



Lateral column lengthening for adolescent idiopathic pes planovalgus deformity – Systematic review



Sanjay Kumar^{a,*}, S.V. Sonanis^b

^a Department of Orthopaedics, Luton & Dunstable Hospital NHS Foundation Trust, Lewsey Rd, Luton LU4 0DZ, United Kingdom

^b Department of Orthopaedics, Hywel Dda University Health Board, Caradoc Road, Aberystwyth SY23 1ER, United Kingdom

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ABSTRACT

Pes planovalgus is the commonest foot deformity in children and presents with wide range of severity and symptoms. Surgery is mostly indicated for significant malalignment, resistant to non-surgical management. Lateral column lengthening is considered an appealing option as does not involve arthrodesis and allows for further growth and foot development.

Methods: We conducted a systematic review on lateral column lengthening for pes planovalgus deformity in line with PRISMA-P Checklist. We carried out detailed literature search on PubMed, Cochrane, EMBASE, CINAHL, Google Scholar and Bibliographies. We analysed selected studies for patient demographics, radiological, clinical outcome and complications.

Results: We identified seven studies with 103 patients involving 156 feet. The mean age was 13.3 years (Range 5.7–42) and mean follow up was 70.2 Months (Range 24.9–156). There was statistical significant improvement in Calcaneal pitch, Lateral Talo-metatarsal and AP Talo-navicular angles (p-value 0.001). The mean preoperative AOFAS Score (71 Feet) was 58.85 (Range 34–78) and mean postoperative AOFAS Score (91 Feet) was 92.25 (Range 73–100). Two studies (32 Feet) used author specified criteria has reported Good/Excellent result in 72% (23/32 feet) and Fair/Poor result in 18% (9/32) feet. Complications were reported in 17.5% (18/103) included nerve related, pseudo arthrosis, non-union and metal related complications.

Conclusion: Surgical intervention with lateral column lengthening has good radiological and clinical outcome with high patient satisfaction and acceptable complications. The literature is mostly retrospective and there is need for prospective, multi-centre studies using patient centred validated outcome measure.

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1. Introduction

Pes planovalgus is one of the commonest foot deformities seen in paediatric orthopaedic practice. The prevalence of flat feet was 2.7% in a study² on 1181 children between ages of 4–13 years. Pfeiffer et al.³ reported that the prevalence decreases with age. In a group of 3 year old children the prevalence was 54%, whereas 6 year old children only 24%. The prevalence of pathological flat foot was less than one percent.³ Most children presenting with flat foot have flexible arches and does not require any intervention. Rigid and pathological flat foot should be differentiated as

associated with other conditions such as congenital vertical talus, tarsal coalition, and skew foot.⁴

There is no consensus to the effectiveness of non-surgical or surgical management for flexible pes planus in children and young adults. Biomechanically, pes planovalgus is complex and involves three dimensional deformities. Surgical treatment is aimed at relieving patient's symptoms by realigning the foot.

Surgical treatment is rarely indicated and reserved for patients, who have persistent localised symptoms despite conservative treatment.⁵ There are several approaches to operative management and surgical reconstruction is usually individualised. The preservation of joint and open physis should be always considered in children and adolescent. Lateral column lengthening as described by Evans⁶ and modified by Mosca⁷ remains most appealing option in children as it allows further growth and does not involve arthrodesis. It corrects the hind foot as well as midfoot

* Corresponding author.

E-mail address: post.skumar@gmail.com (S. Kumar).

deformity; however this mechanism of correction remains unclear. This technique is based on the concept of three dimensional reorientations and localisation of sustentaculum tali to lift talonavicular joint. The lengthening osteotomy also tightens the peronei tendons and planter aponeurosis to facilitate planter flexion of first ray.

Evans⁶ felt that this technique was contraindicated in neurological disorders such as cerebral palsy (CP) and spina bifida, where the graft was predisposed to be sunk into the main fragment because of poor quality of bone. He also felt that there was tendency of over-correction in neurological cases. This technique has been used successfully in neurological disorders by other authors.^{7,8} Phillips⁹ reported results of patients operated by Evans 7–20 years after operation. Seventeen of the twenty three feet showed improvement when assessed on the criteria of relief of symptoms and clinical appearance, and stood the test of time.

We carried out a systematic review on lateral column lengthening to evaluate the clinical and radiological outcome, complication and re-operation rate in the literature. Our aim was to assess the results of surgery for pes planovalgus in children and young adults. To the best of our knowledge, there is no systematic review in the published literature on this topic.

2. Material and methods

This review was performed in line with PRISMA-P 2015 checklist¹ (Preferred reporting items for systematic review and meta-analysis protocols). The Pubmed, Cochrane, CINAHL, EMBASE, Google Scholar and bibliography of articles was searched for all relevant articles against search criteria. The keywords used for search are summarised in Table 1.

