

# Effect of Modified Lapidus Arthrodesis on Rearfoot Alignment

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## Purpose

A preliminary study performed at our institution by McSpadden et al demonstrated significant changes in rearfoot alignment following Modified Lapidus Arthrodesis on a limited study population (n=14 feet) (12). The purpose of the present study was to build on the study design by McSpadden et al by increasing subject number thus increasing the statistical power for determining the effect of the Modified Lapidus Arthrodesis on rearfoot alignment with both AP and lateral radiographs. Additionally we sought to further determine the outcomes based on foot type.

## Methodology

An IRB approved database search of Allegheny Health Network including The Western Pennsylvania Hospital Foot & Ankle Institute was performed to identify patients who underwent a Modified Lapidus Arthrodesis without concomitant osseous procedures proximal to the metatarsophalangeal joints between 2010 and 2017. Patients excluded were those who underwent revision of a first tarsometatarsal arthrodesis or had any osseous procedures performed proximal to the metatarsophalangeal joints. 27 patients (27 feet) met inclusion criteria and had available preoperative and post-operative radiographs. When available, long-term radiographs were measured. Retrospective chart and radiographic review was performed to measure pre and post-operative angles commonly associated with rearfoot alignment utilizing reference points and angular relationships described by Avino and Lamm on AP and lateral views (2,10). All radiographic measurements were performed by the primary study author using a goniometer (DePuy ACE). Additionally a technique and formula to measure talar head uncovering as previously described by McSpadden et al and shown in Figure 1 was used (12). Subjects were then separated into rectus-foot and flatfoot subgroups to determine if foot type influences the correction achieved. Criteria for Flatfoot inclusion was calcaneal inclination angle <17°, talar declination angle >25°, and lateral talocalcaneal angle >40°. Pre- and postoperative measurements were analyzed using paired Student t-test.

## Literature Review

The Modified Lapidus Arthrodesis has become a reliable procedure for correction of hallux valgus with associated metatarsus primus varus due to both predictability of outcomes and low rate of recurrence (5,9,11). Recent literature has demonstrated improvement in patient outcomes with regards to early weight-bearing (14). Arthrodesis of the first metatarsocuneiform joint was initially described by Albrecht and Truslow for the correction of metatarsus primus varus and later popularized by Lapidus (1,11,18). Bierman confirmed additional benefit of the procedure with stabilization of the foot through mechanical pull of the peroneus longus as previously observed by Catanzariti (3,4). Avino et al demonstrated significant changes in sagittal plane alignment of the medial column following isolated Modified Lapidus on lateral radiographs (2).

Total (n=27)	Preoperative	Postoperative	Mean Difference	P Value*
Calcaneal Inclination Angle	17.37	17.59	0.22	0.6188
Talar Declination Angle	24.0	21.67	-2.33	<.05
Lateral Talocalcaneal Angle	42.63	39	-3.63	<.05
Meary's Angle	6.85	5.37	-1.48	0.0631
Medial Cuneiform Height (mm)	23.85	26.12	2.27	<.05
Medial Cuneiform to Fifth Metatarsal Distance (mm)	11.15	14.37	3.22	<.05
Metatarsal Declination Angle	20.59	19.22	-1.37	0.1670
AP Talocalcaneal Angle	19.74	18.96	-0.78	0.3162
AP Meary's Angle	5.26	6.29	1.03	0.3014
Talar Head Uncoverage (%)	18.73	16.22	-2.51	<.05

Table 1. Results for all subjects

## Results

Twenty-seven patients (27 feet) met inclusion criteria for this retrospective review. Average age was 34.9 (range 14-80). Average follow-up was 6.48 months (range 1-29 months). There were 10 right feet and 17 left feet. Pre- and postoperative measurements are shown above in Table 1. Statistical significance was shown in the following measurements: talar declination decreased by 2.33° from 24.0° to 21.67° (p= <.05). Lateral talocalcaneal angle decreased by 3.63° from 42.63° to 39.0° (p= <.05). Medial cuneiform height increased by 2.27 mm from 23.85 mm to 26.12 mm (p<.05). Medial cuneiform to fifth metatarsal distance increased by 3.22 mm from 11.15 mm to 14.37 mm (p <.05). Talar head uncovering decreased 2.51% from 18.73% to 16.22% (p= <.05). In the rectus-foot subgroup significant changes were seen in talar declination, -2.34° (p<.05), lateral talocalcaneal angle, -4.22° (p<.05), medial cuneiform height, +1.74 (p<.05), medial cuneiform to fifth metatarsal distance, +3.26 (p<.05), and talar head uncovering, -5.49% (p<.05). In the flatfoot subgroup, significant changes were seen in Meary's angle, -4.6°(p= <.05) and AP talocalcaneal angle, -2.4° (p= <.05). There were no correlating significant measurements found in both subgroups.



