Radiographic Assessment and Complications of Peroneal Tendon Lengthening in ″Rigid″ Progressive Collapsing Foot Deformity: A Retrospective Cohort Study

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INTRODUCTION: Progressive collapsing foot deformity (PCFD), is typically characterized as flexible or rigid. Rigid PCFD is often treated with hindfoot arthrodesis, causing stiffness and risks future ankle arthritis. The peroneus brevis(PB) is the primary opponent of the posterior tibialis(PT) and can become contracted as the PT weakens with collapse. This restricts inversion and the hindfoot would appear rigid. PB to peroneus longus(PL) transfer has been suggested. PB±PL z-lengthening with lateral column lengthening(LCL) has been used as a joint/motion sparing alternative to avoid arthrodesis. LCL can cause lateral column pain and PB±PL lengthening may help mitigate by decreasing joint reaction forces. This study evaluates the clinical and radiographic outcomes of PB+/-PL lengthening as an adjunct to joint sparing reconstructive procedures using LCL for patients with rigid PCFD.

METHODS: This IRB-approved retrospective cohort study evaluated patients with rigid PCFD who underwent peroneal tendon lengthening as part of flatfoot reconstruction between 2012 and 2021 Inclusion required weight-bearing radiographs pre-operatively and at follow-up visits post-operatively. Exclusions included flexible PCFD, ankle fusion or replacement, cavovarus/equinovarus deformities, or Charcot arthropathy. Radiographic measurements—Meary's angle, calcaneal pitch, talonavicular coverage angle (TNCA), talar head uncoverage, AP talus-first metatarsal angle (TFMA), hindfoot moment arm (HMA), and plantar fascia distance (PFD)—were manually obtained pre-operatively, at 6 months, and at the last follow-up. Complications were classified as minor (e.g., superficial infection, delayed healing, hardware removal) or major (e.g., revision surgery, arthrodesis). Pre- and post-operative lateral foot, sinus tarsi, and subfibular pain were recorded. Descriptive statistics summarized demographics and complications, while intra-class correlation coefficients assessed measurement reliability. Radiographic comparisons between time points used estimated marginal means, with p-values <0.05 considered significant.

RESULTS: A total of 32 patients (34 feet; 18M, 16F) with mean age of 48.4 years (range 13-70) and BMI of 31.9 were analyzed. Mean follow-up was 38.0 ± 3.5 months. Two patients(5.8%) developed superficial infections, one(3.1%) delayed wound healing, and seven(20.6%) hardware pain requiring removal, all with satisfactory pain relief. Post-operatively, the incidence of sinus tarsi and subfibular pain decreased(Figure 1d).One patient with persistent sinus tarsi pain later required subtalar fusion. Importantly, no patients(0/34 feet) had post-operative lateral column pain at the CC joint, cuboid, lateral Tarsometatarsal joints, or 5th metatarsal. Radiographic analysis showed significant improvements at 6 months, including Meary's angle(-5.9°), calcaneal pitch(+4.5°), TNCA(+21.8°), talar head uncoverage(+24.3%), AP TFMA(-12.1°), HMA(-8.0 mm), and PFD(-6.3 mm)(p<0.001). Improvements were maintained at final follow-up without loss of correction.

DISCUSSION AND CONCLUSION: In this retrospective cohort study of 32 patients undergoing PB(+/-PL) lengthening together with LCL for rigid PCFD, as a joint-sparing alternative to arthrodesis, we observed a low complication rate with no cases of post-operative lateral column pain. Additionally, there was a reduced incidence of subfibular and sinus tarsi pain after surgery. Significant improvements were observed in all radiographic measurements at 6 months post-operatively compared to pre-operative imaging, with corrections maintained at the most recent follow-up. These findings underscore the effectiveness of PB(+/-PL) with LCL as an alternative to arthrodesis in reconstruction of rigid PCFD.

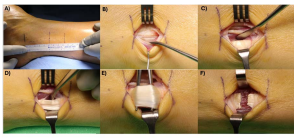

Figure 1: Fractional lengthening of peroneus brevis. A): 3 cm incision placed 5 cm proximal to the tip of the fibula. B) The lateral compartment is entered from the anterior part. C) The peroneus longus is identified and retracted (dorsal to the freer elevator). D) The muscle belly of the peroneus brevis is freed from the peroneus brevis tendon. E) A hemostat is placed under the tendon to prepare for lengthening. F) After fractional lengthening of the tendon is performed a gap of 1 to 1.5 cm remains depending on hindfoot position. Complete release is confirmed with differential motion of the tendon ends.

Figure 1b. Outcome Metrics by Timepoint Comparisons. For all metrics, post-op measurements are significantly better than pre-op. However, 6-months post-op and the last follow-up time, there is no change except one. The exception is calcaneal pitch, where we see an average decrease of -1.30 degrees from 6-month follow-up to last follow-up.

Outcome metric	Timepoints	Difference	Std Error	Adj. p-value
Meary's angle	preop -> 6mo	-5.371	0.852	>0.005
	preop -> last	-5.721	1.048	>0.005
	6mo -> last	-0.350	1.048	0.940
Calcaneal pitch	preop -> 6mo	4.581	0.310	>0.005
	preop -> last	3.283	0.410	>0.005
	6mo -> last	-1.298	0.410	0.006
Talonavicular coverage angle	preop -> 6mo	-20.893	1.774	>0.005
	preop -> last	-21.840	2.399	>0.005
	6mo -> last	-0.947	2.414	1.000
% talar head uncoverage	preop -> 6mo	-0.202	0.022	>0.005
	preop -> last	-0.206	0.029	>0.005
	6mo -> last	-0.004	0.030	0.991
Talus first metatarsal angle on AP	preop -> 6mo	-11.384	1.281	>0.005
	preop -> last	-11.804	1.708	>0.005
	6mo -> last	-0.420	1.718	0.968
Hindfoot moment arm	preop -> 6mo	-7.348	1.309	>0.005
	preop -> last	-8.560	1.486	>0.005
	6mo -> last	-2.152	1.490	0.418
Plantar-fascial distance	preop -> 6mo	-8.081	0.904	>0.005
	preop -> last	-5.868	1.151	>0.005
	6mo -> last	2.213	1.220	0.883

Figure 1c. Concomitant Procedures Performed with Peroneus Brevis Lengthening During Surgical Reconstruction of Rigid PCFD in 32 Patients (34 Feet).

Procedure	Number	Percent of surgeries (%)
Lateral column lengthening	34	100
Cotton osteotomy	26	76.5
Medial displacement calcaneal osteotomy	14	41.2
Lapidus procedure	6	17.6
Talar neck closing wedge osteotomy	2	5.9
Supramalleolar osteotomy	2	5.9
Subtalar arthrodesis	1	3.0

Figure 1d. Location of Pain Before and After Surgery

Location of Pain	Pre-operative (n=34) Number of feet (%)	Post-operative (n=34) Number of feet (%)
Lateral foot (CC, lateral TMT, 5th metatarsal)	1 (2.9)	0 (0.0)
Sinus tarsi	19 (55.9)	4 (11.8)
Subfibular	20 (58.8)	2 (5.9)

Abbreviations: CC, calcaneocuboid; TMT, tarsometatarsal