendinopathy.

Methods: A total of 189 patients met inclusion criteria. The open Strayer method was preferred. However, if the myotendinous junction could not be adequately visualized without expanding the excision, then a Baumann procedure was performed. The decision between the two did not depend on preoperative contracture. Patient demographics and visual analog scale (VAS) scores were obtained via the electronic medical record. Telephone interviews were completed to collect postoperative Patient-Reported Outcomes Measurement Information System (PROMIS) and Foot Function Index (FFI) scores. The data were analyzed using the type 3 SS analysis of variance test to identify individual patient factors associated with reduced PROMIS, FFI, and VAS scores.

Results: No demographic variables were found to be significantly associated with postoperative complications. Patients who reported tobacco use at the time of surgery had significantly decreased postoperative PROMIS physical function ($P = .01$), PROMIS pain interference ($P < .05$), total FFI scores ($P < .0001$), and each individual FFI component score. Patients undergoing their first foot and ankle surgeries reported numerous significant postoperative outcomes, including decreased PROMIS pain interference ($P = .03$), higher PROMIS depression ($P = .04$), and lower FFI pain scores ($P = .04$). Hypertension was significantly associated with an increased FFI disability score ($P = .03$) and, along with body mass index (BMI) >30 ($P < .05$) and peripheral neuropathy ($P = .03$), significantly higher FFI activity limitation scores ($P = .01$). Pre- and postoperative VAS scores demonstrated improvement in patient-reported pain from a mean of 5.53 to 2.11, respectively ($P < .001$).

Conclusion: We found in this cohort that numerous patient factors were independently associated with differences in patient-reported outcomes following a Strayer gastrocnemius recession performed for plantar fasciitis or insertional Achilles tendinopathy. These factors include, but are not limited to, tobacco use, prior foot and ankle surgeries, and BMI. This study strengthens previous reports demonstrating the efficacy of isolated gastrocnemius recession and elucidates variables that may affect patient-reported outcomes.

Level of Evidence: Level III, retrospective cohort study.

Keywords: Foot and ankle, gastrocnemius recession, outcomes

Introduction

Historically, gastrocnemius recession (GR) procedures were used to treat equinus contractures in cerebral palsy patients; however, with better understanding of various foot and ankle pathologies such as plantar fasciitis (PF), midfoot-forefoot overload syndrome, metatarsalgia, diabetic foot ulcers, pes plano-valgus, and Achilles tendinopathy, this procedure has been increasingly performed to improve patient's symptoms.[5,18,24] Despite its increased utilization in treating various pathologies of the foot and ankle, there is limited evidence to demonstrate the long-term outcomes of this procedure.

Effects of foot and ankle pathologies on quality of life and outcomes following surgery were classically analyzed using Foot Function Index (FFI), American Orthopaedic Foot & Ankle Society (AOFAS) Clinical Rating Systems, and Foot and Ankle Ability Measure (FAAM). In recent years, there has been a paradigm shift in measuring patient-reported outcomes with computerized adaptive tests (CATs). CATs individualize questions based on initial responses and tailor queries that are most appropriate to the patient. The National Institutes of Health–supported CAT, known as the Patient-Reported Outcomes Measurement Information System (PROMIS), has been validated in a variety of medical and orthopaedic conditions as a superior assessment of physical function, pain, mental health status, and resulting outcomes from treatment.[4,12-16]

To date, there is sparse literature published evaluating outcomes of isolated GR utilizing the PROMIS scoring system for PF or insertional Achilles tendinopathy. The primary aim of this exploratory study was to determine factors associated with PROMIS, FFI, and visual analog scale (VAS) scores following isolated GR.

