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## RESEARCH ARTICLE

### IS FLAT FOOT A PREVENTABLE FACTOR IN CHRONIC VENOUS INSUFFICIENCY?

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#### Manuscript Info

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#### Abstract

The presence of a venous pumping mechanism in the foot may be significant for venous return in the lower extremities. The anatomy and physiology of venous foot pump {VFP} is essential of effective interventions for prevention, treatment, and management of venous disease in the lower limbs. Though many studies have identified the risk factors for prevalence of venous disease, only few have investigated for risk factors for venous disease progression. Therefore, the aim of this study was to investigate the relationship of flatfoot and varicose vein and the progression of venous disease. We did a pilot study on 12 patients with bilateral varicose vein with bilateral pes planus where we presume the cause of CVI is secondary to VFP dysfunction.

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#### Introduction:-

Varicose veins of the lower limbs is a peculiarly human condition- attributed to our upright posture. 10-35% of adults have some form of CVD. Venous foot pumps (VFP) play an important role in affecting venous return. Dysfunctions of VFP –related to CVD. We hypothesize VFP dysfunction due to static foot disorders as an etiology of CVD. This can be preventable/ correctable and should be part of the management of CVD. Based on our clinical experience, we present a series of 12 cases with bilateral pes planus and varicose veins.

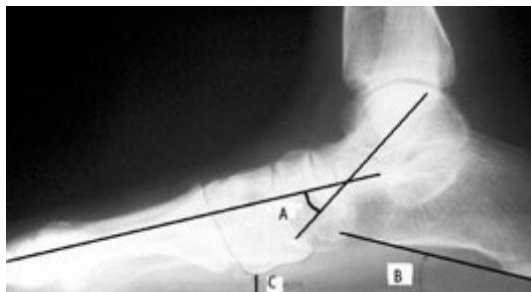
Prior studies have identified several risk factors for chronic venous insufficiency (CVI). These include older age, male sex, Caucasian ethnicity, family history of venous disease, smoking, and obesity. Studies have also reported foot characteristics and ankle mobility to be associated with chronic venous disease. Specifically, in cross-sectional analyses, the presence of flat feet has been associated with varicose veins and chronic venous insufficiency. Uhl et al. reported a positive association between the presence of flat feet and increased severity of CVI. In the San Diego Population Study, and in cross-sectional analyses, flat feet were associated with the presence of trophic changes and deep venous system obstruction in women.

Though many studies have identified the risk factors for prevalence of venous disease, only few have investigated for risk factors for venous disease progression. Therefore, the aim of this study was to investigate the relationship of flatfoot and varicose vein and the progression of venous disease.

#### Methodology:-

A non consecutive case series of 12 patients in total from January 2020 to January 2021 who were doppler proven varicose veins included in this study. Flat foot was evaluated Radiologically using Forefoot-Hindfoot angle, talonavicular coverage angle (Meary's angle) and it was grading according to

Venous duplex was done during rest as well as during combination of movements consisting of alternating plantar flexion/dorsiflexion of toes and foot (X 10 times). Parameters measured are *Mean peak velocity* in Popliteal veins and Posterior tibial veins.

