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HALLUX VALGUS IN A HOSPITAL POPULATION IN KENYA.

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H58/79502/2012

A study submitted in partial fulfillment of the requirements for the degree of Masters of Medicine in Orthopedic Surgery, University of Nairobi.

2017

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DEDICATION

This work is dedicated to my parents, Mr. Avtar Singh & Mrs. Gurcharan Kaur Chauhan who encouraged me daily and were patient enough with me as I put in long hours in this study.

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ABBREVIATIONS AND DEFINITION

ACFAS – American College of Foot & Ankle Surgeons

AOFAS – American Orthopedic Foot & Ankle Society

BMI – Body Mass Index

DMAA – Distal Metatarsal Articular Angle

HMIS – Hallux Metatarsophalangeal-Interphalangeal Score

HV – Hallux Valgus

HVA – Hallux Valgus Angle

HVI – Hallux Valgus Interphalangeous Angle

IMA – InterMetatarsal Angle

MTP – Metatarsal

MTPJ – Metatarsophalyngeal Joint

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ABSTRACT

Background

Hallux Valgus is an irreversible foot deformity that's often overlooked by the surgeon and medically unknown to the patient. Despite its abundant mention in literature, prevalence is not known and keeps on varying with every article while it's associations with other foot deformities remains non constant. Being progressive, it's known to lead to pain & impaired gait if not attended to early. No published literature concerning Hallux Valgus exists in our setup.

The purpose of this study was to determine the prevalence of Hallux Valgus in the local population and to evaluate it's severity and associated foot characteristics.

Design

Prospective Cross sectional Study

Setting

PCEA Kikuyu Rehab Hospital Orthopedic out-patient clinics

Patients & Methods

Persons between the ages 18-65 years who met the outlined criteria were recruited on a simple random basis. A questionnaire was given and clinical examination of the foot done to collect data on demographics, etiological parameters (extrinsic (Footwear/BMI) + Intrinsic (Family History/ Shape of foot, Sex, 1st MTPJ characteristics), pes planus and sensory modalities around the joint. Those who clinically demonstrated a HVA >15^{o} qualified for a weight bearing foot radiograph to measure HVA/IMA/ Sesamoid positioning and joint congruency. Meyers angle was calculated to determine presence of Pes Planus.

Data was then analysed using MS Excel and SPSS version 20. Frequency tables were formulated and chi square tests and spearman correlations done on the data together with Relative risk assessment where necessary. P values of 0.05 were considered significant. This was presented in the form of charts, tables and bar graphs.

Results

A prevalence of 26.6% was recorded for persons between 18-65 years. Mild Hallux Valgus was seen in 56.5% with 37.7% and 5.8% having moderate and severe valgus respectively. Females (55.1%) were more affected than males (44.9%), Family history of Valgus was not an association though 35.7% of those with positive history mentioned their mother as the affected person and had higher risk of getting moderate and severe valgus. BMI was inversely related to prevalence and no associations were seen with flat feet or foot wear use. Severity of hallux valgus increased with age with an increasing proportion of people with hallux valgus as age progressed. Most had Egyptian feet (62.3%) while greek feet were at more risk of developing hallux valgus. No conclusion was reached on the types of metatarsal heads and a positive correlation was seen with altered sensory nerve function along the dorsocutaneous pathway. Data was not conclusive enough to show any statistical significance when it came to associated factors like Age, Sex, Family History, BMI, Footwear, Shape of foot, Shape of metatarsal head.

Conclusions and Recommendations

The Kenyan population aged 18-65 years has a 26.6% prevalence of Hallux Valgus with more than half of them having mild Hallux Valgus. Females are slightly more affected than males with an inverse relation of BMI to the prevalence and increasing proportion of Hallux valgus with advancing age. No significance was seen with flat feet, footwear, shape of feet, metatarsal heads, sex, age and family history with a positive correlation with altered dorsocutaneous sensory pathway. Lack of awareness of this condition and subsequent health seeking behaviors need to be looked into. Longer surveillance periods with larger sample populations are recommended with biomechanical studies to fully ascertain the role of footwear.

Chapter 1

INTRODUCTION

For quite some time an enlarged 1st MTPJ was synonymous with Hallux Valgus. Carl Hueter is credited with correctly describing it as the lateral turning of the great toe at the joint in 1877 coming up with 5 distinct characteristics[1–3]. The word Bunion(Tulip) that was initially used to describe all deformities at the 1st MTPJ (bursitis, ganglion etc) is now used to describe the inflammation and bony medial eminence that becomes apparent with progression of the deformity.

The 1st MTPJ is a unique and the most complex of joints in the forefoot[3]. The first ray takes up to one third of the body weight as it preserves the medial arch. This complex joint provides the final pivot during the propulsive phase of the gait. The head of the metatarsal has no dynamic stabilizers making it susceptible to extrinsic forces[3–5]. A cordial relationship between the forces across the joint must exist in order to avoid joint instability. Hallux Valgus not only involves significant pathological changes to bone but also the soft tissue structures making it a very complex 3D deformity of the foot[3,4].

Hardy and Clapham first described the Hallux Valgus Angle in 1951 that turned out to be the hallmark in describing and classifying Hallux Valgus[6–9]. Prior to this, most assessment was visually based. Authors have suggested different ways of classifying the condition but currently the AOFAS adhoc committee on angular measurements has set a cut off of 15º. Based on this the classification is as Mild (15 - <20), Moderate (20 - <40) & Severe (>40)[8,9].

Hallux Valgus is first noticed when there are cosmetic changes in the forefoot but gradually develops into a painful foot with abnormal biomechanics[10]. In older people Hallux Valgus has been linked as an independent risk factor for falls due to impairment of balance secondary to gait disturbances[11–13]. Menz et al concluded in their study in 2005 that the association was even stronger with uneven surfaces and increasing severity. This coupled with footwear incompatibilities and foot pain leads to a decrease in mobility and declining quality of life[10,12,14].

A major part of the literature on this condition is oriented towards surgical correction. However most patients with Hallux Valgus do not undergo surgery hence a gap exists in terms of patient

education and surgeon enthusiasm[15].In the western world a significant number of patients undergo correctional surgery making it the leading procedure in foot surgery[5,16]. In that view, cosmetic surgery is on the rise and a search on Google of the words 'cosmetic foot surgery' revealed almost 1 million results by 2016.However, the complete opposite is happening in the developing world with rudimentary literature to compare with. Surgical interventions are costly and chances of recurrence are usually high[17]

The exact prevalence of Hallux Valgus is not known as it keeps on changing with every study. Part of the reason is due to the variability in the definition of Hallux Valgus and the diverse sampling methods employed by authors[11,18–20]. One of the largest population studies conducted in the UK by Roddy et al in 2008 showed a prevalence of 28% through the use of questionnaires[19]. Okuda et al in 2014 depicted a prevalence of 12.8% in Japanese females less than 20 years of age[21] while Wu et al in 2010 showed a 36% prevalence amongst Chinese females between the age of 18-65 years[22]. Closer to our setup, Owoeye et al in 2011 illustrated a 15.4% prevalence amongst the youth population in Nigeria by using questionnaires to secondary school students and undergraduates[23]. Most recently, Nishimura et al in Japan used X-rays together with questionnaires to come up with a prevalence of 22.8% amongst Japanese rural population extracts in 2014[18,24]. The challenge here is that every study has different target populations, exclusion criteria and sampling techniques.