Methods

After obtaining Institutional Review Board approval, patient's Medical Record Numbers (MRNs) were screened using *Current Procedural Terminology* (*CPT*) code 27687 (gastrocnemius recession) at a single institution from 2013 to 2021. A total of 1339 patients were obtained from the CPT query of the database. Inclusion criteria for this study required patients to be at least 18 years of age, have a preoperative diagnosis of heel pain, secondary to, insertional Achilles tendinopathy (AT), or PF that was subsequently treated via isolated gastrocnemius recession with a minimum 1-year follow-up. Additionally, patients must have undergone at least 1 year of conservative management including physical therapy, eccentric strengthening, and heel cord and plantar fascia stretching and activity limitation. Patients were excluded if they underwent another operation at the same time as the GR or if their pathology was a neurologic contracture (eg, secondary to cerebral palsy, stroke, traumatic brain injury). A total of 189 patients met these criteria and were included in the study. The open Strayer method was preferred. However, if the myotendinous junction could not be adequately visualized without expanding the excision then a Baumann procedure was performed. The decision between the two did not depend on preoperative contracture. The electronic medical record was used to obtain patient demographic information including sex, age, and body mass index (BMI). Comorbidities were recorded and included history of tobacco use, chronic nonsteroidal anti-inflammatory drugs (NSAIDs) use, diabetes mellitus, hypertension, peripheral neuropathy (PN), ASA score, rheumatoid arthritis, and prior history of foot and ankle surgeries. Presence of equinus, PF, AT, and duration of preoperative symptoms were also recorded. Visual analog scale (VAS) scores were used to record preoperative and postoperative pain level.

Surgical complications such as infection, development of sural neuropathy, and need for surgical revision were recorded. Follow-up visits and telephone interviews were used to collect postoperative PROMIS and FFI scores.

Patient-Reported Outcomes

The PROMIS Pain Interference (PI) version 1.1, Physical Function (PF) version 1.2, and depression version 1.0 CATs were administered. Higher scores correlate with more association with each category. For example, a patient with a PI score of 60 has a pain score 1 SD above the general population. Preoperative and postoperative pain was measured via VAS, which was scored on a scale from zero (no pain) to 10 (worst pain imaginable). FFI domains of pain, disability, and activity limitation were collected and scored on a scale of 0 to 50, 0 to 90, and 0 to 30, respectively. Each patient's total FFI score (average of the 3 scores) was calculated. Higher scores correlate with negative outcomes.

Statistical Analysis

Descriptive statistics associated with patients undergoing isolated gastrocnemius recession are described in Table 1. R statistical software (version 4.2.0) was used for statistical

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Table 1. Basic Patient Demographics.

Characteristic	n (%) or n
Sex	
Male	51 (27)
Female	138
Age	
>40 y	149 (79)
<40 y	40
BMI	
>30	140 (74)
<30	49
Tobacco use	
Yes	54 (29)
No	135
Diabetes	
Yes	32 (17)
No	157
Hypertension	
Yes	97 (51)
No	82
Presence of peripheral neuropathy	
Yes	31 (16)
No	158
Rheumatoid arthritis	
Yes	3 (2)
No	186
Equinus contracture	
Yes	131 (69)
No	58
Chronic NSAID	
Yes	78 (41)
No	111
Duration of symptoms	
≥24 mo	77 (41)
<24 mo	112
History of previous foot and ankle procedures	
Yes	42 (22)
No	147
ASA	
1-2	78 (41)
3-4	111
Achilles tendinopathy	
No	130 (69)
Yes	59
Plantar fasciitis	
No	57 (30)
Yes	132

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index; NSAID, nonsteroidal antiinflammatory drug.

analysis. *P* values less than .05 were considered significant. An analysis of variance was performed on the data set to evaluate for preoperative patient variables with statistical effect on preoperative VAS scores and postoperative PROMIS, FFI, and VAS. Assumptions were checked using the Shapiro-Wilk test for normality and *Q*-*Q* plots. Tukey multiple comparisons were performed post hoc for significant *F* values ($P < .05$) with 3 or more categories. A post hoc power analysis determined that for a desired 80% power, the minimum number of participants to detect a 2-point difference in PROMIS scores was 49 patients.

Results

A total of 189 patients met our inclusion criteria with a minimum follow-up of 1 year. Of these individuals, 138 (73%) were female, 149 (79%) were older than 40 years, and 140 (74%) had a BMI greater than 30. Analysis of comorbidities found 54 (29%) having a history of tobacco use, 32 (17%) with diabetes, and 97 (51%) with hypertension. Other factors analyzed included 78 (41%) reporting chronic NSAID use (consistent use for more than 1 year), 77 (41%) with chronic (>24 months) symptoms, 131 (69%) with presence of equinus (inability to passively dorsiflex to neutral regardless of the position of the knee), 132 with PF (70%), 59 with insertional AT (31%), 78 (41%) with an ASA score of 1 or 2, and 3 (1.6%) with rheumatoid arthritis. Regarding previous management, 42 (22%) reported prior foot and ankle procedures and all patients claimed insufficient improvement in symptoms with conservative treatments. The mean follow-up was 4.33 years, ranging from 1.0 to 10.92 years.