The author performed literature searches on electronic databases with above keywords and reviewed abstracts. The articles meeting the inclusion criteria were reviewed by authors. The inclusion criterion was Randomised Controlled Trials; Prospective or retrospective case studies on the surgery for pes planovalgus deformity. Patient data; radiological; clinical outcome and complications included in the studies. Patient followed for a minimum of 24 months. All studies that did not meet the above criteria were excluded from the review as well as studies not available in English language. Studies with predominant neurological (cerebral palsy) deformity and non-joint preserving procedures like arthrodesis were also excluded from the study.

We collected patient demographic data including number of patients and feet operated, age of patient, follow up duration. Clinical and radiological outcome was documented. For radiological parameters we used talo-metatarsal and calcaneal pitch angle as was most commonly used by most studies. We also recorded underlying pathology, additional procedures, post-operative

management, complications and re-operations. We also noted the number and nature of additional soft tissue procedures.

2.1. Statistical analysis

GraphPad prism 7 (GraphPad Software Inc, San Diego, California Software Version 7) and differences with p-value < 0.05 was considered statistically significant. An independent sample t-test was performed to analyse preoperative and postoperative radiological measurements of calcaneal pitch angle, lateral talo-1stmetatarsal angle and talonavicular coverage angle.

3. Observations and results

The initial search of the literature with the above keywords identified 391 articles. We excluded 286 articles with their titles including duplicates and identified 105 for further evaluation of abstract. Twenty one studies were assessed by reading full text against inclusion criteria and identified seven studies (Table 2).

There were 156 calcaneal lengthening osteotomies performed on 103 patients in these seven studies. The mean age at the time of surgery was 13.3 Yrs. (Range 5.7–42) and mean length of follow up was 70.2 Months (Range 24.9–156). There were 33 females and 29 males of the 62 patients in four studies where information available. The underlying aetiology was Idiopathic in 146 feet, congenital conditions (like uncorrected club foot, skew foot) in 5, polio in 4, tibialis posterior insufficiency in one foot and not specified in 9 feet. Table 3 has demographic information.

3.1. Radiological outcome

Pes planovalgus is complex deformity involving multiple joints and in three dimensions. There were numerous radiological parameters reported and available in four of the seven studies. Calcaneal pitch angle, lateral talo-1stmetatarsal angle, AP Talonavicular coverage angle were most commonly used in the studies therefore were included in the review. Summary of these values is given in Table 4, with further details shown in Table 5.

From these publications as listed above, mean preoperative calcaneal pitch angle was 10.4 (SD ± 4.0, Range 4.4–12.9) and the mean postoperative CP Angle was 21.9 (SD ± 6.2, Range 17.3–31) (p Value = 0.001). The mean preoperative Lateral Talo-1stmetatarsal angle was 19.7 (SD ± 7.0 Range 15.5–27.5) and improved to 5.2 (SD ± 6.4 Range -0.3–13.7) (p Value = 0.001). The mean preoperative AP Talo-navicular coverage angle also improved from 28.4 (SD ± 7.3, Range 21.8–38.6) to 6.0 (SD ± 8.5, Range -3.4–13.7) (p value < 0.0001). We used GraphPad Software to calculate statistical significance using sample t-test.

Normal values are reported variably in the literature. According to Escobedo et al¹⁶, normal calcaneal pitch angle is 18–20°, however range from 17 to 32° is reported as normal in literature. The talo - 1st metatarsal angle greater than 4° and talo-navicular coverage angle greater than 7° are considered abnormal. Measurement is shown in Diagram 1.

3.2. Clinical outcome

Four publications (91 feet) used AOFAS Score¹⁷ for measuring clinical outcome and preoperative scoring was available in three studies. Two publications (32 feet) used author specified criteria and one used ACFAS Score for measuring clinical outcome.

The mean preoperative AOFAS Score¹⁷ was 58.84 (Range 34–78) and mean postoperative AOFAS Score was 92.25 (Range 73–100) as shown in Table 6. Two studies that used author specified criteria has reported Good/Excellent result in 72% (23/32 feet) and Fair/

Table 1
Keyword searches for identifying articles.

Planovalgus surgery	AND	Children
Planovalgus surgery	AND	Paediatric
Planovalgus surgery	AND	Adolescent
Planovalgus surgery	AND	Pediatric
Lateral column lengthening	AND	Children
Lateral column lengthening	AND	Paediatric
Lateral column lengthening	AND	Adolescent
Calcaneal lengthening osteotomy	AND	Children
Calcaneal lengthening osteotomy	AND	Paediatric
Calcaneal lengthening osteotomy	AND	Adolescent
Calcaneal osteotomy	AND	Juvenile
Pes Planovalgus surgery	AND	Paediatric
Flatfoot surgery	AND	Paediatric

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