The prevalence of Hallux Valgus has been shown to increase with age with Menz et al in 2005 showing a 74% prevalence amongst the elderly[8,11,12]. Age and Gender have also been shown to have a strong association with the condition[8,17,19]. Females are more predisposed to develop Hallux Valgus[6,8,12,19,25,26]. The arguments on Footwear and its contributions towards Hallux Valgus will last a lifetime. However strong associations have been shown with Sim-Fook et all predicting in 1958 that shoe wearing population were 15 times likely to develop Hallux Valgus[18,27] with Coughlin & Thompson in 1995[28] and Kato et al in 1981 (who showed an increased prevalence with an upsurge of high heeled shoes)[29] concurring with the above. Nguyen et al in 2009 also showed an association between fashionable foot wear and hallux valgus in females[17]. On the other hand, Barnicat and Hardy, Gottschalk et al, Shine in 1965 and most recently Coughlin et al have all presented some evidence that shoe wear alone is not a significant factor in development of Hallux Valgus[8,30–32].

A meta-analysis by Nix et al in 2010 estimated a prevalence of 7.8% in the Juvenile to 35.7% in the elderly with 23% in the population between 18-65 years. They illustrated that it was more prevalent in females (30%) compared to men (13%)[18,20]. This study pooled from 78 papers should give a much clearer picture of the problem at hand. With Access Economics 2008 and Butterworth et al in 2010 pointing out that Hallux Valgus accounts for 6.7% of all forefoot surgery and that 27% of patients with foot problems have suffered from a fall[33,34], a justification for further evaluation of this condition is essential.

The purpose of this study therefore is to illustrate the prevalence of Hallux Valgus in a hospital based Kenyan population and assess its severity together with associated foot conditions documented in literature.

Chapter 2

LITERATURE REVIEW

Historical perspective & Background of Hallux Valgus

Hallux Valgus also known as Abducto Valgus has been with us for centuries. As much as it being a common forefoot deformity, numerous papers have been written to understand its etiology[35]. Two opposing viewpoints have dominated the debates – An extrinsic approach where its related to habitual wearing of pointed shoes and an intrinsic approach relating to hereditary, congenital, biomechanical and traumatic causes.[35] No consensus has been reached to date.

The term Hallux Valgus literally means 'outward turning of the big toe'[5]. The term has been credited to Carl Hueter who 1st described it in 1871 with the following 5 characteristics[3]:

a) Static subluxation of the 1st MTPJ, medial deviation of 1st Metatarsal and lateral deviation of great toe.[3]
b) Rotatory deformity of great toe[3]
c) Dislocation of the sesamoids within the tendons of the great toe short flexor (flexor hallucis brevis) due to medial deviation of 1st metatarsal bone[3]
d) Plantar disposition of great toe abductor tendons (Abductor Hallucis)[3]
e) Lateral disposition of the tendons of the great toe long flexors and extensors (Flexor & Extensor Hallucis Longus)[3]

This was the first indication that this was a complex joint that needed further evaluation. Numerous changes have been made to the above in due course.

Hallux Valgus was initially referred to Bunion (latin - bunio) that means turnip.[3]Bunion can refer both to the inflammation of the bursa overlying the MTPJ and to the bony medial eminence which becomes apparent with deformity progression.[36] Bunion was initially used to describe all other deformities seen in the 1st MTPJ such as bursitis, Ganglion, edema of joint e.t.c. Currently its used to only signify increased medial eminence of 1st MTPJ.[3]

Hallux Valgus was initially considered belonging to a 'low class of surgery' (Volkman et al 1856)[35] where callus trimming was popular and done by the barbers and shoe adjustments by

boot makers. Surgical techniques for treatment for Hallux Valgus have existed since the 1800s including arthroplasty, osteotomies and joint destruction procedures. Early records depict various procedures with Metcalf (1912) reporting 15 different ones, Timmer (1930) reported 25, Verbrugge (1933) – 51, Perrot (1946) – 68 amongst others[35]. These variety of procedures represent the recalcitrant nature of the condition and the rather lack of proper understanding of the deformity.[35] Its impact on patient education can therefore be detrimental with undesirable outcomes.

Much of the initial diagnosis was based on the naked eye evaluation. However, Hardy & Clapham in 1951 published a study that became the basis of present practice of the pre-operative measurements of HVA & IMA where they compared patients with HV with controls.[5] Their HVA measurement were at 15.7^0 and IMA measurement at 8.5^0 . Later on in 1960, Piggot et al studied the congruency of the 1st MTPJ and the development of Hallux Valgus related to this congruity[5]. With lateral deviation, the congruency between the proximal phalanx and the articular surface is lost and hence can be used as a measure of instability[5]. Pelet et al underlined the importance of the Distal Metatarsal Articular Angle (DMAA) which centers on the relationship between the distal articular surface of the 1st metatarsal head and the long axis of the metatarsal.[5]

Hallux Valgus can therefore be summed up as complex progressive deformity that begins with the lateral deviation of the great toe (Hallux) and medial deviation of the 1st Metatarsal (Metatarsus Primus Varus)[9]. Apart from the deformity at the joint, it also involves patho-physiological changes in soft tissue structures of the foot arch, sesamoid mechanism and metatarsocuneiform joint leading to associated distortions and instability of the foot[3].

Anatomy around the 1st Metatarsophalyngeal Joint

The human foot consists of 26 bones with two of them being sesamoid bones. Interconnecting them and maintaining the foot structure are hundreds of ligaments together with muscles & tendons. One of the most important joints is the 1st Metatarsophalyngeal Joint (MTPJ) that plays a major role in achieving normal gait. Many authors note that one of the most obvious changes between the primate and human foot was the shape and motion of the first metatarsal[35]. The reason was for the metatarsal to become a major weight bearing bone with the lesser metatarsals

becoming less significant for weight bearing. The evolution of the muscles and ligaments around this joint also aided in reducing motion and transforming it into a major factor in gait and weight bearing in humans[35]. Indeed this has to be a special joint worth thinking about.

The 1st MTPJ is termed as a complex joint by many[3,35]. It presents as two well defined joints with a common joint capsule and surrounded by ligaments and muscles[4,35]. The distal portion is a partial ball and socket joint between the 1st metatarsal and proximal phalanx while the second is a rounded groove between the plantar 1st MTP and the dorsal surfaces of the two sesamoids[4,5,18,35].

