

Retrospective Cohort Study

Return to physical activity after gastrocnemius recession

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Abstract**AIM**

To prospectively investigate the time taken and patients' ability to resume preoperative level of physical activity after gastrocnemius recession.

METHODS

Endoscopic gastrocnemius recession (EGR) was performed on 48 feet in 46 consecutive sportspersons, with a minimum follow-up of 24 mo. The Halasi Ankle Activity Score was used to quantify the level of physical activity. Time taken to return to work and physical activity was recorded. Functional outcomes were evaluated using the short form 36 (SF-36), American Orthopedic Foot and Ankle Society (AOFAS) Hindfoot score and modified Olerud and Molander (O and M) scores respectively. Patient's satisfaction and pain experienced were assessed using a modified Likert scale and visual analogue scales. P -value < 0.05 was considered statistically significant.

RESULTS

Ninety-one percent ($n = 42$) of all patients returned to their preoperative level of physical activity after EGR. The mean time for return to physical activity was 7.5 (2-24) mo. Ninety-eight percent ($n = 45$) of all patients were able to return to their preoperative employment status, with a mean time of 3.6 (1-12) mo. Ninety-six percent ($n = 23$) of all patients with an activity score > 2 were able to resume their preoperative level of physical activity in mean time of 8.8 mo, as compared to 86% ($n = 19$) of patients whose activity score was ≤ 2 , with mean time of 6.1 mo. Significant improvements were noted in SF-36, AOFAS hindfoot and modified O and M scores. Ninety percent of all patients rated good or very good outcomes on the Likert scale.

CONCLUSION

The majority of patients were able to return to their pre-operative level of sporting activity after EGR.

Key words: Endoscopic gastrocnemius release; Time return to work; Return to physical activity; Post-operative outcomes; Foot and ankle

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Core tip: Whilst the biomechanical advantage of surgical off-loading from gastrocnemius recession is well proven, the potential for weak push-off strength post-operatively continues to be debated. We are not aware of any published literature investigating the impact of the gastrocnemius recession procedure on the ability to return to physical activity. This study aims to investigate the hypothesis that the majority of patients will be unable to return to their pre-operative level of physical activity after a gastrocnemius recession procedure.

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INTRODUCTION

Gastrocnemius recession has evolved into a well-established surgical procedure that is increasingly performed in orthopaedic foot and ankle surgery. It is indicated primarily in individuals who experience symptoms from biomechanical overload caused by an equinus ankle resulting from a tight superficial posterior compartment musculature that restricts ankle dorsiflexion^[1]. Gastrocnemius contracture may result in an ankle equinus deformity which in turn alters the foot biomechanics and increases forefoot pressures^[2]. Gastrocnemius contracture has been implicated as the cause of a variety of foot and ankle pathologies including metatarsalgia^[3], diabetic foot ulcer^[4], pes planus deformity^[5], hallux valgus^[6] and plantar fasciitis^[7]. It is postulated this may be secondary to excessive forefoot loading and heel hypervalgus^[8]. The diagnosis of gastrocnemius tightness is primarily clinical using the Silfverskiöld test^[8]. The test is positive when an ankle dorsiflexion of less than or equal to 10° on knee extension is increased to more than 10° on knee flexion whilst the hindfoot is held in neutral^[9].

With the advent of minimally invasive surgical techniques and instruments to support it, an endoscopic approach to gastrocnemius recession has been proposed as an alternative to open gastrocnemius recession^[10]. The efficacy and safety profile of endoscopic gastrocnemius recession (EGR) has been investigated in a number of case series with the procedure being associated with a

shorter postoperative recovery, fewer wound-related complications and greater patient satisfaction^[10,11].

Complications of gastrocnemius recession has been well documented in the literature^[12]. Of these, the potential for significant plantarflexion weakness attributed to lengthening of the gastroc-soleus muscle unit^[13] has generated much concern amongst orthopaedic surgeons and sports medicine practitioners alike. Whilst the biomechanical advantage of surgical off-loading from gastrocnemius recession is well proven, the potential for weak push-off strength when performed in a sportsperson continues to remain a concern. We are not aware of any published literature investigating the impact of the gastrocnemius recession procedure on the ability to return to preoperative level of physical activity.

The primary aim of this study was to prospectively evaluate a consecutive series of patients undergoing gastrocnemius recession with regards to the time taken and their ability to return to preoperative level of physical activity. The secondary aim of the study was to evaluate the functional outcome and complication profile of the gastrocnemius recession procedure when performed endoscopically in a consecutive series of patients.

