Efficacy of Gastrocnemius Recession in Relieving Recalcitrant Foot Pain

Audrey W. Branom
Pacific University

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Abstract

**Background:** Gastrocnemius recession has been recently studied as a method to relieve recalcitrant foot pain in patients with isolated gastrocnemius contracture. Studies on the biomechanics of walking have proposed that limited ankle dorsiflexion results in improper weight loading across the foot, resulting in multiple pain pathologies. Recession of gastrocnemius muscles increases ankle dorsiflexion. This review aims to evaluate the efficacy of gastrocnemius recession relieving foot pain.

**Methods:** Exhaustive search of available medical literature was completed using Medline-OVID, CINAHL, and Web of Science using the keywords: gastrocnemius and recession. Articles with visual analog scales were included, while studies focusing on one type of foot pathology or gastrocnemius contractures due to neurologic conditions were excluded. GRADE was used to evaluate the studies.

**Results:** The search resulted in two studies that address the clinical question. Both studies are retrospective and demonstrate remarkable pain relief in patients after gastrocnemius recession. The level of evidence supporting gastrocnemius recession as an effective treatment for recalcitrant foot pain is very low over these two studies.

**Conclusion:** In order to provide stronger evidence to support this treatment, better-designed studies including control groups must be developed. The raw data of the studies supports further investigation, as the results are promising.

**Keywords:** gastrocnemius, recession
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Efficacy of Gastrocnemius Recession in Relieving Recalcitrant Foot Pain

Audrey W. Branom

A Clinical Graduate Project Submitted to the Faculty of the School of Physician Assistant Studies

Pacific University
Hillsboro, OR
For the Masters of Science Degree, August 8, 2015

Faculty Advisor: Dr. Mary Von

Clinical Graduate Project Coordinator: Annjanette Sommers, PA-C, MS
Biography
Audrey Branom is a longtime resident of Western Washington, most recently of Seattle. She received a Bachelor of Science degree in General Biology and a Bachelor of Arts degree in Latin American Studies from University of Washington in 2007. Prior to PA school, she worked as a medical office assistant, an EMT, and an ER Technician in the Greater Seattle area. She looks forward to pursuing any of her many medical interests, and returning home to the community that inspired her to become a Physician Assistant.
Abstract

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**Keywords:** gastrocnemius, recession
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Table I: Characteristics of Reviewed Studies
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List of Abbreviations

ADL...............................Activities of Daily Living
GRADE..........................Grading of Recommendations, Assessment, Development, and Evaluation
NIH..................................National Institutes of Health
NSAID.............................Non-Steroidal Anti-Inflammatory Drugs
RCT...............................Randomized Controlled Trial
ROM...............................Range of Motion
VAS...............................Visual Analog Scale
Efficacy of Gastrocnemius Recession in Treating Recalcitrant Foot Pain

BACKGROUND

Supporting the weight of the entire human body, feet carry a load greater than any other region of the body. A recent systematic review\(^1\) found that about 24% of adults age 45 or older have frequent foot pain. While the types of pain experienced in different specific pathologies vary in location and severity, any type of foot pain has the potential to limit function. Whether it is sharp, dull, or aching, experiencing any type of pain in the foot is now recognized as a risk factor for impaired function, even to the extent of disability, and an increased risk of falling.\(^1\) So, rather than ignoring or undertreating foot pain, patients and providers should more aggressively address foot pain in the younger years. A procedure that has recently become more popular among orthopedic surgeons for treating chronic foot pain of multiple pathologies is gastrocnemius recession.

The theory supporting gastrocnemius recession has been discussed in medical literature since the first half of the 1900s, but only recently has it come back into medical literature. Initially, the procedure was used as a method to relieve the spastic lower leg contractures seen in patients with neurological conditions such as cerebral palsy. Today, it has been implemented as a procedure to relieve foot pain in patients with non-spastic isolated gastrocnemius contracture.\(^2\) It is postulated that an isolated gastrocnemius contracture results in limited ankle dorsiflexion at the start of the stride, leading to overloading of the fore and mid foot with weight rather than a normal rocking motion.\(^3\) Recent research implicates this overloading in the development or aggravation of many foot pathologies, including plantar fasciitis, metatarsalgia, hallux valgus, diabetic foot ulcer, posterior tibial tendon insufficiency, and symptomatic adult acquired flatfoot.
According to DiGiovanni et al, isolated gastrocnemius contracture is common, present in “roughly three-quarters” of patients with foot and ankle symptoms, but also in “one-quarter” of the asymptomatic. While most research is focused on adults who have already developed pathologies of the foot, some research in the pediatric population demonstrates that gastrocnemius recession could effectively prevent the progression of foot and ankle structural conditions. In order to determine the presence of an isolated gastrocnemius contracture, the Silfverskiöld test is most commonly used to measure the limitation of range of motion, although there is debate between practitioners as to what range of dorsiflexion with knee extension and flexion actually constitutes a contracture of the gastrocnemius.