The first Metatarsal is the shortest and broadest of all the metatarsals[5]. At the base are 2 tubercles, medial for the insertions of Tibialis anterior and lateral for the insertions of Peroneus longus[5]. The remaining surfaces are rough for attachments of ligaments. A fan shaped ligamentous band originates from the medial and lateral metatarsal epicondyles and constitutes the collateral ligaments of the 1st MTP[4,5]. The head presents with a crista that begins on the anterior aspect of the articular cartilage and continues plantarly. On either side is a groove for articulation with the sesamoids with the groove on medial side larger than the lateral one[5]

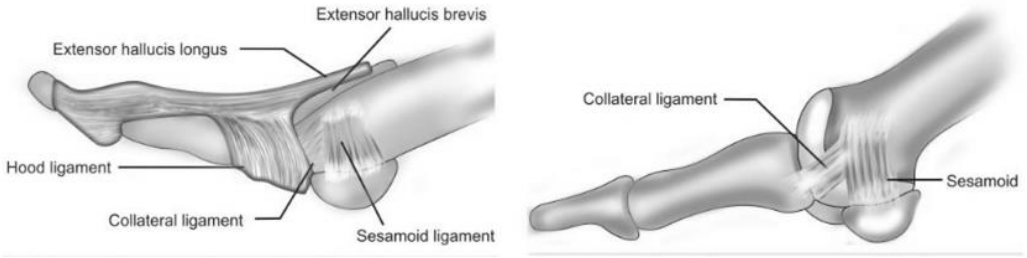


Fig 1 :Diagram of the 1st MTPJ showing the collateral & extensor mechanisms around the joint

(Extracted from Coughlin M. et al. Surgery of the Foot & Ankle. Philadelphia, Mosby Elsevier. 2007)

The sesamoids are fibrous, cartilaginous or osseous structures almost always contained within a tendon and are known to alter the pull of a tendon, decrease friction at articular surfaces and decrease pressure within a tendon to allow circulation to the tendon[5]. The sesamoids are connected by vertical fibers to the sides of the 1st Metatarsal head and by horizontal fibers to the plantar base of the proximal phalynx[35]. Oblique fibers run from the epicondyles of the metatarsal head to the plantar sides of the base of the proximal phalynx[35]. They are interconnected by dense fibrous tissues forming the intersesamoid ligament.[4,5,35,37].The lateral sesamoid in addition is

connected by the transverse metatarsal ligament to the plantar plate under the 2nd metatarsal head[35]. This connection tries to maintain a relatively constant distance between the sesamoids and the plantar plate of the 2nd metatarsal head[35]. Each sesamoid is also united by an ill defined sesamophalyngeal ligament to the base of the proximal phalanx forming the anatomic and functional unit called sesamophalyngeal apparatus described by Gillette in 1972[4]. This moves backwards and forwards relative to a fixed metatarsal head. Hence in Hallux valgus or traumatic displacements, the sesamoids always follow the proximal phalanx and are displaced with it rather than the metatarsal head[4].

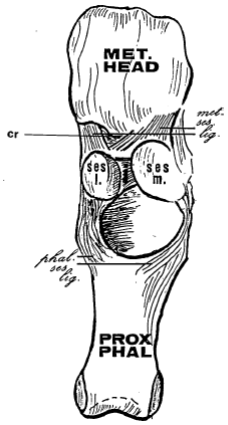


Fig 2: Diagram showing the Sesamophalangeal and Metatarsosesamoid complexes.

Key :

Met.Ses. Lig – Metatarsosesamoid ligament. Cr. – Median Crest

Phal.ses. Lig. – Sesamophalangeal ligament. I – Intersesamoid Ligament

Extracted from Coughlin M. Hallux Valgus.Journal of Biomechanics. 1996. 78-A(6); pg 8

The 1st MTPJ is characterized by numerous muscle and tendinous attachments that help move the big toe[4]. They are arranged around the joint in 4 main groups[5]:

- **Dorsally** – The Extensor Hallucis Longus(EHL) and Brevis(EHB) passes dorsally and centrally. EHL is anchored medially and laterally by the hood ligament and inserts into distal phalynx while the EHB inserts beneath the hood into dorsal aspect of base of proximal phalynx[5]. The hood acts as a stabilizer for these two.[37]
- **Plantar** – The Flexor Hallucis Longus(FHL) crosses centrally and attaches into the distal phalanx[5]. It is hence craddled between the sesamoids during weight bearing by virtue of lying plantar to the crista and intermetatarsal ligament.[37] The Medial & Lateral heads of Flexor Hallucis Brevis inserts into the medial & Lateral sesamoids[5].
- **Medially** – The Abductor Hallucis tendon passes medially and inserts into medial sesamoid and medial plantar tubercle of the proximal phalynx[5]. This creates a force vector that pulls the proximal phalanx into varus.[37]

- **Laterally** – The Adductor Hallucis tendon passes laterally from its origins on the lesser metatrsal shafts and inserts into lateral sesamoid (transverse head) and proximal phalanx (oblique head)[5]. This creates a force vector that pulls the proximal phalanx into valgus.[37]

Two other muscles help maintain anatomic alignment of the joint. These are the Tibialis Anterior which inserts on the medial and most dorsal aspect of the base of the medial cuneiform, 1st metatarsal , and the Peroneus Longus that comes to attach on a more plantar aspect of the medial cuneiform and 1st metatarsal base.[37] It is worth noting that none of these muscles attach directly on to the head of the metatarsal.

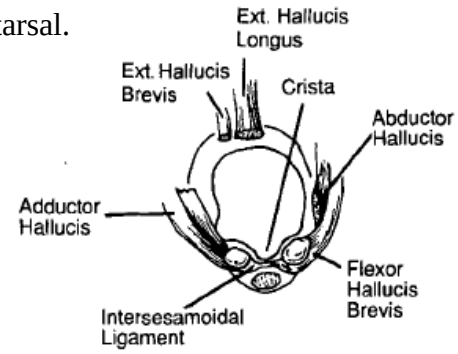


Fig 3: Cross Sectional Diagram of the 1st MTPJ showing the orientation of the muscles around the Joint

(Extracted from Coughlin M. Hallux Valgus, An instructional course lecture AAOS. JBJS Amr. 1997. 78-A; pg 933)

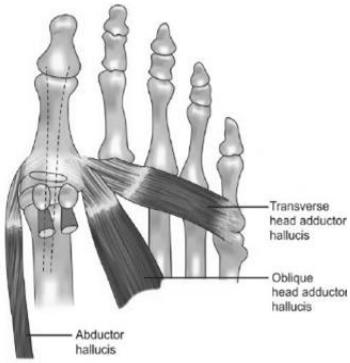


Fig 4: Diagram showing the 1st MTPJ with vector balance of the Adductor Hallucis and Abductor Hallucis

(Extracted from Coughlin M, et al. Surgery of the Foot & Ankle.Philadephia, Mosby Elsevier. 2007)

Stability at the 1st MTPJ is hence provided by an interaction between the Static and Dynamic Factors around the joint. These are summarized in the table below[5].

Static Stabilizers	**Dynamic Stabilzers**
Capsuloligamentous Sling of the 1st MTPJ	Abductor Hallucis
Medial & Lateral Collateral Ligaments	Adductor Hallucis
Bony Shape of 1st MTPJ (rounded surface less stable)	Tibialis Anterior + Peroneus Longus
Hood Ligament (Stabilizes Extensor Tendons dorsally)	Plantar Aponeurosis (through Windlass mechanism)
Sesamoid Ligament (Connects Sesamoids to Metatarsal Head)	

Pathogenesis of Hallux Valgus

The first ray bears almost a third of the body weight as it maintains the position of the medial arch[9]. Deformities affecting the integrity of the first ray can result in Hallux Valgus[9]. The first MTPJ is one of the most significant transmitters of body weight bearing onto the surface during walking hence is sensitive to abnormal stress forces that can lead to a deformity of static nature[3]. It is worth noting that although numerous stabilizing structures are present around the first MTPJ, none of them attach on the head of the metatarsal making it quite vulnerable to extrinsic forces[3–5]. Hallux Valgus not only involves significant pathological changes to bone but also the soft tissue structures making it a very complex deformity of the foot[3,4].