MATERIALS AND METHODS

Subjects

With Institutional Review Board approval, 48 feet (25 left and 23 right) in 46 consecutive patients (34 female and 12 male; mean age 49.7 ± 18.6 years; range 21 to 83 years) who underwent EGR through a single lateral portal using the Smart Release Endoscopic Carpal Tunnel Release System were included in the study (Table 1). All patients who were recruited for the procedure had an isolated gastrocnemius contracture which was confirmed clinically with the Silfverskiöld test. Patients with ankle joint pathology resulting in an equinus or spastic contractures secondary to neurological injury were excluded.

The same operative technique was applied to all patients and all procedures were performed by 2 senior foot and ankle fellowship trained orthopaedic surgeon at a single institution within a 3-year period. In all patients, the aponeurosis for both the medial and lateral heads of the gastrocnemius was released at the distal muscle-tendon junction.

Follow-up

The mean follow-up period was 32 ± 7.7 mo, with minimum duration of 24 mo (range 24 to 60 mo). The primary outcome measure recorded was the time taken from the operative day to a point in the future when the patient was able to participate in their preferred physical activity or sport at a level that was similar to their preoperative level of activity. In order to evaluate and stratify the level of physical activity pursued by the individual patient, the ankle activity score developed and validated by Halasi and associates^[14] was used. This 10-point scoring system is based on the type and level of physical activity, with 0 points indicating the lowest

Table 1 Patient demographics

Demographic	Value
No. of patients	46
No. of feet/recessions	48
Age	Mean: 49.73 ± 18.59 yr Range: 21 to 83 yr
Gender	Female: 35 Male: 13
Side of operation	Left: 25 (52.1%) Right: 23 (47.9%)
Follow-up months	Mean 32 ± 7.66 mo Range 24-60 mo

activity level and 10 points indicating the highest activity level. Time taken before patients returned to the same level of physical activity based on the Halasi score was recorded. As a surrogate marker of return to activity, time taken to return to full time employment was also recorded.

Secondary outcome measures were evaluated using validated scoring systems. Functional evaluation was carried out preoperatively, at 1 year and 2 years postoperatively using the short form 36 (SF-36), American Orthopaedic Foot and Ankle Society (AOFAS) Hindfoot score and Modified Olerud and Molander (O and M) Score. The Likert scale and visual analogue pain scores (VAS) were used to evaluate patient satisfaction and pain scores respectively.

The preoperative scoring was done during the preoperative clinic consultations whilst the postoperative scores were tabulated during postoperative consultation visits.

Statistical analysis

IBM SPSS Statistics version 20 was used to perform statistical analysis of the collected data. The analysis aimed to identify any significant change between the preoperative and 2-year postoperative scores of SF-36, AOFAS Hindfoot score, Modified O and M and VAS Scores. Paired parametric Student *t*-test was performed on the data sets. Descriptive statistics were used for the demographic variables. Results were expressed as means ± SD. A *P*-value of < 0.05 was considered statistically significant.

RESULTS

Functional outcome

Forty-two out of the 46 patients (91%) were able to return to their preoperative level of physical activity after EGR at the time of final follow-up. The mean duration of time taken to return to preoperative level of physical activity was 7.5 mo (range 2 to 24 mo). Of the 4 patients who failed to return to preoperative level of physical activity, at the 2-year follow-up, the first patient had dropped from a Halasi score of 4 to 2, the second patient a Halasi score 2 to 1 and the last two patients also dropped from Halasi scores 2 to 1. These final 2 patients

Table 2 Demographics of patients who successfully returned to preoperative level of physical activity and preoperative employment status

Halasi ankle activity score	No. of patients	Mean time to return to physical activity (mo)	Mean time to return to work (mo)
0	0	-	-
1	0	-	-
2	22	6.1	4.1
3	7	14.0	3.1
4	13	8.3	3.7
5	3	6.0	2.3
6	0	-	-
7	0	-	-
8	1	3.0	3.0
9	0	-	-
10	0	-	-
Total	46	7.5	3.6

were unable to return to physical activity due to other concomitant musculoskeletal problems (back and knee pathologies).

The mean duration of time taken to return to preoperative employment status for those who were engaged in employment (*n* = 37) was 3.6 mo (range 1 to 12 mo). Of the 37 patients analysed, 20 patients held sedentary desk-bound jobs. The time return to employment for this subset was 3.3 mo. In a further subset of 17 patients (35%) who held more physically demanding employment that necessitated them being on their feet for prolonged periods or performing manual tasks (salesperson, fitness instructors) the time return to employment was 3.9 mo. Overall, only 1 patient was unable to return to his original employment as a chef at the time of final follow-up due to persistent leg pains from prolonged standing.

