

# Idiopathic Toe Walking: Retrospective Cohort Study Demonstrates Gastrocs/Soleus/Achilles Surgery Results in Greatest Improvement in ROM and Greatest Resolution of Toe Walking

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INTRODUCTION:

The treatment for idiopathic toe walking remains controversial. Prior studies have typically included patients with multiple diagnoses including neurologic conditions, and without mid- to long-term follow up.

The natural history of toe walking is resolution within the first decade of life for most patients, with only a minority of children requiring treatment. Techniques such as stretching, physical therapy, and rigid inserts have not been shown to alter the natural history. There is moderate evidence for the use of casting and surgery in the treatment of toe walking. The primary aim of this study was to determine what proportion of toe walking patients treated with casting, surgery and conservative management (which includes physical therapy, orthotics, and observation) had resolved toe-walking at a minimum of 6 months posttreatment. Subanalysis was based on presence of pretreatment contracture (groups: < 0 degrees, 0 - 10 degrees, > 10 degrees). The secondary aim was to determine the degree of improvement in ankle dorsiflexion (with knee extended) at final follow up compared to pretreatment.

## METHODS:

Idiopathic toe walkers who underwent treatment or observation at our tertiary care hospital between January 2020 and January 2021 were identified via CPT billing and ICD-10 diagnosis codes. Patients were 4.5-11 years at time of treatment/observation. Patients with cerebral palsy, autism, muscular dystrophy, or other neuromuscular conditions were excluded, as were patients with less than 6 months of follow up. Resolution was defined as the parent or treating orthopaedic surgeon explicitly noting that the patient was no longer toe walking. Patients were categorized by contracture per treated extremity: < 0 degrees (n = 56), 0 - 10 degrees (n = 100), and > 10 degrees (n = 16). Treatment arms included conservative management with observation (+/- PT/orthotics), serial casting (with on-average 6 weeks of dorsiflexion walking casts changed every 2 weeks), and gastrocnemius recession, gastrocnemius/soleus recession, or Achilles lengthening with 4-6 weeks of walking casts. Post-casting or post-surgical use of night splints or daytime AFOs was at the surgeon's discretion. Descriptive statistics and t-tests were conducted with the level of significance set at  $p < 0.05$ .

## RESULTS:

Patient characteristics (Table 1) and treatment outcomes (Table 2) are reported. The mean follow-up time was  $2.0 \pm 1.3$  years. Observation (+/- PT/orthotics) resulted in poor resolution of toe walking. Toe walking resolved for none of the extremities in the < 0 degrees group, 2/32 (6%) in the 0 - 10 degrees group, and 2/12 (17%) in the > 10 degrees group. Casting resulted in resolution of toe walking for 11/19 (58%) extremities in the < 0 degrees group, 25/59 (42%) in the 0-10 degrees group, and 2/4 (50%) in the > 10 degrees group. Surgery led to resolution of toe walking for 30/35 (86%) limbs in the < 0 degrees group and 7/9 (78%) limbs in the 0 - 10 degrees group. No one in the > 10 degrees group was treated with surgery.

For toe walking patients with pre-treatment ankle dorsiflexion of < 0 degrees (n=56), no limbs (0/2) treated with observation (+/- PT/orthotics) had resolved toe walking, 11/19 (58%) limbs treated with casting resolved, and 30/35 (86%) limbs treated with surgery resolved.

For toe walking patients with pretreatment ankle dorsiflexion of 0-10 degrees (n=100), 2/32 (6%) limbs treated with observation (+/- PT/orthotics) resolved, 25/59 (42%) limbs treated with casting resolved, and 7/9 (78%) limbs treated with surgery resolved.

For toe walking patients with pretreatment ankle dorsiflexion of > 10 degrees (n=16), there was resolution of toe walking for 2/12 (17%) limbs treated with observation (+/- PT/orthotics) and 2/4 (50%) limbs treated with casting. Surgery was not used for any patients with pretreatment ankle dorsiflexion of > 10 degrees.

For patients treated with observation (+/- PT/orthotics), range of motion significantly worsened over time ( $-2.0 \pm 6.5$ ,  $p < 0.001$ ). Ankle dorsiflexion was significantly improved after treatment with casting ( $9.0 \pm 9.0$ ,  $p = 0.017$ ) and surgery ( $19.7 \pm 11.4$ ,  $p = 0.002$ ).

