

Juvenile Bunion Deformities: Success vs Recurrence Rates Using a Distal vs Shaft vs Proximal Surgical Approach

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Introduction:

Hallux valgus is a triplanar deformity which involves medial deviation of the first metatarsal, lateral deviation of the hallux, as well as elevation and valgus rotation of the first ray. In literature, the prevalence of this deformities in the pediatric population averages at approximately 36% of the population. There is an abundance of available literature which supports good and excellent outcomes of surgical intervention at the metatarsal head, shaft, and base for the correction of hallux valgus in adults. Yet, when utilizing the same surgical techniques in the pediatric population, outcomes are largely unsatisfactory due to the high rate of recurrence. According to a study from the Journal of Children's Orthopaedics, juvenile bunion surgery has reported recurrence rates as high as 61%.¹³ Additionally, the presence of an open growth plate in adolescents makes the time to intervention and surgical planning more challenging. The goal of this study is to compare the post-operative outcomes of metatarsal head, shaft and base procedures to identify the optimal technique in management of adolescent bunion deformity. This study compares the use of osteotomies, arthrodesis, and the hemiepiphyodesis for management of the juvenile bunion. As there are many complications that can be seen in bunion surgery, the focus of this study was evaluating the rate of recurrence and symptomatic undercorrection.

Methods:

Search Strategy:

- Relevant publications were identified by electronically searching the PUBMED database in April 2019.
- Studies were identified using the keywords "juvenile", "hallux valgus", and "bunion."
- Articles were reviewed for inclusion/ exclusion by the authors of this study.

Inclusion Criteria:

- Studies evaluating surgical treatment options for Juvenile Hallux Valgus.
- Studies documenting pre-operative radiographic angles, post-operative radiographic angles, complications and recurrence of deformity.
- Articles published in a peer review journal limited to publication in the last 30 years
- Articles published in English language

Exclusion Criteria:

- Studies evaluating patients over the age of 20 at the time of surgery.
- Case Studies
- Studies with less than three months follow-up
- Studies evaluating conservative management of juvenile hallux valgus.
- Studies that did not document recurrence or symptomatic undercorrection as a complication.

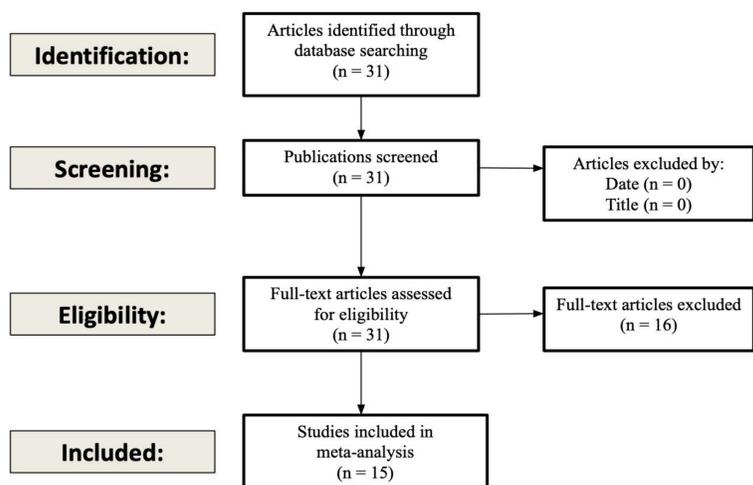


Figure 1: Diagram of article selection process.

Author (Year)	Avg Pre-Op IM angle	Avg Post-Op IM angle	Avg Pre-Op HV angle	Avg Post-Op HV angle
Ilker Abdullah Sarikaya (2018)	13	8	31	8
James Aronson (2001)	13.8	6	34	16
Younis A Tahab (2003)	19	9	41	17
Michael J. Coughlin (1995)	12.2	4.8	27.8	10
Michael J. Coughlin (1995)	12.2	2.3	27.8	8.3
Michael J. Coughlin (1995)	12.2	8.3	27.8	22.9
Allen J. Selner (1992)	15.1	6.5	27.7	15.5
T. Gicquel (2013)	13.61	12.74	28.06	19.45
Eric W. Edmonds (2015)	13.0	10.2	31.2	11.6
Total Average Angle	14.24	7.54	31.54	14.31

Author (Year)	Average Pre-Op IM angle	Avg Post-Op IM angle	Avg Pre-Op HA angle	Avg Post-Op HA angle
Yuvraj Agrawal (2015)	11.4	6.7	26.1	11.6
Shine John (2010)	14.29	5.64	27.43	12.79
Total Average Angle	12.85	6.175	26.77	12.2

Author (Year)	Average Pre-Op IM angle	Avg Post-Op IM angle	Avg Pre-Op HA angle	Avg Post-Op HA angle
Michael J. Coughlin (1995)	12.2	8.4	27.8	23.1
David Grace (1999)	13.3	7.9	N/A	N/A
Eric W. Edmonds (2015)	15.3	9.0	32.6	19.0
Total Average Angle	13.6	8.43	30.2	21.05

Author (Year)	Average Pre-Op IM angle	Avg Post-Op IM angle	Avg Pre-Op HA angle	Avg Post-Op HA angle
Sabah Y. (2018)	13	11	26	22
Jon R. Davids (2007)	15.45	13.13	34.64	31.18
C. Schlickewei (2018)	14.1	10.5	26.5	20.2
Total Average Angle	14.18	11.54	29.05	24.46

Tables: These tables were generated via literature review demonstrating type of procedure, follow up time, success rate, recurrence rate, and average pre and post op angles of correction

Results:

- A total of 259 patients and 385 limbs were included in this review, of whom underwent either a metatarsal head, shaft, base or hemiepiphyodesis procedure for correction of hallux valgus.
- 122 patients consisting of 175 limbs were underwent a distal metatarsal osteotomy approach for correction of juvenile hallux valgus. Average overall complication rates post-operatively were 12.6%. However, this number includes a percutaneous approach study that alone had 10 complications out of 22. With exclusion of the single percutaneous study, the overall complication rate of distal metatarsal osteotomy for correction of juvenile hallux valgus is improved to 8.45%. Average IM angle correction was 6.7 degrees.
- 36 patients consisting of 61 limbs underwent a shaft metatarsal osteotomy for correction of juvenile hallux valgus. Average overall complication rates post-operatively were 24.6%. Average IM angle correction was 6.67 degrees.
- 60 patients consisting of 77 total limbs underwent a proximal metatarsal shaft osteotomy for correction of juvenile hallux valgus. Average overall complication rates post-operatively were 6.5%. Average IM angle correction was 5.17 degrees.
- 41 patients consisting of 72 total limbs underwent a first metatarsal lateral hemiepiphyodesis for correction of juvenile hallux valgus. Average overall complication rates were noted to be 2.78%. Average IM angle correction was 2.64 degrees.



Figures 1A, B, C, and E: Angles measured and correct screw positioning, these images were taken from Schlickewei et al. 2018. (A) HAV angle (B) IM angle (C) Proximal metatarsal articular angle (D) Metatarsal length ratio

Figures 2A and 2B: pre-operative and postoperative radiograph of screw fixation for lateral hemiepiphyodesis from Schlickewei et al. 2018.

Author (Year)	Name of surgery	Mean Follow Up Time	Overall Success Rate	Recurrence/Complications
Ilker Abdullah Sarikaya (2018)	Hohman	36 months	96%	1
James Aronson (2001)	Modified Peterson	23.4 months	83%	3
Younis A Tahab (2003)	Modified Mitchell	5-14 years	100	0
Michael J. Coughlin (1995)	McBride	60 months	50%	2
Michael J. Coughlin (1995)	Chevron	60 months	75%	4
Michael J. Coughlin (1995)	Chevron+Akin	60 months	100%	0
Allen J. Selner (1992)	Transverse V-Osteotomy	28.5	100%	0
T. Gicquel (2013)	(Percutaneous) Reverdin Isham	30 months	69.7%	10
Eric W. Edmonds	Distal Osteotomy	13.5 months	91.7%	2

Author (Year)	Name of Surgery	Mean Follow Up	Overall Success Rate (%)	Recurrence/Complications
Yuvraj Agrawal (2015)	Scarff+Akin	32 months	70.2%	10 (14 limbs)
Shine John (2010)	Scarff	57 months	92.9%	1

Author (Year)	Name of Surgery	Mean Follow Up	Overall Success Rate (%)	Recurrence/Complications
Michael J. Coughlin (1995)	Proximal 1st Metatarsal Osteotomy	60 months	100 %	0
David Grace (1999)	Lapidus	61 months	91.3 % (21/23)	2
Eric W. Edmonds (2015)	Proximal Osteotomy	15.3 months	78.6 %	3

Author (Year)	Name of Surgery	Mean Follow Up	Overall Success Rate (%)	Recurrence/Complications
Sabah Y. (2018)	Lateral Hemiepiphyodesis	3.5 years	100 %	0
Jon R. Davids (2007)	Lateral Hemiepiphyodesis	4 years and 2 months	100 % (although 2/7 patients felt no difference in cosmesis)	0
C. Schlickewei (2018)	Lateral Hemiepiphyodesis	27.8 months	93.9 %	2

Discussion:

- The epiphysiodesis is a unique approach for correction of juvenile hallux valgus which demonstrated the least recurrence and symptomatic undercorrection at 2.78%. However, overall correction may be limited when considering moderate to severe deformities as the correction of IM angle was only on average 2.64 degrees. This surgical technique is additionally less commonly utilized due to the steep learning curve of the procedure.
- Although the distal metatarsal osteotomy seemed to be the preferred surgical option with the largest patient population in literature review, this procedure had an undercorrection and recurrence rate as high as 12.6%.
- While the head osteotomy has the added benefits of preserving the open growth plate and requires less aggressive soft tissue dissection, consideration of alternative surgical intervention with less risk of recurrence may be warranted.
- Overall, when approaching a juvenile bunion deformity, exhaust all conservative treatment options first, especially when the growth plate remains open. When all else fails, only operate surgically if the deformity is symptomatic.
- In our review of literature, the proximal metatarsal osteotomy and first tarsometatarsal joint arthrodesis had adequate outcomes in a smaller patient population with a recurrence and symptomatic undercorrection rate of 6.5%. The authors of this study recommend careful planning to the time of surgical intervention when considering proximal metatarsal osteotomies and encourage consideration of proximal metatarsal surgery only once patients have reached skeletal maturity.

Conclusion:

The lateral hemiepiphyodesis for surgical correction of juvenile hallux valgus demonstrates the lowest rate of recurrence and symptomatic undercorrection post-operatively, however, this procedure only achieves a small degree of IM angle correction which may limit its application to only mild and moderate bunion deformities. The distal metatarsal osteotomy is generally considered the safest option when surgically managing patients with an open physis, although it had higher rate of recurrence and undercorrection than anticipated. The proximal metatarsal procedures, which included the TMTJ arthrodesis showed a lower rate of recurrence than distal intervention, although surgical intervention at proximal metatarsal should only be considered after patient has achieved physeal closure.

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