Although more orthopedic surgeons are implementing this procedure as a method to alleviate recalcitrant foot pain, there has been little literature or research to support its use. While anecdotal experience and case study literature shows the potential for this procedure, a systemic review of the present literature would help to better establish if this procedure is effective in relieving pain and investigate which foot pain pathologies experience the most pain relief.

METHODS

An exhaustive search of available medical literature was conducted using Medline-OVID, CINAHL, and Web of Science using the key words: gastrocnemius and recession. The search was then narrowed to include only English language articles and studies on humans. The bibliographies of the articles were further searched for relevant sources. Articles with primary data evaluating the change in visual analog scale for foot pain treated with gastrocnemius recession were included. Other inclusion criteria included refractory foot pain failing
conservative treatment, adverse events associated with the procedure, and live human (non-cadaver) study participants. Studies were excluded if they only evaluated one type of foot pathology or if the gastrocnemius contracture was caused by a neurological condition. Relevant articles were assessed for quality using the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) method. A search on the National Institutes of Health (NIH) clinical trials website was also conducted.

RESULTS

The initial search identified 132 articles for review, limiting to both English language and human studies. After screening relevant articles for inclusion and exclusion criteria, a total of two articles met inclusion criteria. These articles include two retrospective case series. See Table I. The search of the NIH clinical trials site revealed two trials relating to gastrocnemius recession for foot pain treatment; both are randomized controlled trials (RCT), with one currently recruiting, and the other not yet recruiting study participants.

Maskill et al

This retrospective case series primarily investigated the efficacy of gastrocnemius recession to relieve recalcitrant foot pain along with the secondary outcomes of adverse events and patient satisfaction. The authors looked at procedures performed between June 2002 and June 2005 at the Orthopedics Associates of Michigan Foot and Ankle clinic in Grand Rapids, MI. Patients were eligible if they had an isolated gastrocnemius contracture as determined by a Silfverskiöld test of less than neutral dorsiflexion in knee extension. Conservative treatment had to be attempted for six months, and could include non-steroidal anti-inflammatory drugs (NSAID), orthotics, stretching, and physical therapy. Patients were excluded if they had any
other procedure performed at the time of the gastrocnemius recession, had foot deformities (varus, valgus, cavus, planus), were diabetic patients with non-healing ulcers, or had no intake visual analog scale for post-operative comparison.  

Out of 1175 gastrocnemius recessions performed at the study center over three years, only 29 patients with 34 procedures met criteria and were able to be contacted. Eight patients were unable to be contacted, with one of those known to be deceased. Of the 29 patients, only eight were men. Five patients had bilateral gastrocnemius recessions, while the 24 unilateral procedures were nearly evenly divided, with 11 right and 13 left feet. Preoperative diagnoses were primarily plantar fasciitis, with 25 patients, but also included six patients with metatarsalgia, and three with arch pain. Three patients had suffered prior foot or ankle trauma, including two MVAs and one fall off a horse; five patients had had prior foot or ankle surgery.

All of the gastrocnemius recessions were performed at the musculotendinous junction, with the fascia left open, and skin closed with absorbable sutures and staples. Patients were allowed to bear weight as tolerated, and were placed into a pneumatic walking boot for two weeks. At the 2 week follow-up appointment, patients had their surgical wounds checked, were moved into a shoe from the boot, and were given home exercises for range of motion. Patients were again seen at 12 weeks post-procedure, with an average of 28.1 weeks of total follow-up post-procedure, ranging from 6 to 96 weeks. For this study, patients were contacted by mail and given a postoperative VAS and satisfaction questionnaire to complete. The average follow-up time for these surveys was 19.5 months after the procedure, with a range of 7 to 44 months.