Of the 189 patients in our study, 185, 161, and 182 completed the PROMIS, FFI, and pre- and postoperative VAS surveys, respectively. Complications were few and included the following: 6 patients (3.17%) had sural neuritis, 6 (3.17%) developed cellulitis, 1 (0.53%) ruptured their Achilles 2 weeks after surgery, 1 (0.53%) developed a deep vein thrombosis, and 1 (0.53%) formed a painful sural neuroma. Demographics for patients who underwent GR are summarized in Table 1. The mean reported PROMIS PF, PI, and Depression scores were 46.03 (SD 11.39), 51.5 (SD 11.97), and 42.78 (SD 11.28), respectively. The average FFI scores for pain, disability, activity limitation, and total were 33.06 (SD 30.77), 36.14 (SD 30.51), 19.16 (SD 27.98), and 32.32 (SD 26.66), respectively. Pre- and postoperative VAS scores demonstrated improvement in patient-reported pain from a mean of 5.53 (SD 2.80) to a mean of 2.11 (SD 2.70), respectively ($P < .001$). The association of various demographic variables with PROMIS, FFI, and VAS scores can be seen in Tables 2, 3, and 4 respectively.

Patients who used tobacco had significantly lower PROMIS physical function scores ($P = .0148$) and significantly higher PROMIS pain interference ($P = .0450$). Tobacco users were also found to have significantly higher FFI pain, disability, activity limitation, and total scores ($P = .0007$, $P < .0001$, $P = .0452$, $P < .0001$, respectively). Patients with history of prior foot and ankle procedures had a significantly lower PROMIS pain interference score

Table 2. Basic Patient Demographics Effect on PROMIS Scores.

	PROMIS Physical Function	*P* Value	PROMIS Pain	*P* Value	PROMIS Depression	*P* Value
Sex		.8451		.4102		.2452
Male	45.52		53.22		43.85	
Female	46.22		52.03		42.37	
Age		.9119		.187		.3469
>40 y	45.58		52.18		42.52	
<40 y	47.72		52.99		43.75	
BMI		.6521		.4527		.7604
>30	45.47		52.38		42.81	
<30	47.68		52.28		42.67	
Tobacco use		.0148[a]		.045[a]		.9573
Yes	42.28		55.18		43.16	
No	47.52		51.23		42.62	
Diabetes		.2827		.9156		.0999
Yes	42.07		53.88		47.08	
No	46.85		52.04		41.88	
Hypertension		.2611		.2177		.9319
Yes	44.15		53.76		43.59	
No	48.07		50.82		41.89	
Presence of peripheral neuropathy		.2767		.0912		.9607
Yes	46.45		50.54		44.57	
No	45.94		52.7		42.43	
Rheumatoid arthritis		.7312		.5297		.1901
Yes	42.2		56.23		49.56	
No	46.09		52.29		42.67	
Equinus contracture		.1499		.6676		.6935
Yes	47.52		51.68		43.25	
No	44.31		53.08		43.28	
Chronic fluoroquinolone use/ chronic NSAID		.056		.24		.8007
Yes	47.85		51.14		43.34	
No	44.76		53.19		42.39	
Duration of symptoms		.6227		.5034		.1085
≥24 mo	44.95		53.3		44.48	
<24 mo	46.82		51.73		41.66	
History of previous foot and ankle procedures		.2896		.0268[a]		.0437[a]
Yes	47.18		48.94		39.5	
No	45.85		53.05		43.39	
ASA		.148		.0861		.466
1-2	49.07		49.92		43.92	
3-4	43.92		54.1		43.57	
Achilles tendinopathy		.2117		.0709		.2684
No	46.1		53.27		43.61	
Yes	45.85		50.38		40.98	
Plantar fasciitis		.9638		.0856		.5965
No	44.45		51.04		41.63	
Yes	46.73		52.93		41.63	

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index; NSAID, nonsteroidal antiinflammatory drug; PROMIS, Patient-Reported Outcomes Measurement Information System.
[a]Statistically significant.

Table 3. Basic Patient Demographics Effect on FFI.