Most studies have concluded that the medial part of the MTPJ is weaker than the lateral part. The weakest portion of the joint capsule lies just above the abductor hallucis tendon and this is usually the first to give way with continuous pressure[4]. This allows the tendon to slide to a more plantar position leading to disruption of force vectors[4]. The failure of the medial supporting structures (Medial Sesamoid, Medial collateral ligaments) is the 'early and essential' lesion in the development of Hallux Valgus[2]

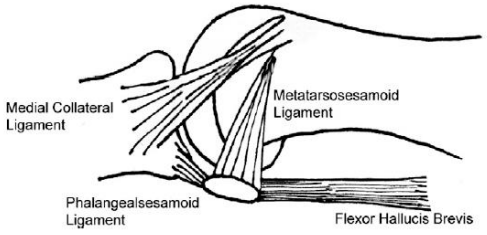


Fig 5: Medial view of the Hallux showing the medial structures

(Reprinted from Perera A, Mason L, Stephens S. The Pathogenesis of Hallux Valgus.JBJS. 2011;93:pg 1651)

This now allows the metatarsal head to move medially, consequently slipping off the sesamoid apparatus[2]. The Abductor Hallucis provides the major support to a well aligned great toe in tandem with the Adductor Hallucis[7,37]. As the deformity progresses, the Adductor Hallucis demonstrates a deforming force on the lateral aspect due to its tethering effect on the sesamoid and proximal phalanx[2,7]. It also inserts a rotational force on the great toe due to its plantar insertions, pronating it as the hallux deviates laterally[2,7].

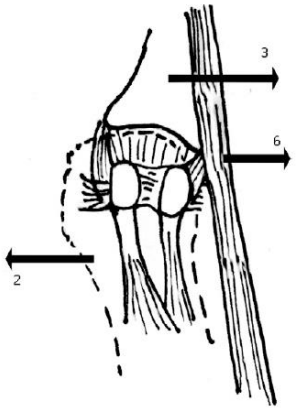
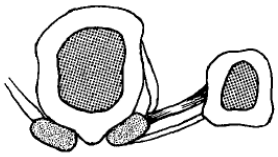


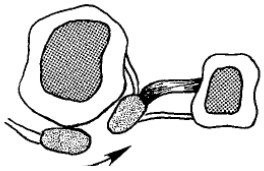
Fig 6 :Image showing medial shift of the metatarsal head (2) with valgus displacement of proximal phalanx(3) due to its attachment to the sesamoids, deep transverse ligament and adductor tendon. Bowstring effect of extensor hallucis longus (6) seen laterally

(Reprinted from Perera A, Mason L, Stephens S. The Pathogenesis of Hallux Valgus.JBJS. 2011;93:pg 1651)

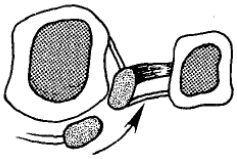
The Sesamoid apparatus has been known to play an integral part in the patho-anatomy of Hallux Valgus. As early as 1928, Robinson et al[35,38] proposed that the problem with hallux valgus was the sesamoid apparatus indicating that removal of them would prevent the deformity. Mc Bride et al proposed that a slightly everted foot will shift the sesamoids laterally such that the vertical axis around which the transverse motion occurs would not pass through the center of the sesamoids leading to disruption of forces around the hallux[35,39]. With the abnormal forces and continuing lateral rotation, the sesamoids displace more laterally in relation to the plantar aspect of the first metatarsal[2,4,7,35]. The Crista (intersesamoid ridge) is gradually eroded with this lateral rotation to a point that it offers no additional resistance to the sesamoid displacement[2,7]. The diagrams below illustrate the above statements.



Normal Alignment of Sesamoids



Crista erodes with medial migration of metatarsal. The medial sesamoid seems to move more towards the center (Arrow)



Lateral sesamoid lies vertically with severe deformity with contracture of the lateral soft tissues

***Fig 7**: (Reprinted from Coughlin M, Boise I. Hallux Valgus. JBJS Am. 1996;78-A:pg 935)*

The Flexor Hallucis Longus and Extensor Hallucis Longus are also affected and start to bowstring with increasing displacement due to the change in forces across the joint. They eventually start acting as dorsi-flexors for the proximal phalanx hence worsening the deformity[2]. Bowstring effect is also seen in the plantar fascia[18,40]

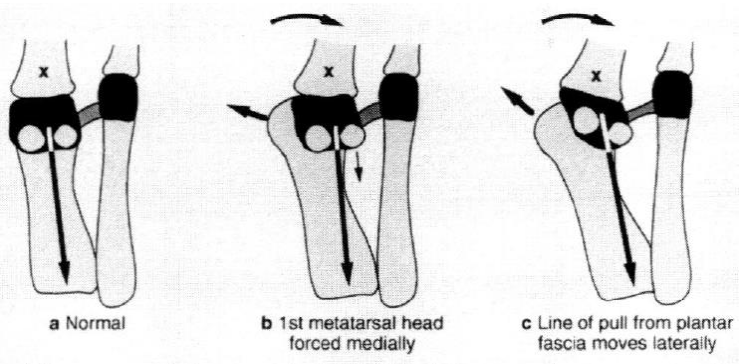


***Fig 8**: Reprinted from Stainsby G. Pathological Anatomy and Dynamic Effect of the displaced plantar plate and the importance of the plantar plate Ann R Coll Surg. 1997; 79(1) pg 63*

Thickening of the bursa overlying the medial eminence is noted mostly due to the pressure effect from shoes[2]. However, it should be noted that the medial prominence is not an exostosis or hypertrophy but the original medial epicondyle of the 1st metatarsal[35]. This is due to disorganization, degeneration, atrophy and eventual disappearance of the cartilage medial to the articulation of the proximal phalanx with the MTP as the deformity progresses giving it the appearance of a hypertrophy of the medial side of the head. Measurements of the medial prominence relative to the shaft of the bone have shown to be of the same size in both normal and the Hallux Valgus foot[35,41]

Etiology of Hallux Valgus

The etiology of Hallux Valgus has been through controversial opinions since Hueter first described the disease in the 19th century. Initially coined a disease exclusive to the privileged shoe wearing population, it has now been agreed upon that both extrinsic and intrinsic factors exist to help demystify this complex and multi-factorial disease. The table below shows the common causes with a few relevant to the thesis being reviewed in detail.

Potential Causes of Hallux Valgus

Extrinsic Factors	Intrinsic Factors
Footwear (high heels, narrow shoes)	Genetics
Excess weight bearing	Sex (female>male)
	Ligamentous laxity
	Other foot deformities (pes planus, hindfoot pronation, metatarsus primus varus)
	Age
	Neuromuscular disorders (eg, cerebral palsy, stroke)

***Fig 9**: Reprinted from Perera A, Mason L, Stephens S. The Pathogenesis of Hallux Valgus.JBJS. 2011;93:pg 1650-61*

Extrinsic Factors

The big toe is vulnerable to extrinsic forces due to the fact that no muscle attaches to the metatarsal head with it being kept in position by several motion vectors.

a) Foot Wear

Foot wear springs to one's mind whenever Hallux Valgus is mentioned. For a very long time, footwear was considered as the main cause of Hallux Valgus. One of the earliest study done by Lam Sim-Fook & Hodgson in 1958 showed 33% of shoe wearing people having HV compared to 1.9% for the barefeet[2,3,5,18,27]. From Japan, Kato & Watanabe showed a steady rise in HV diagnosis and operations after 1970(when sales of footwear started rising) with it being rare before 1970 when traditional footwear(wooden clogs with a splint between the great toe and 2nd toe) was prevalent[2,3,5,7,18,29].

