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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 1st metatarsophalangeal joint (MTPJ) is one of the most common operations in the treatment of 1st 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 1st 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 1st metatarsal angle and talar 1st metatarsal angle were not significantly changed.



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

Methods

Using our electronic database, all operations involving 1st 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 st 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 st 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 1st 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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