	FFI Pain	*P* Value	FFI Disability	*P* Value	FFI Activity Limitation	*P* Value	FFI Total	*P* Value
Sex		.9613		.7326		.4943		.8089
Male	34.23		36.06		19.56		32.91	
Female	32.59		36.17		28.26		26.28	
Age		.7863		.29		.15		.7106
>40 y	33.83		38.04		19.99		33.73	
<40 y	30.06		28.75		15.95		26.88	
BMI		.9173		.3061		.0482[a]		.3077
>30	34.23		36.54		18.08		32.6	
<30	28.67		34.64		23.21		31.27	
Tobacco use		.0007[a]		.0001[a]		.0452[a]		.0001[a]
Yes	46.09		51.89		26.96		45.78	
No	28.16		30.21		16.23		27.26	
Diabetes		.8561		.9934		.6156		.9781
Yes	39.5		46.66		29.4		41.51	
No	31.7		33.92		17.01		30.39	
Hypertension		.1403		.0294[a]		.0097[a]		.023[a]
Yes	37.83		43.65		25.66		38.76	
No	27.44		27.31		11.53		24.75	
Presence of peripheral neuropathy		.5614		.5878		.0297[a]		.3532
Yes	37.28		42.17		33.59		39.59	
No	32.28		35.03		16.51		31.05	
Rheumatoid arthritis		.1652		.7187		.4747		.5603
Yes	5.33		33.44		34.33		25.29	
No	33.58		36.19		18.87		32.46	
Preoperative ROM		.2739		.111		.4531		.1285
Full	31.59		34.2		17.01		30.6	
Partial	38.45		44.29		23.81		38.96	
Chronic fluoroquinolone/ NSAID use		.5419		.6531		.7858		.6127
Yes	34.92		36.82		17.78		33.11	
No	31.69		35.64		20.17		31.75	
Duration of symptoms		.5137		.5408		.4214		.4447
≥24 mo	32.87		35.67		17.18		31.59	
<24 mo	33.44		36.29		20.68		32.84	
History of previous foot and ankle procedures		.0428[a]		.1034		.982		.0993
Yes	23.26		29.89		20.97		26.32	
No	35.68		37.96		18.68		33.93	
ASA		.6912		.0884		.4888		.1936
1-2	28.11		25.79		11.96		24.26	
3-4	36.08		42.45		23.55		37.24	
Achilles tendinopathy		.5283		.7008		.8077		.6254
No	33.02		34.13		18.54		31.14	
Yes	33.13		40.22		20.42		34.74	
Plantar fasciitis		.1409		.9912		.2165		.8055
No	33.3		43.39		28.38		37.87	
Yes	32.94		32.68		14.77		29.67	

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index; FFI, Foot Function Index; NSAID, nonsteroidal antiinflammatory drug; ROM, range of motion.

[a]Statistically significant.

Table 4. Basic Patient Demographics Effect on VAS.

	Preoperative VAS	*P* Value	Postoperative VAS	*P* Value
Sex		.8555		.9026
Male	5.33		2.05	
Female	5.61		2.13	
Age		.0246[a]		.6432
>40 y	5.78		2.13	
<40 y	4.61		2.02	
BMI		.0479		.3436
>30	5.8		2.11	
<30	4.71		2.1	
Tobacco Use		.4187		.4524
Yes	5.75		2.35	
No	5.44		2.01	
Diabetes		.997		.7961
Yes	5.83		2.7	
No	5.47		2	
Hypertension		.5109		.4178
Yes	5.64		2.45	
No	5.4		1.75	
Presence of peripheral neuropathy		.0848		.9707
Yes	4.53		2.28	
No	5.71		2.08	
Rheumatoid arthritis		.5642		.9707
Yes	6.66		3.66	
No	5.51		2.08	
Preoperative ROM		.7332		.0749
Full	5.65		2.09	
Partial	5.52		2.28	
Chronic fluoroquinolone use/chronic NSAID		.593		.0788
Yes	5.7		2.5	
No	5.4		1.82	
Duration of symptoms		.2751		.9957
≥24 mo	5.32		2.16	
<24 mo	5.65		2.1	
History of previous foot and ankle procedures		.1943		.2896
Yes	4.92		1.69	
No	5.71		2.24	
ASA		.3867		.0911
1-2	5.13		1.56	
3-4	5.8		2.49	
Achilles tendinopathy		.8217		.2449
No	5.24		2	
Yes	6.17		2.36	
Plantar fasciitis		.6981		.3161
No	5.8		2.61	
Yes	5.41		1.89	

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index; NSAID, nonsteroidal antiinflammatory drug; ROM, range of motion; VAS, visual analog scale.
[a]Statistically significant.