The average preoperative VAS pain score for all diagnoses was 8/10, decreasing to 2/10 after the procedure. Within the plantar fasciitis patients, the average pain decreased from 8.1/10 to 1.9/10. Metatarsalgia had a lower average preoperative pain of 7.5, but did not decrease as
much with a 2.2/10 postoperative rating. Arch pain, which due to the small sample size was deemed insignificant, the pain decreased from 9.3 to 3.3. Patients that still were using pain medication was 27.5%, but only 6.7% patients were using narcotics, of which none were used for pain from this procedure. Patients overall were satisfied with their procedures, with 93.1% both satisfied with their results and would recommend the procedure to a friend. Of the patients who only had the unilateral procedure, 92% would have the procedure performed on the contralateral leg if needed. There were no adverse events noted, including sural nerve injury, wound healing problems, or dissatisfaction from calf weakness or scarring.  

The authors noted that pain relief was only statistically significant for patients diagnosed with plantar fasciitis and metatarsalgia, as there were too few patients with a diagnosis of arch pain to make the data significant. In their discussion, the authors also note that their research is the first to show pain relief through gastrocnemius recession when no foot deformity is present. While they believe that their results were accurate, the authors also note that future studies must include a control group in order to “definitively prove this relationship” between gastrocnemius recession and foot pain relief when no deformity is present.  

Molund et al  

This retrospective case series also looked at the efficacy of gastrocnemius recession for relief of chronic foot pain along with patient satisfaction and adverse event rates. Study participants were detected in the database of the Oslo University Hospital, Ullevål in Oslo, Norway between 2006 and 2011. Patients were eligible if they had a pre-operatively confirmed isolated gastrocnemius and either had a gastrocnemius recession as a single procedure or combined with minor forefoot procedures. In this study, Silfverskiöld’s test was deemed positive
for isolated gastrocnemius contracture if no ankle dorsiflexion past neutral was present with knee extension, but more than 10 degrees was present in knee flexion. Exclusion criteria included any other major procedures performed concurrently, such as hallus valgus correction, midfoot arthrodesis, or any corrective surgery to the mid- or hind-foot. 4

Through the database, 93 patients were found to be eligible and 73 responded to the invitation to participate in the study. The patients that responded were 16 men and 57 women, with a median age at surgery of 50 years (range 18-79) and a median follow-up time at invitation of 45 months (range 7-87). Two independent foot and ankle surgeons reviewed the medical records and divided patients into subgroups based on their diagnoses. The largest subgroup was metatarsalgia, with 28 patients, followed by plantar fasciitis with 18 patients, Achilles tendinopathy with 7, calf pain with 6, and pes planovalgus with 5. Nine patients were classified in the “Other” subgroup. Minor forefoot procedures were performed on 11 feet in 10 patients, and included three corrective osteotomies of the 5th metatarsal, three extirpations of Morton’s neuromas, four hammertoe corrections, and one screw removal. 4

The gastrocnemius recessions were performed using a modified Strayer approach, with a medial longitudinal incision at the level of the gastrocnemius aponeurosis, which was then closed in layers. After wound closure, the ankle was placed in 10 degrees of dorsiflexion while a plaster of Paris cast was applied. Patients were allowed to bear weight as tolerated immediately postoperatively. After two weeks, the cast was removed and cut in half coronally, so that the dorsal portion of the cast could be used as a night splint for the next four weeks. For this study, patients completed a questionnaire that addressed postoperative satisfaction, adverse events, whether patients would have the procedure performed again if they could know the result in
advance, recommendation of the procedure to other patients, and change in plantar flexion power since the surgery. The median time of questionnaire completion after surgery was 45 months.  

In this study, the authors did not calculate the overall result of the VAS score changes, instead keeping the diagnosis subgroups divided; the satisfaction and adverse events rates were reported overall. Based on their analysis, the authors determined that only the results for the plantar fasciitis and metatarsalgia subgroups was statistically significant due to their larger patient numbers. The VAS score for plantar fasciitis decreased from 7.0 (SD 2.3) preoperatively to 1.8 (SD 2.5) postoperatively, while the VAS score change for metatarsalgia was not as great, changing from 5.6 (SD 2.7) preoperatively to 2.3 (SD 3.0) postoperatively. The other diagnosis subgroups had reductions in pain, with 5.4 to 2.0 for calf pain, 4.4 to 2.8 for Achilles tendinopathy, 4.3 to 3.6 for pes planovalgus, and 5.0 to 3.3 for “Other”, but these were not statistically significant. Overall, 62% of the patients reported a good or excellent result of the procedure, with 67% stating that they would have the procedure performed again knowing the actual result, and 70% would recommend the procedure to other patients with recalcitrant foot pain. In the plantar fasciitis group, the responses were 78% across the board; in the metatarsalgia group, only 50% of patients reported a good or excellent result, but 61% would have the procedure again and recommend it to other patients. For the other subgroups that were not statistically significant, most of the responses fell in the same range, with over half to three quarters of the respondents indicating positive responses to the questions; the only outliers were the Achilles tendinopathy with 86% would have procedure again and the other group with 87% recommending the procedure to others.  