However, Coughlin et al reported that only 24% of their patients had constricting foot wear playing a major role in development of HV[2,42]. Barnicat and Hardy showed that HV did occur in the bare feet African population in both sexes[30], suggesting that foot wear was not the main and only predictive factor of HV. Gottschalk et al also presented that HV was present in both the urban and rural African populations where the urban were stipulated to wear shoes compared to the no shod rural feet[31]

Footwear characteristics have also been shown to have an impact on Hallux Valgus. Fashionable footwear for the women includes those with heels and narrow toe boxes. Narrow toe box has been shown to have a constricting effect on the forefoot leading to imbalances of the forces around the first MTPJ. Wearing heels also alter the biomechanics around the 1st ray. Forefoot pressures have been shown to increase by 22% when a less than one inch heel is worn to up to 76% when a three inch heel is worn[15]. Nguyen et al reported that females who wear high heels as their major footwear had an increased prevalence of hallux valgus[17]. Al Abdulwahab et al showed an association between narrow toe box shoes and hallux valgus where 77% of their Saudi population who developed hallux valgus wore narrow toe box shoes while 85% of those without Hallux Valgus had wide round toe boxes[43]. However Wu et found no association between high heels and Hallux Valgus in their study[22]. A meta analysis by Nix et al was also inconclusive[44]

The conclusions from the above contrasting views is that foot wear is a major extrinsic factor in development of HV and that the deformity will occur to a much lesser extent in an unshod foot compared to a shod foot. Indeed, this is supported by a statement by Myerson et al who say that 4% of the world's population will develop the deformity regardless of the type of footwear or lack of it[45]

b) Excessive Loading

A perception exists that Hallux Valgus increases with excessive loading of the joint. However no study has come forth to give a direct link between the two. The only exception is a study by Miller et on Ballet Dancers(who wear narrow toe box shoes and tiptoe on their forefoot) that showed a weak association[2,46] that was also supported by Daniel Wu et al[22]. However a study by Okuda et al showed no association between the two[21] together with a research by Einarsdottier et al[47]

Authors have not been able to establish a clear link between Body Mass Index and HV[2,48]. Nguyen et al showed that an increase in BMI was associated with a decrease in prevalence of HV in females while the opposite was observed in males[17]. They thought that this may be due to the assumption that women with normal BMIs are more likely to wear more fashionable shoes as compared to obese women. This was supported by Golighty et al who concluded that an increase in BMI decreases the likelihood of HV[49] while Cho et al in their study on the Korean population demonstrated high BMI in those with HV[26]. However, Frey et al[2,48] showed no association of the above, a fact supported by Roddy et al[17,19].

Intrinsic Factors

a) Genetic Predisposition

A lot of studies have shown a female predilection for the development of HV[4]. Studies across the world have shown that more than 90% of the patients who come for any form of HV surgery are females. Hardy et al showed that 63% of the patients in their study with HV had a parent with HV[5,6] while Coughlin et al illustrated that 94% of the mothers whose children had HV also had a bunion[50]. A maternal inheritance has been suggested by Okuda et al who showed a 60.4% chance of an affected mother having a child with HV[21]. They also showed a 48% positive Family

history amongst their HV subjects[21]. Coughlin and Jones in another study demonstrated that 83% of their patients with HV had a positive family history[8]. In studies involving Juvenile and young adults, the theory of genetics is further strengthened by Coughlin and Mann who showed a 94% maternal transmission[2,51] which was further supported by Chell et al[52]. Therefore it can be safely concluded that females are more affected than males and that a maternal inheritance pattern (possibly autosomal dorminant with incomplete penetrance) exists though no specific study has been done to show the inheritance pattern.

b) Sexual Dismorphism

As stated earlier, Hallux Valgus is known to occur more commonly in females. Footwear has been implicated as one of the major extrinsic factors here (see above).

Differences noted between male and female foot anatomy may also play a role here. Females tend to have a more round and smaller metatarsal head articular surface leading to reduced stability of the joint and higher chances of progression of HV since its less resistant to transverse plane deformity changes[8,53].

Females have also been shown to have a more adducted 1st metatarsal with the differences in the tarsometatarsal articulation between the two sexes being suspected[2,54]. Ligamentous Laxity[2,55] and 1st ray hypermobility[2,56] is also more common in females than males.

c) Pes Planus

The association of pes planus with HV is controversial[36]. Flat foot changes the mechanical forces and momentum working on the 1st MTPJ[4]. Here, the medial side of the forefoot takes more weight than normal which is transmitted to the great toe[4]. With pronation of the foot, the 1st ray also rotates longitudinally placing the axis of the 1st MTPJ in an oblique plane to the floor[2,4,25]. Balancing forces now become deforming leading to progression of the deformity.

Since the initial mention by Inman et al who suggested that HV was uncommon in the cavus foot[57,58], subsequent papers are inconclusive on the role of pes planus in HV. Kilman& Wallace showed no association in their study on Juvenile Hallux Valgus[59]. Coughlin & Jones did not find an association between pes planus and the severity of Hallux Valgus[8] which was supported in the paper by Grebing et al[60]. Okuda et al also found no association between pes planus and HV[21].

However, Hohman et al[61] and Westbrook et al[62] have shown an association of pes planus with HV. Eustaceet al illustrated that 1st metatarsal pronation is associated with HV and increases as the IMA increases. This pronation is also associated with a medial longitudinal arch collapse suggesting a link of flat foot with HV[2,63]

Nguyen et al showed that men with pes planus and twice likely to have HV than those without. There was no statistical significance in females[17]. They thought of this being due to a difference in foot structures of males and females[53,64]

This leaves a gap in research as to whether Pes Planus does really lead to Hallux Valgus. No study has been done on the prevalence of HV in pes planus feet. At the moment a person with both pes planus and hallux valgus is at a higher risk of rapid progression due to disturbances of forces.

d) Metatarsal Anatomy

Studies on the metatarsal anatomy have revealed distinct proposals related to HV. Specific attention has been paid to the metatarsal dimensions, articular morphology and the associated biomechanics surrounding it.

i) Metatarsal Dimension and types of feet

Morton et al in 1935 looked at relative lengths of metatarsals and described a short first metatarsal of what he called the Morton foot which he believed would lead to pronation and hypermobility of the 1st ray causing a higher prevalence of Hallux Valgus[2,65]. However, further research with more reliable parameters have over time shown a low association between the two (4%)[2,8,60].