(*P*=.0268) and described lower FFI pain (*P*=.0428). Patients undergoing their first foot and ankle procedure reported significantly higher PROMIS depression scores (*P*=.0437). Hypertension associated with higher FFI disability and activity limitation (*P*=.0294 and *P*=.0097, respectively). A BMI >30 was an independent predictor of higher FFI activity limitation (*P*=.0482) and higher preoperative VAS scores (*P*=.0479). Additionally, PN was

associated with higher FFI activity limitation ($P = .0297$). Patients aged >40 years had significantly higher preoperative VAS scores ($P = .0246$) and experienced decreased change from preoperative to postoperative VAS score ($P = .0372$).

Discussion

Recent studies have proposed GR as a viable treatment option for PF and AT.[5,18,19,24,28] Despite the increasing utility of GR, there is a lack of literature analyzing the factors affecting patient-reported outcomes. Our study is the only study to date that conducts a comprehensive analysis of patient factors for reduced PROMIS scores following GR. In addition, this study includes the largest cohort of patients with PROMIS scores following GR. This information has the potential to be used by physicians as a prognostic guide for patients considering gastrocnemius recession for heel pain.

Ficke et al[7] and Smith et al[28] first reported significant improvements in FFI and VAS for PF and AT, respectively, in small cohorts of 18 and 25 patients. Our study supports the outcomes found in the aforementioned studies and expands to encompass the PROMIS score domain, larger sample size, and more granular examination of numerous factors associated with patient-reported outcomes.

Two of the most common indications for a GR are AT and PF. After controlling for confounding variables, patient-reported outcomes following GR for either pathology were not significantly different. With results from an average followup of 4.33 years (minimum 1 year requirement), we are led to believe that GR will provide positive mid- and long-term results for patients with AT or PF. Additionally, multiple studies have found GR to significantly decrease VAS scores.[5,17-19,22] Although these studies are low in power, our study strengthens the conclusions by demonstrating an average decrease in VAS by 3.42 points.

Looking at the data, it is evident that tobacco use has a significant association with patient-reported outcomes following GR. The concept of tobacco usage negatively impacting orthopaedic outcomes has been widely reported in the literature, especially its influence on nonunion, avascular necrosis, wound healing, and functional outcomes.[1,20,21,29] In 2019, a systematic review by Beahrs et al[3] included 52 articles and concluded that patients undergoing foot and ankle procedures who use tobacco have more pain, lower overall patient satisfaction, and higher rates of wound healing complications. Audet et al[2] recently described tobacco dependence to be an independent predictor for worse FFI scores and prescription pain medication usage. Additionally, a 2021 systematic review by Heyes et al[10] concluded that tobacco use negatively impacts pain control and functional outcomes following foot and ankle procedures, likely because of the peripheral nature of the vasculature. Our results support these prior conclusions and show that tobacco usage is associated with significantly higher PROMIS pain interference (0.0450), FFI pain ($P = .0007$), FFI activity limitation ($P = .0452$), FFI disability ($P = .0001$), FFI total ($P = .0001$), and lower PROMIS physical function ($P = .0148$).

PN diminishes sensory feedback in the lower extremity, leading to increased risk of falls, significantly slower walking speeds, and poorer lower extremity physical function independent of diabetes.[32] To our knowledge, minimal literature has cited the association of preoperative PN on postoperative outcomes in foot and ankle surgery.[27] Our study is the first to show the potential association of PN and activity limitation ($P = .0297$) following GR.