In this study, the self-reported adverse event rate was 38%. Most commonly, patients reported pain or swelling (12%) and leg cramps (11%). Other adverse events included infection
nerve injury (3%), pulmonary embolism (1%), chronic regional pain syndrome (1%), deep vein thrombosis (1%), and other complications (4%). Plantar flexion power change from before to after the procedure was also self reported in the questionnaire, with 27/73 stating better plantar flexion power, 19/73 noting no difference, 10/73 with reduced but presenting no practical problems, 13/73 reduced, and very reduced 4/73.4

In their discussion, the authors noted the limitations of this study4 as “its retrospective nature, lack of a control group, and the small number of patients in each group.” When compared to other studies, the authors also cannot account for the higher rate of complications, although the rate is 11% when the authors exclude all but what they consider serious adverse events, which are verified through the patient’s medical record. Also, this study is limited in its statistical significance to the plantar fasciitis and metatarsalgia, as these groups had the greater number of patients.4

DISCUSSION

The recent interest in gastrocnemius recession to treat recalcitrant foot pain has led to the orthopedic research community laying the groundwork with literature to support further research. Biomechanical and computer modeling studies6,13 have supported the theory of gastrocnemius recession to relieve isolated gastrocnemius contracture and its related foot and ankle pathologies; now surgeons are publishing case studies in order to show the potential for patient application of this theory. As this review shows, there is great potential for gastrocnemius recession as a treatment for refractory plantar fasciitis, as pain relief and patient satisfaction were significant in both studies. Therefore, gastrocnemius recession should be considered for patients with at least a six-month history of refractory foot pain due to plantar fasciitis. As for other foot pathologies,
the use of gastrocnemius recession did not result in as much pain relief and patients were less satisfied, so the procedure should only be used to prevent the progression to significant debility, such as ADL limitation or mobility device use. The incidence of adverse events was not significant enough to outweigh the potential for patient benefit. These recommendations cannot be strongly supported based on the current literature, but studies such as these, though weak on the GRADE scale are the foundation for upcoming research to validate gastrocnemius recession for foot pain treatment. For example, an upcoming RCT out of Oslo University Hospital lead by Molund looks to establish the efficacy of the procedure for chronic plantar fasciitis. The ability to conduct future studies relies on the information collected through case studies such as those evaluated in this study, even though they contain serious weaknesses.

The largest variation in the data between the studies was seen in adverse event reporting. As noted by Sammarco et al, the significant adverse events for this procedure are sural nerve injury, skin issues, and weakness. In the Maskill et al, no adverse events were noted in the chart. The self reported adverse event rate of 38% in Molund et al seems alarmingly high, though when the authors reviewed the charts of those reporting these events, they only found about 11% of them qualified as significant postoperative complications, with the remainder being subjective complaints such as pain and swelling. The discrepancy between these complication rates could be a result of differing techniques and experience of the surgeons. Although the postoperative protocols between the studies differed, the extent of the follow-up in each of the studies and the focus on longer-term outcomes makes this asymmetry less significant. It is interesting to consider: Molund et al included pain and swelling as an adverse event of the procedure, although in the context of a surgical procedure, it would be expected to be present in all patients.
Given that gastrocnemius recession has only been recently used to treat larger numbers of foot pain patients, there is a lack of standardized and validated methods to assess the outcomes of the procedure. While Maskill et al\textsuperscript{2} and Molund et al\textsuperscript{4} used similar satisfaction surveys which can be easily compared, these surveys have not been validated for their reliability and accuracy.\textsuperscript{5} Other investigations into gastrocnemius recession have used validated functional outcome surveys, such as the Foot Function Index\textsuperscript{15} and SF-36,\textsuperscript{16} that have been extensively studied in assessing patients.\textsuperscript{5,10} The use of validated outcome measurements would increase the strength of evidence, especially when comparing results within and between studies.