When stratifying the level of physical activity using the Halasi ankle activity score, 22 patients (48%) claimed to participate only in low-intensity physical activity (defined as Halasi ankle activity score ≤ 2) whilst the remaining 24 patients (52%) participated in higher-intensity physical activity (defined as Halasi ankle activity score > 2) (Table 2).

Overall, 96% (*n* = 23) of those engaging in higher intensity activity (Halasi ankle activity score > 2) were able to return to their preoperative level of physical activity whilst only 86% (*n* = 19) of patients with Halasi ankle activity score ≤ 2 were able to do so. When comparing these 2 categories of patients, those with a Halasi ankle activity score of more than 2 reported a mean time return to activity of 8.8 mo (range 2 to 24 mo). In contrast, those with a Halasi ankle activity score of 2 or less reported a mean time return to activity of 6.1 mo (range 2 to 12 mo).

Secondary outcome measure

Preoperative, 1-year postoperative and 2-year postoperative SF-36, AOFAS, Modified O and M and VAS scores were obtained in all 46 patients. The preoperative and 1-year postoperative scores were compared and evaluated (Table 3).

Table 3 Summary of results (preoperative and 1-year postoperative)

Parameter	Preoperative Mean \pm SD	1 yr post-op Mean \pm SD	Improvements Mean \pm SD	P-value
SF-36				
Physical functioning	64.79 \pm 27.58	84.58 \pm 15.74	19.79 \pm 26.74	< 0.001
Role limitations due to physical health	45.83 \pm 41.68	84.38 \pm 23.98	38.54 \pm 42.83	< 0.001
Role limitation due to emotional problems	61.10 \pm 44.21	89.92 \pm 24.26	28.82 \pm 51.32	< 0.001
Energy/fatigue	60.42 \pm 18.24	65.63 \pm 15.80	5.21 \pm 14.95	0.02
Emotional well-being	74.00 \pm 16.46	74.04 \pm 17.40	0.04 \pm 18.46	0.988
Social functioning	74.79 \pm 21.23	96.25 \pm 7.20	21.46 \pm 22.51	< 0.001
Pain	60.78 \pm 21.38	91.30 \pm 12.48	30.52 \pm 24.17	< 0.001
General health	68.33 \pm 18.73	73.27 \pm 17.25	4.94 \pm 13.37	0.014
AOFAS Hindfoot Score	71.60 \pm 18.89	91.79 \pm 7.24	20.19 \pm 19.89	< 0.001
Modified Olerud and Molander score				
Pain	13.23 \pm 6.32	22.19 \pm 4.72	8.96 \pm 6.99	< 0.001
Stiffness	6.56 \pm 4.15	8.44 \pm 2.76	1.88 \pm 4.33	0.004
Swelling	7.60 \pm 3.57	8.54 \pm 2.91	0.94 \pm 4.46	0.152
Stair climbing	6.67 \pm 2.79	8.33 \pm 2.60	1.67 \pm 3.15	0.001
Running	1.56 \pm 2.34	2.29 \pm 2.52	0.73 \pm 1.78	0.007
Jumping	2.19 \pm 2.51	2.92 \pm 2.49	0.73 \pm 2.06	0.018
Squatting	4.38 \pm 1.67	4.48 \pm 1.54	0.10 \pm 1.93	0.71
Supports	7.92 \pm 3.69	8.85 \pm 2.78	0.94 \pm 3.67	0.083
Activities of daily life	0.00 \pm 0.00	17.08 \pm 4.59	17.08 \pm 4.59	< 0.001
Total	50.10 \pm 15.89	83.13 \pm 15.73	33.02 \pm 18.09	< 0.001
VAS	5.00 \pm 2.38	1.21 \pm 1.79	3.79 \pm 2.60	< 0.001

VAS: Visual analogue score; AOFAS: American Orthopedic Foot and Ankle Society.

When comparing functional outcomes at 1-year postoperative, there were significant improvements in all domains of the SF-36 questionnaire except for emotional well-being. There was significant improvement in AOFAS Hindfoot score of 20.19 ± 19.89 ($P < 0.001$), from a mean of 71.60 ± 18.89 preoperatively to 1-year postoperative mean of 91.79 ± 7.24 . There was also significant improvement in modified O and M score at the 1-year postoperative mark, with significant improvements in 7 out of the 9 domains of the O and M score.