Studies have demonstrated the increased incidence of foot and ankle pathologies and decreased response to conservative and surgical management in patients with elevated BMI.[9,23,33] This is likely due to a combination of factors including altered biomechanical loading and chronic inflammation due to cytokine release from adipose tissue.[31] Obesity and its negative impact on orthopaedic surgical outcomes is a topic that has been well documented, although our results do not fully support these prior concepts. Ficke et al,[7] in a study of obese plantar fasciitis patients undergoing gastrocnemius recession, demonstrated a significant reduction in FFI and VAS scores as well as satisfaction rates of 76%. Our data found that BMI >30 did not have a significant association with PROMIS PI ($P = .4527$), PF ($P = .6521$), or Depression ($P = .7604$). Although it was significantly associated with FFI activity limitation ($P = .0482$). The role obesity plays in foot and ankle surgical outcomes is conflicting and appears to depend on the type of procedure performed. Our results support the notion that BMI >30 was not associated with the majority of outcomes, the association with FFI activity limitation is likely due to the diminished baseline activity status of the obese population.[6]

Prior history of foot and ankle surgery appears to be a protective factor regarding patient outcomes. Patients with a prior history of foot and ankle surgery reported lower PROMIS pain and depression when compared to the group undergoing their first foot and ankle surgery. These findings are likely due to varying expectation levels prior to the surgery, as patients undergoing their second surgery are more likely to have realistic expectations regarding pain management and functional limitations.[30] Further studies will be needed to interpret whether these differences in PROMIS scoring are due to altered patient expectations, timing of operation, or a combination of factors. It is difficult to analyze any potential relationships based on these outcomes alone.

The prevalence of foot and ankle pain increases with age.[11] Age >40 years was significantly correlated with elevated preoperative VAS scores compared with individuals aged <40 years. Their postoperative VAS scores were comparable. This is interesting and indicates these patients may

receive the most benefit from the procedure regarding pain reduction. These findings are supported by their PROMIS pain and FFI pain scores showing no difference postoperatively. Patients with ASA scoring of 3 and 4 had significantly higher postoperative VAS scores comparatively to those with ASA scores 1 and 2 (but not FFI and PROMIS). This is likely due to the increased systemic health issues and increased comorbidities associated with the classification criteria.[8]

Literature has identified diabetes mellitus as a risk factor for noninfectious complications in foot and ankle surgery as diabetics typically have more comorbidities and systematic issues with peripheral vasculature.[26,34] Interestingly, diabetes mellitus was not an associated risk factor in our study as it did not affect PROMIS, FFI, or VAS scoring. Nonetheless, it is an important comorbidity that needs to be discussed when counseling patients prior to surgery. Special consideration should be paid to the glycated hemoglobin (HbA_{1c}) values, as poorly controlled diabetes will typically have more profound systemic repercussions.

Sex, hypertension, TA, and symptom duration did not have significant associations with PROMIS.

Samuelsen et al[25] in 2017 found that patients with chronic NSAID or opioid use demonstrated lower pain tolerance and increased pain sensitivity, which is supported by the results in our study. Chronic NSAID use independently predicted higher postoperative VAS pain scores but did not predict elevated PROMIS pain interference of FFI pain scores. Further studies would need to be done to analyze its true impact.

In our study, mean scores in all 3 PROMIS domains were within 1 SD of the general population. Indicating, at a minimum, that GR, on average, allows patients to return to the general population baseline regardless of preoperative status and associated patient factors.

This study is not without limitations. Because of the retrospective nature of this study, there is the potential for biases and confounding variables. Because PROMIS and FFI scores were collected postoperatively, there are no preoperative scores to compare as a baseline. Although we do not have preoperative PROMIS and FFI scores, the focus of the study is to determine the factors associated with the postoperative outcome scores. This is the first study that identifies factors associated with postoperative PROMIS scores for GR. There was no correction for alpha inflation from multiple statistical tests, and therefore some of the results may not represent true associations. Further research is needed to expand on the associations discussed in this study, for example, by collecting prospective data points to evaluate improvements in functional outcome scores over time. Although this study was completed at a single large academic center, the patient population is complex, diverse, and largely generalizable to the wider adult population.

Conclusions

Patient-reported outcomes are significantly associated with numerous patient-related factors. Before undergoing an isolated gastrocnemius recession, patient characteristics and their potential impact on surgical outcomes should be discussed. Given our exploratory findings, it is possible that patients with tobacco use, obesity, age >40 years, PN, and ASA score 3 and 4 will have a higher risk of not doing as well as those without these comorbidities.

Ethical Approval

Institutional review board approval was obtained.

