Examination of the Learning Curve Associated with Minimally Invasive Surgery for Hallux Valgus: A Systematic Review

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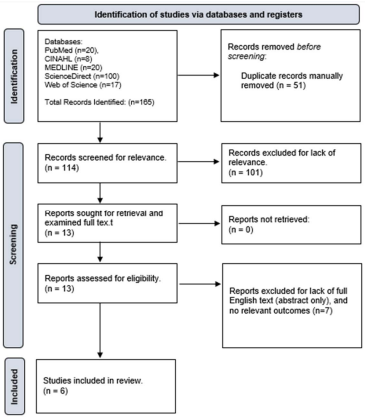
INTRODUCTION: Hallux valgus (HV) is a common orthopaedic foot and ankle condition involving deformity and subsequent pain and dysfunction of the first ray. In recent years, minimally invasive surgery (MIS) has been increasingly used and has been regarded as one of the most innovative surgical interventions for HV. However, limited data exists on the nature of the learning curve associated with MIS for HV and its impact on surgeon training, complication rates, and patient outcomes. The purpose of this systematic review is to examine the learning curve associated with MIS for the treatment of HV.

METHODS: A systematic review was performed using PubMed, ScienceDirect, Web of Science, CINAHL, and MEDLINE databases from database inception to February 16, 2023. Full search terms used in each database was ("Minimally invasive surgery" OR "percutaneous") AND ("hallux valgus" OR "bunion") AND "learning curve." Inclusion criteria was articles with level of evidence I-III, any outcomes associated with learning curve, MIS, and diagnosis of HV in adult patients. Exclusion criteria was articles not examining the learning curve, open surgeries, and no diagnosis of HV.

RESULTS: Six articles out of 165 articles meet inclusion criteria. For all six articles, 368 total patients (422 total feet) were included in the study with an average age of 55.69 years. Three studies reported the number of surgeries needed to reach the plateau phase of the learning curve of MIS for HV, with a frequency weighted mean of 35.5 surgeries (range 27 – 40). In the selected articles, significant results were found for increased OR time and fluoroscopy shots in the learning phase. There was no significant increase in complications in the learning phase. There was no significant decrease in patient outcomes, or the quality of correction performed during the learning phase.

DISCUSSION AND CONCLUSION: An average of 35.5 surgeries (range 27 – 40) are needed to reach the plateau phase for MIS for HV. The learning phase of the learning curve of MIS for HV has a significant increase in OR time and fluoroscopy usage. However, the learning phase of the learning curve of MIS for HV is not associated with decreased outcomes or higher complication rates.



Number	Author (Year)	Group	N (Patients)	N (Feet)	Age (Years)	Number of Surgeries until Learning Curve	First Group of Fluoroscopy Shots During Surgery (Shots)	Last Group of Fluoroscopy Shots During Surgery (Shots)	Mean Fluoroscopy Taken (Shots)	Mean OR Time (Min)
1	Palmanovich (2020)	One Group	50	50	53 (range17-81)	27	240 (one patient)	238 (one patient)	44 (one patient)	67 (one patient)	111 (range 30-250)	66 (range 34 to 185)
2A	Ghiotti (2021)	Group 1- First 30 feet	21	30	55.43 (range 27-83)	-	52.46 (range 40-75)	-	-	-	-	-
2B	Ghiotti (2021)	Group 2- Last 30 feet	25	30	52.5 (range 28-74)	-	40.23 (range 30 - 50)	-	-	-	-	-
3	Neufeld (2021)	One Group	94	98	56.6 (range 15-84)	-	-	-	-	-	-	-
4A	Jovett (2017)	Group 1- First 53 cases	36	53	56 (SD 13.1)	-	-	-	-	-	-	-
4B	Jovett (2017)	Group 2- Last 53 cases	42	53	54 (SD 13.5)	-	-	-	-	-	-	-
5	Lewis (2023)	One Group	53	58	57.5 (SD 13.4)	39	121.6 (SD 21.6) for learning period	-	102.9 (SD 29.2) for plateau period	-	111.7 (SD 27.3)	62.6 (SD 16.9)
6	Toepfer (2022)	One Group	47	50	57.4 (range 25-78)	40	58.8 (average of first 10 patients)	168.9 (average of first 10)	35.1 (average of last 10)	81.1 (average of last 10)	126.6 (SD 40.8, range 65-231)	46.8 (SD 12.1, range 31-90)

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2	Lewis (2023)	53	58	57.5 (SD 13.4)	39	111.7 (SD 27.3)	62.6 (SD 16.9)
3	Toepfer (2022)	47	50	57.4 (range 25-78)	40	126.6 (SD 40.8, range 65-231)	46.8 (SD 12.1, range 31-90)
					35.5	116.2	58.7