Viladot et al in 1973 described 3 types of feet namely the Egyptian foot (Big toe longest), Greek Foot (2nd toe longest) and Squared Foot (Equal length of 1st and 2nd Toes)[5,66]

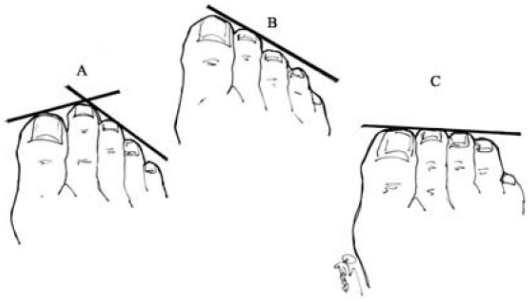


Fig 10: Types of Feet

A – Greek Foot, B – Egyptian Foot,

C – Square Foot

He went further to reclassify the feet as Index Plus (Long 1st MT), Index Minus (Short 1st MT) and Index Plus-Minus (Equal length). A person with Index Plus (similarly to Egyptian Foot) is more likely to get Hallux Valgus. Viladot showed an incidence of 73% for Egyptian feet as compared to 21% for Greek feet and 6% for square feet[4,66]

ii) Metatarsal Congruency

The congruency of the 1st MTPJ has been shown to play a part in development of Hallux Valgus. A congruent joint is one where the metatarsal and proximal phalangeal surfaces are aligned together[7,67]. Metatarsal heads have been seen as being round, square or chevron type. A round head has been shown to be more common in cases of Hallux Valgus due to the fact that its less congruent compared to the others and hence less stable[67]. Heden et al showed a 90% incidence of round heads in participants with Hallux Valgus in their study[2,68] while Piggot et al showed that only 9% of participants with Hallux Valgus in his study had congruent joints[7,67].

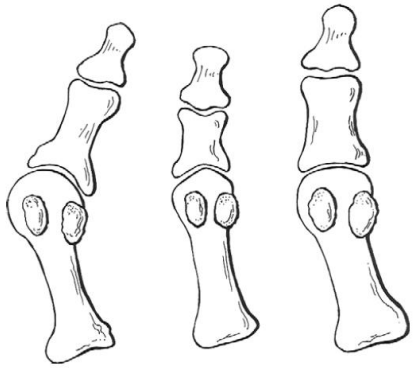


Fig 11: Metatarsophalangeal Joint Congruency

A – Curved/Round

B – Chevron

C - Flat

Extracted from Coughlin M, Caroll PJ. Hallux Valgus: Demographics, Etiology, and Radiographic Assessment.Foot& Ankle Int. 2007;28(7):pg 759-777

Square or Chevron shaped heads have shown to be more stable and tend to resist subluxation[2,8]. Phillips et al in 2000 observed that the joint behaves like a hinge to the vector of the extensor and flexor tendons (that runs through the vertical axis of motion). Hence the more rounded the articulation is, the closer the vertical axis lies to the surface thus any small displacements medially or laterally produces greater angular changes as compared to a flatter articulation.[2,4,6,8,45,69]

Prevalence of Hallux Valgus

The exact prevalence of Hallux Valgus remains unknown. This is mostly due to the variability in the definition of Hallux Valgus by various authors and the diverse sampling methods employed (Questionnaires, Clinical and radiological evaluation). In Kenya, no data exists on the above and knowledge on the disease is limited to both the patient and the surgeon. Most studies done in the western world involve patients who are being followed up in specialized foot clinics hence a tendency towards bias. Questionnaires still remain the choice of data collection.

Much of the literature on the prevalence of Hallux Valgus has been discussed in the Introduction of this thesis. Below is a tabulation of some of the available and relevant literature:

Author	Prev.	Sampling Technique	Sample Population	Location	Notes
Roddy et al (2008)	28%	Questionnaire	Adults >30 yrs	UK	
Okuda et al (2014)	12.8%	Questionnaire + Footprints (FOOTLOOK)	Females <20 yrs	Japan	
Wu et al (2010)	36%	Questionnaire + Manchester score	Females 18-65 yrs	China	
Owoeye et al (2011)	15.4%	Questionnaires	Youth pop (Sec + Undergrad	Nigeria	
Nishimura et al (2014)	22.8%	Questionnaires + X-rays	Rural population (non specific)	Japan	HV angle >20
Cho et al (2009)	64.7%	Questionnaire	Rural pop (40 – 69yrs)	S. Korea	Pts being screened for chronic. Cond.
Menz et al (2011)	36.3%	Questionnaires	>56 yrs	UK	

Fig 12: Summary on Prevalence based on previous available literature

Nix et al conducted a meta-analysis in 2010 where they analysed 78 papers and came up with a prevalence of 7.8% for the Juvenile, 35% for the Elderly and 23% for adults aged 18-65 years. They also showed that Hallux Valgus was more prevalent in the females (30%) compared to men (13%). This meta-analysis serves as an important record when discussing Hallux Valgus epidemiology though not much can be said about its standardization in terms of sampling methods, population samples and variables.

Clinical & Radiological Assessment of Hallux Valgus

Fig 13: Types of Hallux Valgus according to the Manchester Scale

It is a rare occurrence to find patients being assessed at the onset of Hallux Valgus. Being a progressive disease, no substantial evidence exists as regards to its onset and patient lack of insight has been stipulated to be one of the causes since they usually notice it when a deformity has occurred and pain has become unbearable.

Clinical assessment is important as it is unique to every individual and aids in future management[35]. Common complaints usually involve non acute onset of pain at the 1st MTPJ that increases during activity. Some may complain of pain around the 1st Metatarsal head with wearing of shoes. In most cases, patients may consult over the deformity over the medial side of the 1st MTPJ that may or may not be painful. Occasionally, overlapping of the second digit or worsening lateral deviation of the first toe may warrant a consult.

Clinical Assessment is done both standing (weight bearing) and sitting (non weight bearing) since Hallux Valgus is a dynamic deformity[37]. The following features are assessed:

- General position of the foot, whether cavus, pronated etc
- Medial prominence (Bunion)
  - Pain over the eminence seen in 70-75% of patients[8,70]
  - Loss of sensation over the course of the dorsal cutaneous Medial nerve seen in 44% of patients. This is due to entrapement of dorsal/plantar cutaneous nerves[8,37,71,72]
  - Skin over it (inflammed, ulcerated)
- Assessment of first MTPJ
  - Rotation of the 1st toe which is usually pronated in Hallux Valgus[37]. Frontal plane deformity checked by looking at the great toe nail and comparing its deviation from the plane of the floor. Usually graded as follows[35]:

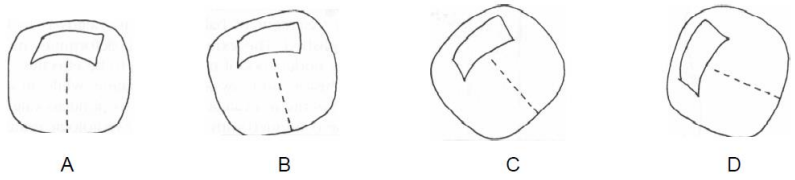


Fig 14: Grading of the Rotation of the First Toe

(A) Grade 0, No rotation. **(B)** Grade 1, Rotation <25°. **(C)** Grade 2, Rotation >25°. **(D)** Grade 3, Rotation >45°

Extracted from Hetherington V. Textbook of Hallux Valgus and Forefoot Surgery.2000.Pg 105

  - Range of Motion at the Joint. Normal range is 65-70° of dorsiflexion and 15-20° of plantar flexion. Tenderness during range of motion may depict a degenerative process.
- Associated Deformities
  - Pes Planus can be detected using various methods with Coughlin et al using the Harris Mat imprints to classify flat foot[8] while Okuda et al used the FOOTLOOK device that scanned feet and printed them on a paper[21]. Most authors use the computerised mat (MatScan etc) that gives a detailed account of the foot[5,17]. In resource poor settings, various techniques can be employed to get imprints. These include use of the Plaster of Paris and mouldable Clay.
  - Second Digit Hammertoe
  - Plantar Keratosis/Callosities

