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### Introduction

A pes planus deformity is a pathology relating to the loss of normality of the complex interaction of the bones and joints of the foot resulting in a flattening of the medial longitudinal arch with or without abduction of the midfoot. The distal aspect of the medial longitudinal arch can be a feature of the deformity. The fusion of the 1<sup>st</sup> metatarsophalangeal joint (MTPJ) is one of the most common operations in the treatment of 1<sup>st</sup> MTPJ arthritis. In patients with concomitant pes planus deformity, it is unknown if reducing and stabilising the distal aspect of the medial ray through a 1<sup>st</sup> MTPJ fusion can subsequently improve the pes planus deformity.

#### Objective

A statistically significant improvement between the pre- and post-operative measurements was identified in Meary's angle, calcaneal pitch angle, talo-navicular coverage angle, intermetatarsal angle and talo-navicular angle (Table 1). Significant changes were also noted in the medial cuneiform height and as expected the hallux valgus angle was also significantly decreased post-operatively. Medial cuneiform 1<sup>st</sup> metatarsal angle and talar 1<sup>st</sup> metatarsal angle were not significantly changed.



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Our primary objective was the analyse the pes planus deformity pre and post 1<sup>st</sup> MTPJ fusion with the null hypothesis that there was no difference.

#### **Methods**

Using our electronic database, all operations involving 1<sup>st</sup> MTPJ fusion using our from January 2011 to October 2021 were identified. To meet the inclusion criteria, cases required pre- and post-operative weightbearing plain radiographs, with a Meary's angle of >4 degrees on pre-operative imaging. Routine pes planus measurements were undertaken by 2 independent observers. Pre- and post-operative measurements were underwent normality testing using the Kolmogorov-Smirnov test, and were then ran through a Wilcoxon Signed Rank or Paired T-Test model to assess for significant change. Routine demographic data was also collected. Data was analysed using IBM SPSS v.27.

#### Results

There were 511 operations identified in our database where  $1^{st}$  MTPJ fusion had taken place. Following radiographic analysis, 61 feet met the inclusion criteria. The mean patient age was 61 years (range 27 – 81). There was no pre-operative correlation between Meary's angle and the hallux valgus angle (Kendall's tau p=.470). Pre-operatively, Meary's line broke at the talo-navicular joint in 33 cases, and navicular-cuneiform joint in 25 cases; the remaining 3 cases broke at the tarsal-metatarsal joint.



		95% Confidence Interval		
Parameter Measured	Mean Change	Lower	Upper	P Value
Meary's Angle	-4.22	-3.01	-5.43	< .001
Talo-navicular Coverage Angle	-2.57	-1.49	-3.65	<.001
Talar-1 <sup>st</sup> Metatarsal Angle	-0.11	-2.18	1.96	.825
Intermetatarsal Angle	-3.74	-2.77	-4.70	< .001
Hallux Valgus Angle	-17.45	-14.03	-20.87	< .001
Talo-navicular Angle	2.22	1.13	3.31	<.001
Calcaneal Pitch Angle	1.46	0.85	2.07	<.001
Medial Cuneiform Height (mm)	3.34	2.00	4.68	<.001
Medial Cuneiform-1 <sup>st</sup> Metatarsal Angle	1.07	-0.88	3.01	.182

Image 1 – Weightbearing pre- and post-operative lateral radiographs from one patient demonstrating changes in pes planus measurements.

A post-operative Meary's angle of  $<4^{\circ}$  from neutral was only achieved in 9/61 (14.8%) of cases. Of the remaining 52 cases, the point at which Meary's line broke moved proximally or distally one joint in 7 cases each; it remained at the same joint in 38 cases. Additional forefoot procedures undertaken at the time of surgery are shown in Table 2.

Toes	Straightening	Joint release	Fusion	Amputation	Osteotomy
2nd	4	7	15	1	3
3rd	2	7	8		3
4th	1	1	3		

Table 1 – Table showing mean reduction or increase in flatfoot measurements (significant results depicted in bold)

Table 2 – Additional forefoot procedures completed in the 61 cases included in the study

#### Conclusion

Our results suggest that 1<sup>st</sup> MTPJ fusion improves axial alignment of the foot as well as reducing Meary's angle by a statistically significant amount, although diagnostic criteria for pes planus remained in most cases.

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