Comparing 1-year postoperative and 2-year postoperative scores (Table 4), there were no statistically significant improvements in the domains of SF-36 questionnaire as well as the AOFAS Hindfoot scores. The modified O and M Score showed significant improvements in only the total score and in 2 out of 9 domains. This suggests that there are no significant ongoing improvements beyond the first year postoperative mark.

Analysis of the VAS score showed significant improvements at both the 1-year and 2-year postoperative marks, with a mean score improvement of 3.79 ± 2.60 ($P < 0.001$) and 4.31 ± 2.45 ($P < 0.001$) respectively. Beyond the first year, there was significant improvement of pain reduction between the first year and second year postoperatively, with improvements of 0.52 ± 1.17 ($P = 0.003$). Ninety percent of all cases reported good or very good outcomes on the Likert scale at the 2-year postoperative follow-up.

DISCUSSION

To ensure a more clinically relevant measurement of return to physical activity, the level of physical activity

was first stratified in this study. The Halasi Ankle Activity score is a validated tool designed specifically for the ankle and enabled a more accurate stratification of the intensity of physical activity pursued by individual patients. Time taken before being able to return to the same intensity of ankle activity postoperatively was used as an objective measure of time taken to return to physical function and a surrogate marker of any permanent functional deficit that may have resulted from the procedure. Similarly, time taken to return to preoperative level of employment was measured to reflect on the economic burden this procedure may have on an individual patient.

In this study, patients with a preoperative Halasi ankle activity score of more than 2 required a longer time to resume their physical activity to the same intensity level when compared to those with Halasi ankle activity score of 2 or less. However, 96% of all patients in the higher level activity group successfully regained their preoperative intensity of physical activity in contrast to only 86% in the second group. This result suggests gastrocnemius recession is unlikely to result in any permanent functional deficit that may compromise return to a higher level of physical activity or sport. We postulate the difference in time taken to return to physical activity in the two groups is likely attributable to higher levels of physical activities necessitating a more prolonged rehabilitation period.

For the cohort of employed patients ($n = 37$), the mean time to return to full time preoperative employment status was 3.6 mo (range 1 to 12 mo). This information is important to highlight to patients, especially those concerned about the ability to resume their occupation, during the peri-operative counselling period when

Table 4 Summary of results (1-year postoperative and 2-year postoperative)

Parameter	1 yr postoperative Mean \pm SD	2 yr postoperative Mean \pm SD	Improvements Mean \pm SD	P-value
SF-36				
Physical functioning	84.58 \pm 15.74	87.08 \pm 14.40	19.79 \pm 26.74	0.144
Role limitations due to physical health	84.38 \pm 23.98	88.13 \pm 23.58	38.54 \pm 42.83	0.169
Role limitation due to emotional problems	89.92 \pm 24.26	90.26 \pm 18.16	28.82 \pm 51.32	0.880
Energy/fatigue	65.63 \pm 15.80	63.85 \pm 15.51	5.21 \pm 14.95	0.290
Emotional well-being	74.04 \pm 17.40	76.02 \pm 13.50	0.04 \pm 18.46	0.274
Social functioning	96.25 \pm 7.20	95.63 \pm 9.07	21.46 \pm 22.51	0.566
Pain	91.30 \pm 12.48	92.43 \pm 13.72	30.52 \pm 24.17	0.401
General health	73.27 \pm 17.25	74.44 \pm 18.23	4.94 \pm 13.37	0.469
AOFAS Hindfoot Score	91.79 \pm 7.24	93.48 \pm 7.81	1.69 \pm 5.83	0.051
Modified Olerud and Molander score				
Pain	22.19 \pm 4.72	22.71 \pm 4.37	0.52 \pm 2.36	0.133
Stiffness	8.44 \pm 2.76	8.85 \pm 2.58	0.42 \pm 2.27	0.209
Swelling	8.54 \pm 2.91	8.85 \pm 2.36	0.31 \pm 1.90	0.261
Stair climbing	8.33 \pm 2.60	8.75 \pm 2.19	0.42 \pm 2.02	0.159
Running	2.29 \pm 2.52	3.23 \pm 2.42	0.94 \pm 1.97	0.002 ^a
Jumping	2.92 \pm 2.49	3.23 \pm 2.42	0.31 \pm 1.90	0.261
Squatting	4.48 \pm 1.54	4.48 \pm 1.54	0.00 \pm 1.03	1
Supports	8.85 \pm 2.78	9.58 \pm 1.74	0.73 \pm 2.06	0.018 ^a
Activities of daily life	17.08 \pm 4.59	17.71 \pm 3.85	0.63 \pm 3.66	0.243
Total	83.13 \pm 15.73	87.08 \pm 15.74	3.96 \pm 10.05	0.009 ^a
VAS	1.21 \pm 1.79	0.69 \pm 1.72	0.52 \pm 1.17	0.003 ^a

^aDenotes significant *P* values. VAS: Visual analogue score; AOFAS: American Orthopedic Foot and Ankle Society.

discussing the anticipated time away from work. Only 1 patient was unable to return to employment at the 2-year follow-up due to leg pains from prolonged standing as part of his job as a chef. The same patient was unable to return to his preoperative level of physical activity and this was attributed to the presence of other concomitant lower back pain and not the gastrocnemius recession procedure alone.