Declaration of Conflicting Interests

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References

1. Anatone AJ, Danford NC, Jang ES, Smartt A, Konigsberg M, Tyler WK. Risk factors for surgical site infection in orthopaedic oncology. *J Am Acad Orthop Surg*. 2020;28(20):e923-e928. doi:10.5435/jaaos-d-19-00582
2. Audet MA, Benedick A, Vallier HA. Tobacco smoking is associated with more pain and worse functional outcomes after torsional ankle fracture. *OTA Int*. 2022;5(1):e175. doi:10.1097/oi9.0000000000000175
3. Beahrs TR, Reagan J, Bettin CC, Grear BJ, Murphy GA, Richardson DR. Smoking effects in foot and ankle surgery: an evidence-based review. *Foot Ankle Int*. 2019;40(10):1226-1232. doi:10.1177/1071100719867942
4. Brodke DJ, Saltzman CL, Brodke DS. PROMIS for orthopaedic outcomes measurement. *J Am Acad Orthop Surg*. 2016;24(11):744-749. doi:10.5435/jaaos-d-15-00404
5. Cychosz CC, Phisitkul P, Belatti DA, Glazebrook MA, DiGiovanni CW. Gastrocnemius recession for foot and ankle conditions in adults: evidence-based recommendations. *Foot Ankle Surg*. 2015;21(2):77-85. doi:10.1016/j.fas.2015.02.001
6. Donnelly JE, Blair SN, Jakicic JM, Manore MM, Rankin JW, Smith BK. American College of Sports Medicine Position Stand. Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. *Med Sci Sports Exerc*. 2009;41(2):459-471. doi:10.1249/MSS.0b013e3181949333