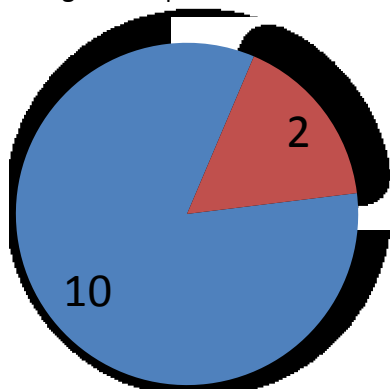


**Fig 1:-** Meary's angle - normal should be around 0 degree

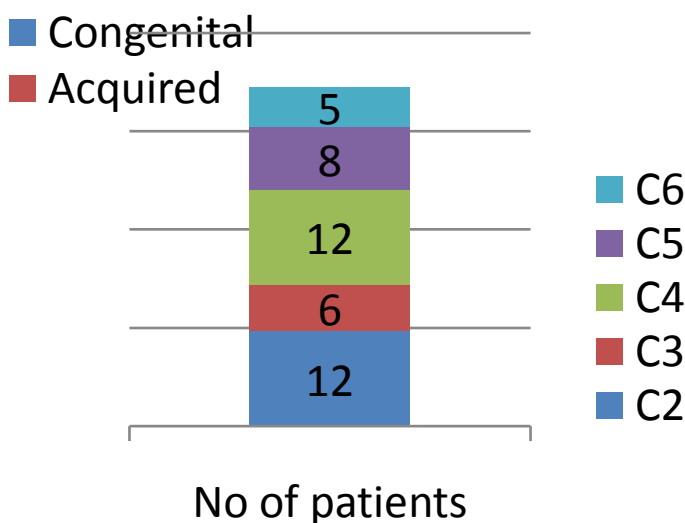


**Fig 2:-** Forefoot - Hindfoot angle

**Fig 3 :-** Pes planus



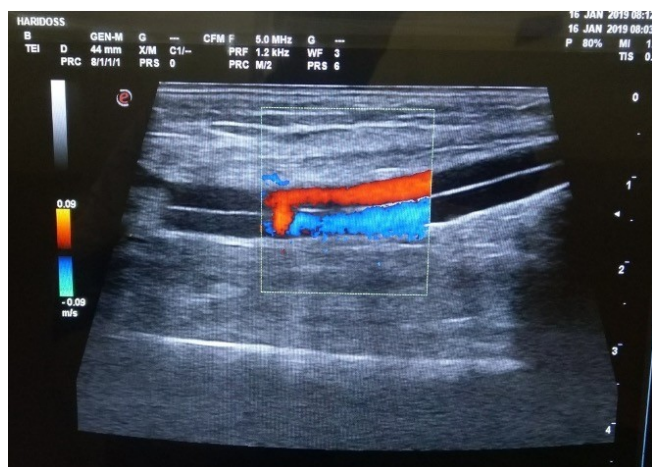
**Fig 4 :-** Patient distribution



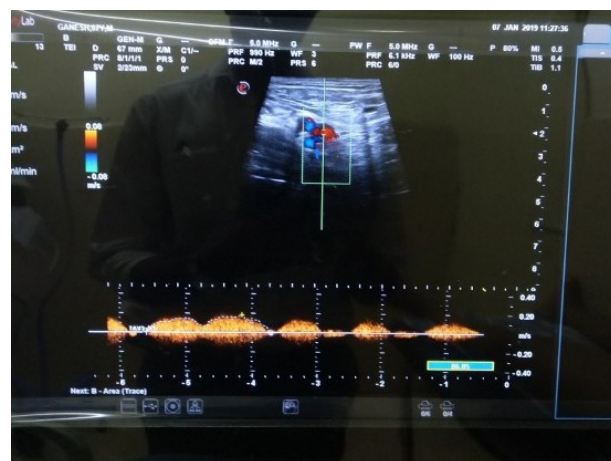
#### Results and Observations:-

Among 12 patients age distribution was between 45-70 years & mean age is 58. Gender distribution was nearly equal [M:F 5:6] . Primary varicose veins with SPJ,SFJ reflux was seen in all but 2 cases. All the patients had gait abnormalities.

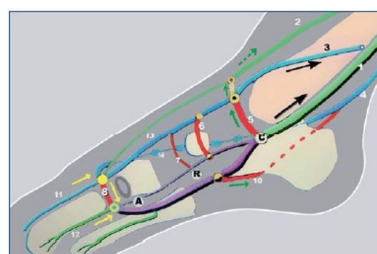
Totally 10 patients had flat foot from childhood itself & 2 patients had trauma to foot after which they had foot deformity. Clinical grading for varicose veins are depicted in Fig 4. Clinically all the patient had advanced disease. We calculated peak systolic velocity in popliteal and posterior veins for all the patients. The mean Peak velocity in Popliteal vein and Posterior tibial veins are very low with 30 cm /sec& 85 cm/sec respectively.



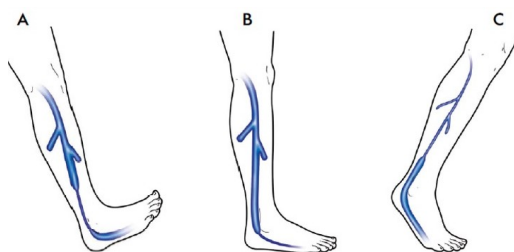
**Fig 5:-** Color Duplex shows venous flow in tibial veins  
- longitudinal view



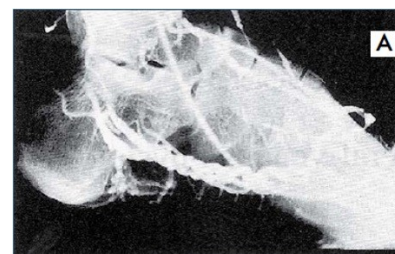
**Fig 6:-** Color Duplex shows PSV in tibial veins



**Fig 7 :-** Anatomy of Foot pump



**Fig 8 :-** Dorsiflexion , weight bearing,  
Plantar flexion leads to distal  
calf,foot,proximal calf pump emptying



**Fig 9 :-** Venography of Foot at Dorsiflexion

### Discussion:-

Pes Planus may be congenital or acquired. PTT (posterior tibial tendon) contraction which causes inversion of the midfoot and elevation of medial longitudinal arch (dynamic stabilizer). PTT action is important for the terminal (push off)/HEEL OFF phase of gait cycle.

Venous drainage of foot includes – Superficial veins of sole, Deep plantar arch/medial and lateral plantar veins, Superficial dorsal plexus, Marginal veins/dorsal arch, Perforating veins ( valveless and bidirectional), 1st metatarsal perforator.

### Important anatomical part of venous pump:

Lateral plantar vein-the bellow of the foot pump

Posterior tibial vein is the default outflow for the foot

Synchronised firing of the three pumps-distal calf/foot/proximal calf are necessary for a smooth forward venous flow.

### Mechanisms:

bowstrings that get compressed on walking , Compression inside muscle layers of sole. VFP acts parallel (independent) to calf pumps.

So any PTT dysfunction impacts these by causing gait disturbances.

### Conclusion:-

VFP dysfunction secondary to flat foot (and other SFD) might play an important role in initiating and sustaining the course of CVD. Malleolar flare might be a surrogate for VFP. This can be addressed by the development of specially

designed footwear with arch support/ compressive stockings with arch support/ mechanical foot pumps/ exercises/surgical correction. We need to investigate if such interventions can delay/prevent CVD in otherwise healthy but at risk populations. Drawback in our studies are very less number of sample size and we don't do any comparative study with patients having normal arch foot and to quantify the venous return in patients having flat foot arch we need further more investigation like plethysmography which would predict much impact of foot arches over venous return and venous disease. We need further more research in this field and should have meaningful outcomes still more.

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