## DISCUSSION AND CONCLUSION:

Surgery resulted in the greatest proportion of resolved toe walking for patients with mild contractures (0 - 10 degrees dorsiflexion) and severe contractures (dorsiflexion < 0 degrees). Patients without contracture were not treated with surgery. Surgical treatment resulted in the greatest pre- to posttreatment range of motion improvement compared to casting and observation (+/-PT/orthotics), with approximately 10 degrees greater improvement than casting and 20 degrees greater improvement than observation. Observation (+/-PT/orthotics) rarely resulted in toe walking resolution, and range of motion worsened with time. For patients with persistent idiopathic toe walking and contracture, surgery should be considered as the first line treatment.

Overall cohort	Cohort subcategorized by pre-treatment ankle dorsiflexion		
	< 0 degrees	0 – 10 degrees	> 10 degrees
Pre-treatment ankle dorsiflexion			
Patient count (n)	82	27	8
Lower extremities (n)	172	56	16
Female sex (n, %)	32 (44%)	12 (44%)	4 (50%)
Mean age at presentation (years)	6.1 ± 2.6	7.2 ± 2.5	5.9 ± 2.4
Mean follow up time (years)	2.0 ± 1.3	1.9 ± 1.3	1.8 ± 1.2

Table 1: Patient characteristics

Pre-treatment ankle dorsiflexion groups	Cohort subcategorized by pre-treatment ankle dorsiflexion		
	< 0 degrees	0 – 10 degrees	> 10 degrees
Patient count (n)	27	47	8
Lower extremities (n)	56	100	16
Management			
Observation +/- PT/orthotics	2 (7%)	32 (68%)	2 (25%)
Resolved	0 (0%)	2 (6%)	2 (25%)
Mean pre-treatment dorsiflexion	-	3.0	15.0 ± 0
Mean post-treatment dorsiflexion	-	3.5 ± 2.1	15.0 ± 0
Mean change in dorsiflexion	-	0.5 ± 2.1	0
p-value	-	0.795	-
He-resolved	2 (100%)	30 (64%)	10 (83%)
Mean pre-treatment dorsiflexion	-10 ± 0	4.0 ± 4.2	21 ± 2.3
Mean post-treatment dorsiflexion	-10	3.7 ± 6.1	12.5 ± 5.4
Mean change in dorsiflexion	0	-0.3 ± 5.7	-8.5 ± 7.1
p-value	-	0.749	0.001*
Onling	22 (81%)	59 (99%)	4 (50%)
Resolved	12 (55%)	23 (42%)	2 (50%)
Mean pre-treatment dorsiflexion	-7.3 ± 7.2	4.4 ± 4.4	30.0 ± 0
Mean post-treatment dorsiflexion	12.7 ± 6.1	10.7 ± 5.8	25.0 ± 0
Mean change in dorsiflexion	20.0 ± 8.9	9.3 ± 7.1	-5.0 ± 0
p-value	< 0.0001*	< 0.0001*	-
He-resolved	8 (42%)	34 (58%)	2 (50%)
Mean pre-treatment dorsiflexion	-9.4 ± 6.8	2.3 ± 2.9	15.0 ± 0
Mean post-treatment dorsiflexion	8.1 ± 2.3	7.2 ± 5.2	10.0 ± 0
Mean change in dorsiflexion	17.5 ± 5.3	4.9 ± 5.7	-
p-value	< 0.0001*	< 0.0001*	-
Suppny	35 (88%)	9 (20%)	0 (0%)
Resolved	30 (86%)	7 (78%)	-
Mean pre-treatment dorsiflexion	-11.4 ± 7.9	0.6 ± 1.0	-
Mean post-treatment dorsiflexion	10.0 ± 6.4	10.0 ± 8.2	-
Mean change in dorsiflexion	21.4 ± 6.5	9.4 ± 7.4	-
p-value	< 0.0001*	0.015*	-
He-resolved	5 (14%)	2 (22%)	-
Mean pre-treatment dorsiflexion	-18 ± 12.0	0 ± 0	-
Mean post-treatment dorsiflexion	10 ± 5.1	10 ± 0	-
Mean change in dorsiflexion	28 ± 7.6	-	-
p-value	0.001*	-	-

Table 2: Treatment outcomes, including resolution rates and ankle dorsiflexion values pre and post treatment.