

# Association of Single-plane Non-adjusted and Bi-plane Adjusted First Metatarsal Protrusion Distance to Hallux - Abductovalgus Deformity

John Sessions, DPM, PhD;  
 Frances LaGrone, DPM;   
 Alden Simmons, DPM;  
 Naohiro Shibuya, DPM, MS, FACFAS

## PURPOSE

- It has been hypothesized that a longer 1<sup>st</sup> metatarsal (i.e. Increased Metatarsal Protrusion) experiences a larger portion of forefoot loading, resulting in hallux abductovalgus (HAV) deformity
- This study explores the “Metatarsal Protrusion” theory by applying the definition for HAV deformity found in 6 prior works used to establish this theory, and applying them to radiographs to test if the theory can be validated

## METHODOLOGY

- AP/Lateral radiographs of 100 patients were used
- Non-adjusted** = Metatarsal protrusion was determined from AP view alone
- Bi-plane Adjusted** = Metatarsal protrusion determined by trigonometric calculation from both AP and Lateral views
- Metatarsal protrusion then tested for association with HAV deformity defined by various methods using Student t-test (one tail)

## RESULTS

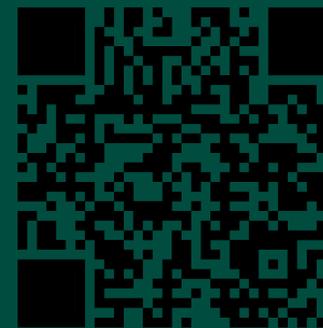
- 6 prior works had attempted to characterize the metatarsal protrusion theory
- We applied each paper's separate definition for HAV deformity to our data
- 4/6 conclusions from prior works matched our data, however p-values in those analyses were ~0.04
- There was no statistical difference between non-adjusted and bi-plane Adjusted data
- Results did not change whether the metatarsal protrusion was derived from non-adjusted or bi-plane adjusted data

## DISCUSSION

- We did not find an association between the metatarsal protrusion and HAV deformity
- Further examination of classical works establishing the metatarsal protrusion theory revealed small sample populations with confounding variables (i.e. rheumatoid arthritis, pediatric-only populations, non-specific measured definitions)



# We could not validate the association between metatarsal protrusion and hallux abductovalgus deformity.



Get the full paper here



# Association of Single-plane Non-adjusted and Bi-plane Adjusted First Metatarsal Protrusion Distance to Hallux - Abductovalgus Deformity

John Sessions, DPM, PhD;  
 Frances LaGrone, DPM;   
 Alden Simmons, DPM;  
 Naohiro Shibuya, DPM, MS, FACFAS

**Table 2:** HAV deformity definitions used in prior MP literature

Study Type	Manuscript	HAV Deformity Definition	
		No Deformity (deg)	HAV Deformity (deg)
Radiographic	D'Arcangelo 2010	HVA: < 24.7	HVA: > 24.7
	Munuera 2008	HVA: < 15	HVA: > 15
	Taranto 2007	HVA: < 20	HVA: > 20
	McCluney 2006	HVA: < 15	HVA: > 15
	Bryant 2000	HVA: 5-15	HVA: > 15
MRI	Rodriguez 2017	HVA: < 15 deg	HVA: > 15 deg

**Table 3:** Sample Size of Non-Deformity/HAV Deformity groups following Parsing of Data Based on Prior Studies HAV Definitions

Study	Sample Size of No Deformity Group		Sample Size of HAV Deformity Group	
	No Deformity	HAV Deformity	No Deformity	HAV Deformity
D'Arcangelo 2010	69	30	30	59
Munuera 2008	40	52	47	59
Taranto 2007	40	37	59	59
McCluney 2006	40	37	59	59
Bryant 2000	37	40	59	59
Rodriguez 2017	40	59	59	59

**Table 4:** Summary of Results

Study Type	Original Study	HAV Deformity Definition cited in Original Study		Original Manuscript Conclusion: is there significant difference between MP for Non-Deformity and HAV Deformity Groups?	Current Study Conclusion	Current Study Agreement with Original Manuscript?	
		No Deformity (deg)	HAV Deformity (deg)				
Radiographic	D'Arcangelo 2010	HVA: < 24.7	HVA: > 24.7	Yes, p-value = <0.001	0.077	0.0581	No
	Munuera 2008	HVA: < 15	HVA: > 15	Yes, p-value = <0.0001	0.040	0.016	Yes
	Taranto 2007	HVA: < 20	HVA: > 20	No, p-value: 0.12 (left), 0.36 (right)	0.117	0.068	Yes
	McCluney 2006	HVA: < 15	HVA: > 15	Yes, p-value = <0.001	0.040	0.016	Yes
	Bryant 2000	HVA: 5-15	HVA: > 15	Yes, p-value = 0.004	0.040	0.012	Yes
MRI	Rodriguez 2017	HVA: < 15	HVA: > 15	No, p-value: 0.89	0.040	0.016	No

**Table 5:** Subject Selection for Specific MP Studies

Study Type	Manuscript	Sample Size (n/Male/Female)	Age Range (yr)	Notes about Subject Selection
Radiographic	D'Arcangelo 2010	(201/74/127)	65-94	- Excludes subjects requiring walking aids - Must have > 7 score on Short Portable Mental Status Questionnaire
	Munuera 2008	(152/30/46)	20-29	- Excludes subjects with history of bone surgery, serious foot injury - Includes bilateral feet from subjects
	Taranto 2007	(45/10/33)	28-82	- Excludes skeletal immaturity, history of foot osseous surgery/trauma/neurologic disorders/walking aids/gait abnormalities/inflammatory disease/hypermobility syndromes
	McCluney 2006	(37/17/20)	9-16	- Excludes subjects with inflammatory bone disorders/soft tissue disorders/previous foot surgery
	Bryant 2000	(60/15/45)	23-74	- Excludes subjects related foot surgery, inflammatory joint disease/syndromes, serious injury in last 12 months
MRI	Rodriguez 2017	(29/0/29)	22-73	- 9 of the subjects with hallux valgus have rheumatoid arthritis - If subject had hallux valgus, largest HVA deformity included
Radiographic	Sessions 2018	(99/34/65)	24-88	- Excludes subjects with history of bone surgery, serious foot injury - Only includes one side per subject