As the study designs as very similar, the limitations of Maskill et al\textsuperscript{2} and Molund et al\textsuperscript{4} mirror each other in introducing potential bias and imprecision. Firstly, the lack of a control group limits the ability to measure the true magnitude of effect. Also, the lack of blinding of the participants and the investigators, while intentional in the design of both studies, allows for potential performance bias. Moreover, the lack of blinding of the preoperative VAS score, postoperative VAS score, and satisfaction survey introduce the potential for detection bias. As a retrospective study, the preoperative VAS score would not have been able to be blinded, but the postoperative results could have been more objective if the patients were assured their results would not be seen by the surgeons who performed their procedure. Additionally, attrition bias is inevitable with a retrospective study, as all eligible patients may not be able to be contacted years after their procedure. Although Maskill et al\textsuperscript{2} and Molund et al\textsuperscript{4} did not include the data from the patients who did not respond to be included in their studies, it is possible that those patients that were otherwise eligible could have provided important information that could have changed the data. Finally, imprecision is introduced into both studies with their relatively small sample sizes, and is increased through division of the participants into subgroups. These multiple
potential sources of bias in both these studies introduce serious limitations, which downgrade the quality of evidence supporting all the results to very low quality based on the GRADE system.\textsuperscript{11}

Across the studies, the evidence to support using gastrocnemius recession for treating recalcitrant foot pain is of very low quality. Based solely on these studies, gastrocnemius recession cannot be supported as a therapy for treating unresponsive, chronic foot pain. However, these studies are significant in providing a foundation on which proposals for higher quality studies can be written and subsequently funded. In fact, one of the RCTs found in the clinical trials search\textsuperscript{12} is being headed by Molund, and the funding of this trial was likely supported by the case studies of Molund et al\textsuperscript{4} and Maskill et al.\textsuperscript{2} Larger sample sizes of more prognostically balanced patients also would help discern the true impact of the procedure on foot pain. An additional point of interest would be to recruit patients with more foot pain diagnoses other than the preponderance of plantar fasciitis and metatarsalgia seen in these studies. With this procedure’s potential to prevent a lifetime of foot pain and possible resulting deformity, it would be especially interesting to investigate the long-term effects on children with foot pain.

CONCLUSION

Although the quality of the current evidence demonstrating the efficacy of gastrocnemius recession is very low according the GRADE method, the trends seen in the data from the studies overall support the need for further higher quality research into the subject. The potential of gastrocnemius recession to help with multiple foot pain pathologies, both as an isolated and a combined procedure, is promising especially since conservative treatments can be ineffective for some patients. While there is still a need for surgeons to have more evidence to strongly recommend this procedure for recalcitrant foot pain, it may prove to be an acceptable option
depending on the characteristics and goals of the patient. With the current evidence, patients
with recalcitrant foot pain, especially from plantar fasciitis, should be considered for
gastrocnemius recession after treatment failure if they would otherwise face the long-term costs
of pain and disability.
References


Table I. Characteristics of Reviewed Studies

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<th>No. of Studies</th>
<th>Design</th>
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<th>Imprecision</th>
<th>Inconsistency</th>
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<th>Importance</th>
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<td>No serious indirectness</td>
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<td>Adverse Events</td>
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<td>No serious inconsistencies</td>
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<td>Very low</td>
<td>Important</td>
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* lack of control group, † small sample size
## Table II. Summary of Findings

<table>
<thead>
<tr>
<th>Study</th>
<th>Number of Patients</th>
<th>Pain Reduction (VAS Score Decrease)</th>
<th>Satisfaction with Result</th>
<th>Adverse Events Rate</th>
<th>Plantarflexion Power Reduction</th>
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<td>0%</td>
<td>N/A</td>
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<tr>
<td>Molund et al</td>
<td>73</td>
<td>5.2/3.3²</td>
<td>62%</td>
<td>38%/11%⁴</td>
<td>22%</td>
</tr>
</tbody>
</table>

¹Plantar Fasciitis subgroup, ²Metatarsalgia subgroup, ³Self-Reported Adverse Events, ⁴“Serious” Adverse Events, determined by investigators