The functional outcomes related to the single portal EGR was also evaluated in this study. The SF-36 scores showed statistically significant improvements in 6 out of 8 components while the modified O and M score revealed statistically significant improvements in 7 out of 9 domains. The AOFAS Hindfoot scores revealed significant improvements between preoperative and 2-year postoperative scores as well. Significant pain relief and high satisfaction rates were reflected by improvements in the VAS score and either good or very good outcomes on the Likert scale. These results are consistent with those from other studies in the current literature^[12,13].

Limitation and strength of the study

There are several limitations to this study. Firstly, this is a single centre series of 46 patients. A larger pool of patients would increase the power of analysis for return to physical activity. Secondly, there were no comparisons made with alternative techniques for gastrocnemius recession and it is conceivable that a different surgical technique may influence time return to physical activity, though there is a paucity of evidence to substantiate this. Finally, patients were not matched for other concurrent musculoskeletal pathology and it is feasible that time return to physical activity may be influenced by other comorbidities.

The primary strength of this study is its novelty in addressing the clinically relevant question of what is the likelihood of return to physical functional activity after a gastrocnemius recession procedure. The minimum follow-up of 24 mo, use of validated functional and activity scoring plus consistency in the surgical technique substantiates the role of this procedure in our therapeutic armamentarium.

The result of this study shows that a vast majority (91%) of patients post gastrocnemius release regained their preoperative level of physical activity after a mean of 7.5 mo. As expected, there is a trend towards a longer recovery period for those who participate in higher level of physical activity. There are significant functional improvements and pain relief following this procedure as assessed at the 2-year postoperative mark.

COMMENTS

Background

Endoscopic gastrocnemius release (EGR) has evolved into a popular procedure that reliably treats ankle equinus from a tight gastrocnemius contracture. There is however considerable anxiety amongst surgeons who perform this procedure that it may result in permanent ankle plantarflexion weakness, thereby preventing return to pre-operation level of physical activity.

Research frontiers

The efficacy and safety profile of EGR has been investigated in a number of case series with the procedure being associated with a shorter postoperative recovery, fewer wound-related complications and greater patient satisfaction.

Innovations and breakthroughs

The potential for significant plantarflexion weakness attributed to lengthening of the gastroc-soleus muscle unit has generated much concern amongst orthopaedic surgeons and sports medicine practitioners alike. This study aims to evaluate the novel clinical question of time taken to return to pre-operative

level of physical activity after EGR.

Applications

The majority of patients are able to return to their pre-operative level of sporting activity after EGR. Ninety-one percent ($n = 42$) of all patients returned to their preoperative level of physical activity after EGR. The mean time for return to physical activity was 7.5 (2-24) mo. Ninety-eight percent ($n = 45$) of all patients were able to return to their preoperative employment status, with a mean time of 3.6 (1-12) mo. Ninety-six percent ($n = 23$) of all patients with an activity score > 2 were able to resume their preoperative level of physical activity in mean time of 8.8 mo, as compared to 86% ($n = 19$) of patients whose activity score was ≤ 2 , with mean time of 6.1 mo.

Terminology

About endoscopic gastrocnemius recession: A variety of muscle-tendon unit release procedures along the calf such as Silfverskiöld, Baumann, Vulpius, Baker and Strayer procedure, have been described over the past century. These involve at least a partial or complete release of the gastrocnemius muscle to diminish its role as the primary plantarflexor of the ankle. Of the many recession techniques that have been described, the one described by Strayer has gained most popularity. Traditionally performed as an open procedure, the Strayer procedure involves making an incision on the ventral surface of the calf and releasing only the gastrocnemius aponeurosis just distal to its muscle belly. With the advent of minimally invasive surgical techniques and instruments to support it, an endoscopic approach to gastrocnemius recession has been popularised as an alternative to open gastrocnemius recession.

Peer-review

This is an interesting research article on the return to physical activity after gastrocnemius recession procedure. In general, the methodology is appropriate, the results are clinically significant, and the implication for clinical practice is quite useful.

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