Figure 1. Technique for calculating pre and post-operative talar head uncoverage. The bisection of the talar neck is drawn with a perpendicular line corresponding to the width of the talar head (w). A second more distal line is drawn from the medial border of the navicular cartilage to the talar bisection. The resultant uncovered width of talar head (u) is divided by w to determine percentage of talar head uncoverage.

Rectus Foot (n=23)	Preoperative	Postoperative	Mean Difference	P Value*
Talar Declination Angle	22.91	20.57	-2.34	<.05
Lateral Talocalcaneal Angle	42.52	38.30	-4.22	<.05
Medial Cuneiform Height (mm)	24.61	26.35	1.74	<.05
Medial Cuneiform to Fifth Metatarsal Distance (mm)	11.17	14.43	3.26	<.05
Talar Head Uncoverage (%)	18.87	16.21	-2.66	<.05
Flat Foot (n=5)	Preoperative	Postoperative	Mean Difference	P Value*
Meary's Angle	13.6	9	-4.6	<.05
AP Talocalcaneal Angle	25.6	23.2	-2.4	<.05

Table 2. Significant results by subgroup

## Discussion

To our knowledge, since the preliminary study by McSpadden et al there have been no published studies on rearfoot angular measurement changes following an isolated Modified Lapidus Arthrodesis. Our findings strengthen the hypothesis and findings of the previous study that an isolated first metatarsocuneiform arthrodesis can significantly alter rearfoot alignment. By nearly doubling the patient population several differences in statistically significant findings were evident. In our study population prior to dividing into rectus and flatfoot subgroups, significant changes were noted with respect to the talar declination angle, lateral talocalcaneal angle, medial cuneiform height, medial cuneiform to fifth metatarsal distance, and talar head uncoverage. These were similar to the findings of the previous study with the exception of Meary's angle which approached statistical significance (p=0.0631) and AP talocalcaneal angle which was not significant with our increased sample size. After dividing into rectus and flatfoot subgroups we did not find any statistically significant findings that correlated between groups. This may be due to our relatively small Flat Foot subgroup, which may in part be explained by the predilection for patients with a symptomatic planus deformity to undergo proximal osseous correction in with or without Lapidus Arthrodesis when indicated. With respect to lateral radiographs, Avino noted significant medial column stabilization with both an increase in medial cuneiform height and Meary's angle. While we did find significant increase in medial cuneiform height in our total patient population, Meary's angle approached but did not achieve statistical significance. Again we did not find significant change with respect to calcaneal inclination or metatarsal declination, strengthening the hypothesis that sagittal correction is obtained through mechanical advantage of peroneus longus. This translates proximally through the fused first tarsometatarsal joint via elongation of the lever arm into dorsiflexion of the talus (3,7). While talar head uncoverage significantly improved in both the total patient population and rectus foot subgroup, we did not find significant improvement in flatfoot subgroup. This invites further study with increased flatfoot subgroup numbers to better determine true benefit of the procedure in patients with pes planovalgus deformity. This is currently under way at our institution. Limitations of our present study include postural changes between pre and postoperative radiographs, variations in surgical technique between surgeons and small sample size of the flatfoot subgroup.



Figure 2. Note the change in Meary's angle as well as lifting of talus in a patient from the flat foot subgroup

## Conclusion

Findings of the present study provide further confirmation of the conclusions from our institution's pilot study that an isolated Modified Lapidus Arthrodesis both stabilizes the medial column and significantly affects the alignment of the rearfoot through the repositioning of the talus. Expansion of the total study population as well as both subgroups within our institution is currently under way to achieve greater statistical significance. If the present findings are further confirmed they may lend guidance to the Foot & Ankle surgeon looking to correct a subtle flexible flatfoot deformity in patients with medial column instability. This in turn could help to potentially avoid imminent rearfoot degenerative changes and the need for later proximal joint destructive procedures.

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