7. Ficke B, Elattar O, Naranje SM, Araoye I, Shah AB. Gastrocnemius recession for recalcitrant plantar fasciitis in overweight and obese patients. *Foot Ankle Surg*. 2018;24(6):471-473. doi:10.1016/j.fas.2017.05.008
8. Foley C, Kendall MC, Apruzzese P, De Oliveira GS. American Society of Anesthesiologists Physical Status Classification as a reliable predictor of postoperative medical complications and mortality following ambulatory surgery: an analysis of 2,089,830 ACS-NSQIP outpatient cases. *BMC Surg*. 2021;21(1):253. doi:10.1186/s12893-021-01256-6
9. Frey C, Zamora J. The effects of obesity on orthopaedic foot and ankle pathology. *Foot Ankle Int*. 2007;28(9):996-999. doi:10.3113/fai.2007.0996
10. Heyes G, Weigelt L, Molloy A, Mason L. The influence of smoking on foot and ankle surgery: a review of the literature. *Foot (Edinb)*. 2021;46:101735. doi:10.1016/j.foot.2020.101735
11. Hill CL, Gill TK, Menz HB, Taylor AW. Prevalence and correlates of foot pain in a population-based study: the North West Adelaide health study. *J Foot Ankle Res*. 2008;1(1):2. doi:10.1186/1757-1146-1-2
12. Hinds PS, Wang J, Cheng YI, et al. PROMIS pediatric measures validated in a longitudinal study design in pediatric oncology. *Pediatr Blood Cancer*. 2019;66(5):e27606. doi:10.1002/pbc.27606
13. Ho B, Houck JR, Flemister AS, et al. Preoperative PROMIS scores predict postoperative success in foot and ankle patients. *Foot Ankle Int*. 2016;37(9):911-918. doi:10.1177/1071100716665113
14. Horn ME, Reinke EK, Couce LJ, Reeve BB, Ledbetter L, George SZ. Reporting and utilization of Patient-Reported Outcomes Measurement Information System® (PROMIS®) measures in orthopedic research and practice: a systematic review. *J Orthop Surg Res*. 2020;15(1):553. doi:10.1186/s13018-020-02068-9
15. Hung M, Baumhauer JF, Latt LD, Saltzman CL, SooHoo NF, Hunt KJ. Validation of PROMIS® physical function computerized adaptive tests for orthopaedic foot and ankle outcome research. *Clin Orthop Relat Res*. 2013;471(11):3466-3474. doi:10.1007/s11999-013-3097-1
16. Hung M, Nickisch F, Beals TC, Greene T, Clegg DO, Saltzman CL. New paradigm for patient-reported outcomes assessment in foot & ankle research: computerized adaptive testing. *Foot Ankle Int*. 2012;33(8):621-626. doi:10.3113/fai.2012.0621
17. Jarin IJ, Bäcker HC, Vosseller JT. Functional outcomes of insertional Achilles tendinopathy treatment: a systematic review. *JBJS Rev*. 2021;9(6):e20. doi:10.2106/jbjs.Rvw.20.00110
18. Maskill JD, Bohay DR, Anderson JG. Gastrocnemius recession to treat isolated foot pain. *Foot Ankle Int*. 2010;31(1):19-23. doi:10.3113/fai.2010.0019
19. Molund M, Paulsrud Ø, Ellingsen Husebye E, Nilsen F, Hvaal K. Results after gastrocnemius recession in 73 patients. *Foot Ankle Surg*. 2014;20(4):272-275. doi:10.1016/j.fas.2014.07.004
20. Patel S, Baker L, Perez J, Vulcano E, Kaplan J, Aiyer A. Risk factors for nonunion following ankle arthrodesis: a systematic review and meta-analysis. *Foot Ankle Spec*. Published online March 4, 2021. doi:10.1177/1938640021998493
21. Pearson RG, Clement RG, Edwards KL, Scammell BE. Do smokers have greater risk of delayed and non-union after fracture, osteotomy and arthrodesis? A systematic review with meta-analysis. *BMJ Open*. 2016;6(11):e010303. doi:10.1136/bmjopen-2015-010303
22. Pickin CC, Elmajee M, Aljawadi A, Fathalla I, Pillai A. Gastrocnemius recession in recalcitrant plantar fasciitis: a systematic review. *J Foot Ankle Surg*. 2022;61(2):396-400. doi:10.1053/j.jfas.2021.10.029
23. Riddle DL, Pulisic M, Pidcoe P, Johnson RE. Risk factors for plantar fasciitis: a matched case-control study. *J Bone Joint Surg Am*. 2003;85(5):872-877. doi:10.2106/00004623-200305000-00015
24. Sammarco GJ, Bagwe MR, Sammarco VJ, Magur EG. The effects of unilateral gastrocsoleus recession. *Foot Ankle Int*. 2006;27(7):508-511. doi:10.1177/107110070602700705
25. Samuelsen PJ, Nielsen CS, Wilsgaard T, Stubhaug A, Svendsen K, Eggen AE. Pain sensitivity and analgesic use among 10,486 adults: the Tromsø study. *BMC Pharmacol Toxicol*. 2017;18(1):45. doi:10.1186/s40360-017-0149-2
26. Sartorius N. Depression and diabetes. *Dialogues Clin Neurosci*. 2018;20(1):47-52. doi:10.31887/DCNS.2018.20.1/nsartorius
27. Sidon E, Rogero R, McDonald E, et al. Prevalence of neuropathic pain symptoms in foot and ankle patients. *Foot Ankle Int*. 2019;40(6):629-633. doi:10.1177/1071100719838302
28. Smith KS, Jones C, Pinter Z, Shah A. Isolated gastrocnemius recession for the treatment of Achilles tendinopathy. *Foot Ankle Spec*. 2018;11(1):49-53. doi:10.1177/1938640017704942
29. Smolle MA, Leitner L, Böhler N, Seibert FJ, Glehr M, Leithner A. Fracture, nonunion and postoperative infection risk in the smoking orthopaedic patient: a systematic review and meta-analysis. *EFORT Open Rev*. 2021;6(11):1006-1019. doi:10.1302/2058-5241.6.210058
30. Stevens KN, Nadarajah V, Jauregui JJ, et al. Preoperative expectations of patients undergoing knee surgery. *J Knee Surg*. 2021;34(6):612-620. doi:10.1055/s-0039-1698805
31. Stewart M. Obesity in elective foot and ankle surgery. *Orthop Clin North Am*. 2018;49(3):371-379. doi:10.1016/j.ocl.2018.02.011
32. Strotmeyer ES, de Rekeneire N, Schwartz AV, et al. The relationship of reduced peripheral nerve function and diabetes with physical performance in older white and black adults: the Health, Aging, and Body Composition (Health ABC) study. *Diabetes Care*. 2008;31(9):1767-1772. doi:10.2337/dc08-0433
33. Weil L Jr. Obesity, feet, and the impact on health care. *Foot Ankle Spec*. 2012;5(3):148-149. doi:10.1177/1938640012448057
34. Wukich DK, Shen JY, Ramirez CP, Irrgang JJ. Retrograde ankle arthrodesis using an intramedullary nail: a comparison of patients with and without diabetes mellitus. *J Foot Ankle Surg*. 2011;50(3):299-306. doi:10.1053/j.jfas.2010.12.028