Radiological Assessment

Weight Bearing Radiographs are done both in the Antero-posterior and Lateral Views. Measurements to be made on the Antero-posterior radiograph include:

- Hallux Valgus Angle (HVA)
  - This is calculated from the bisection of the axis of the first metatarsal and the first proximal phalanx. Hardy & Clapham in 1951 first described the Hallux Valgus angle and came up with an 'artificial dividing line of 15°.[6,36] This has been supported by Coughlin et al[4,7] and most recently endorsed in a guideline by the American Orthopedic Foot & Ankle Society ad hoc Committee on Angular measurements[8,73]
  - Based on the above, Coughlin et al and Clapham et al came up with a classification for Hallux Valgus as mild, moderate or severe (See figure below).
- 1-2 Intermetatarsal Angle (IMA)
  - This is calculated from the intersection of the axis of the first and second metatarsal shafts. Normal values are usually less than 9°.[6,8,73]
- Distal Metatarsal Articular Angle (DMAA)
  - This measures the articulation of the distal first metatarsal head as compared to the long axis of the 1st metatarsal[18,74].
  - Its calculated by marking two points on the most medial and lateral parts of the metatarsal articular surface with a line joining them to define the slope of the articular surface. Then a perpendicular line to the above is drawn. A second line which is the longitudinal axis of the 1st Metatarsal is drawn and the angle between it and the perpendicular line is the DMAA. This is shown in the figure below
  - Normal DMAA is less than or equal to 6°.[6,18,73,74]

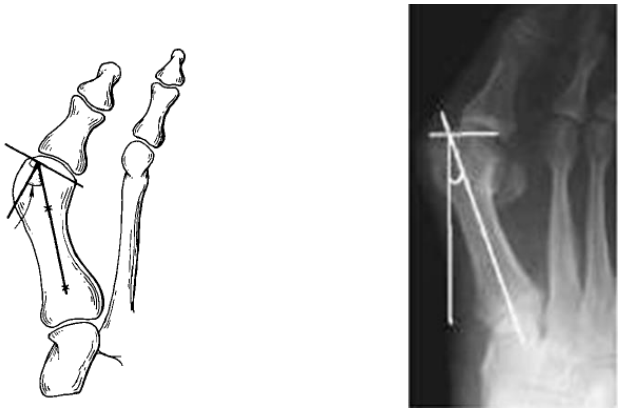


Fig 15*: DMAA*

Extracted from Coughlin M, Caroll PJ. Hallux Valgus: Demographics, Etiology, and Radiographic Assessment.Foot& Ankle Int. 2007;28(7):pg 759-777

- Hallux Valgus Interphalangeous Angle (HVI)
  - This is formed by the insersection of the longitudinal axis of the distal phalanx and the proximal phalanx[8]. Normal Values are given as 10^{o} or less[8,73,75].

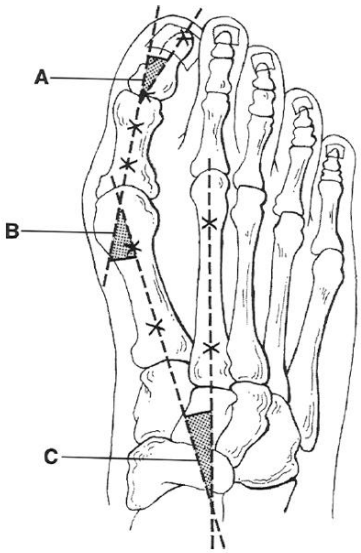


Fig 16: Angles important in Radiological Evaluation

A – Hallux Valgus Interphalangeous Angle

B – Hallux Valgus Angle

C – Intermetatarsal Angle

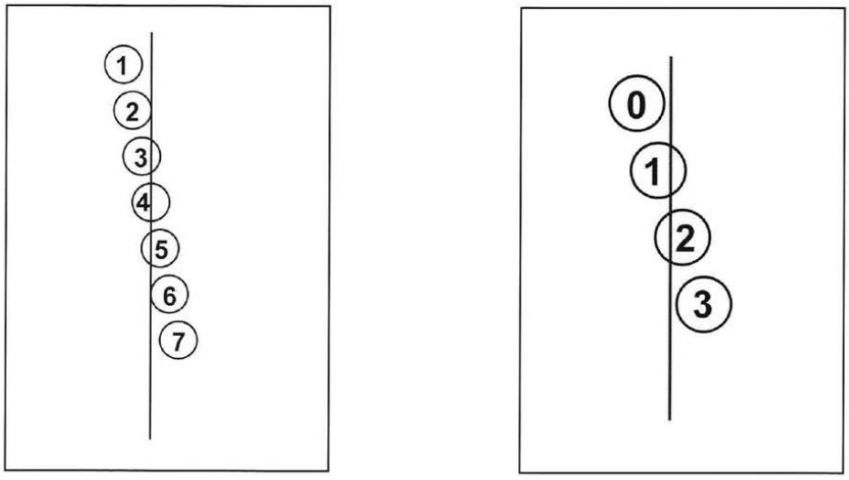
Extracted from Coughlin M, Caroll PJ. Hallux Valgus: Demographics, Etiology, and Radiographic Assessment.Foot& Ankle Int. 2007;28(7):pg 759-777

Based on the above information, a classification of Hallux valgus has been deduced as summarized below:[6–9,36,73]

Radiographic Classification of Hallux Valgus			
	HVA (°)	IMA (°)	Subluxation of Lateral Sesamoid on AP View (%)
Normal	<15	<9	—
Mild	<20	≤11	<50
Moderate	20–40	<16	50–75
Severe	>40	≥16	>75

Fig17*: Classification of Hallux Valgus*
Data from Hecht PJ, Timothy J L. Hallux Valgus.Medical Clinics of North America. 2014;98(2). Pg 230

- Sesamoid Position
  - Sesamoid subluxation away from the head of the metatarsal commonly seen in Hallux Valgus and its importance lies in assessing disease progression and potential for recurrence of deformity[7,76,77].
  - AOFAS came up with a grading system according to the positioning of the tibial (medial) sesamoid and the longitudinal axis of the first metatarsal[7,78]. This includes,
    - Grade 0 – Sesamoid with no lateral displacement relative to bisection line
    - Grade 1 – 50% of overlap of sesamoid relative to the line
    - Grade 2 - > 50% overlap
    - Grade 3 – Sesamoid fully displaced laterally beyond the reference line



Tibial Sesamoid Positioning as described by Hardy and Clapham

Tibial Sesamoid Positioning as recommended by AOFAS

Fig 18*: Sesamoid Positioning*

Extracted from Boberg J, Torgrude E, Poock J. Radiological Evaluation of Hallucod Sesamoids. The Podiatry Institute. 2003;Chpt 12: Pg 52

- Hardy & Clapham had initially come up with a classification that included seven positions of the tibial sesamoid[6,7,79]. The AOFAS is a modification of this as shown above. Kuwano et al also came up with an analysis of the rotational position of the sesamoid. However a consensus has not been reached on which classification to use.
- Agrawal et al based their classification on the Lateral sesamoid and its displacement from the cortical margin of the first metatarsal[80,81]. They argued that the medial migration of the first metatarsal exposes the lateral sesamoid on a AP radiograph where the projection of the medial sesamoid remains predorminately under the body of the the first metatarsal hence hindering the visualization of the medial sesamoid[80,81]. This is shown in the diagram below:

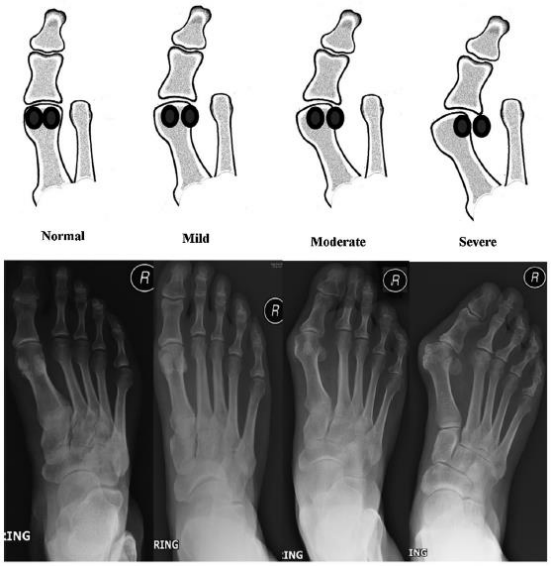
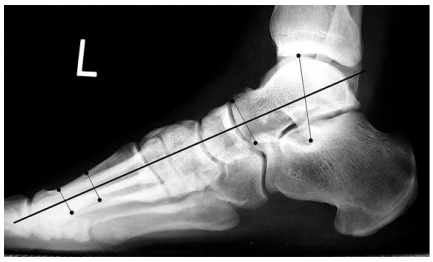


Fig 19*: Radiographic Image showing Sesamoid position with severity of Hallux Valgus*

Extracted from Panchani S, Reading J, Mehta J. Inter & Intra- observer reliability in assessment of the position of the lateral sesamoid in determining severity of Hallux Valgus.The Foot. 2015; Pg 1-3

In addition, Joint Congruency is checked for and also the size of the medial eminence and the metatarsal protrusion distance can also be assessed.

- Pes Planus Determination
  - This will be done by determining the Meary Angle (Talar- 1st Metatarsal Angle). This is formed between the long axis of the talus & the 1st Metatarsus on a weight bearing lateral xray. An Angle greater than 4^{o} depicts presence of pes Planus.



Meary Line, Normal Foot

Meary angle > 4°, Pes Planus

Clinical Scores& Scales

Various scores have been employed to assess and collect more information about the occurrence and progression of this disease. However most studies tend to modify these scores so as to suit their target population and objectives. Some of the scores that will be useful in our study are:

- Visual Analogue Scale
  - This psychometric response scale can be used to grade the pain at various joints such as the first MTPJ. It has usually been combined with the Happy-Sad face grading for ease of understanding. Patients usually grade their pain on a scale of 1-10

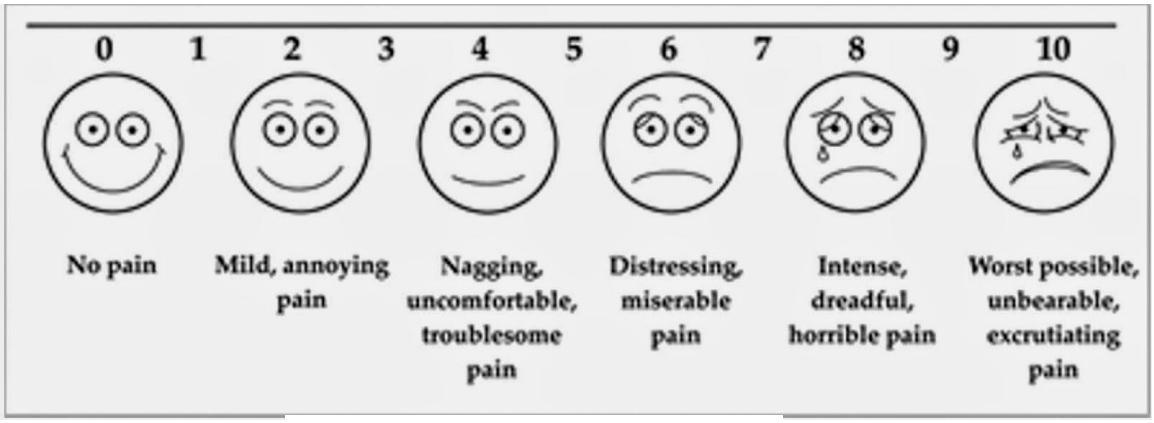


Fig 20*: Modified Visual Analogue Scale*

- ACFAS (American College of Foot and Ankle Surgeons) Scoring Scale
  - This is a clinical instrument that has been designed to measure subjective and objective parameters around the foot. It has 4 modules and allows for modifications depending on the study. In our case, Module 1, which centers on the parameters around the 1st ray, is of importance[82,83]. For our target population and objectives,

we will modify the Module 1 so as to maximise the amount of information extracted from the participants and come up with an independent scoring system. (Check Appendix 1)

- Hallux Metatarsophalangeal Interphalangeal Scale (HMIS)[84]

This is a modified clinical scoring system that is more specific for Hallux Valgus. It has a total score of 100 points and includes information on pain, functionality, footwear requirements, joint motion at MTP and IPJ together with the alignment of the 1st MTPJ and IPJ.[85]In our study, we shall pick extracts from this scale to fit our target population and objectives.(Check Appendix 2).

Chapter 3

JUSTIFICATION OF THE STUDY

Hallux Valgus is currently the commonest forefoot condition being mentioned in the world with a significant impact on the quality of life. Early diagnosis and knowledge is paramount in order to improve this. Lack of awareness exists amongst the local population and the orthopedic fraternity with no previous study done in our region to support this. No epidemiological data exists making it difficult to estimate the impact on different populations with diverse characteristics. Study methodologies in previous studies around the world have been based on case series on select populations with the use of questionnaires in most of the studies creating bias and skewed conclusions. Scarce radiological information exists to support this. As a result no preventive health seeking policies exist due to non availability of data and poor understanding of extrinsic factors such as footwear involved in its pathogenesis.

This study will help underline the burden of disease in the local setup and help create awareness amongst the Kenyan population and orthopedic surgeons. It will also form the benchmark for formulation of health policies and formation of specialty foot clinics that will aid in improving the Quality of Care for the patient. Data from this study will act a reference when it comes to pre operative assessment of the condition and be availed for early intervention to slow down the progression of this overlooked and understated condition.

STUDY QUESTION

What is the prevalence, degree of severity and common associated foot conditions of Hallux Valgus in a hospital population in Kenya?

STUDY OBJECTIVES

Broad Objective

To Study the Prevalence of Hallux Valgus and its associations in an adult population at a hospital in Kenya

Specific Objectives

1. To establish the Frequency of Hallux Valgus in the local population
2. To Assess the degree of Hallux Valgus Severity
3. To determine associated factors with Hallux Valgus

Chapter 4

STUDY DESIGN & METHODOLOGY

Design

Cross Sectional Prospective Study

Area Description

PCEA Kikuyu Orthopedic &Rehabilitation Centre (KORC) – Outpatient Department

- KORC is 37 bed capacity unit located near Kikuyu Town within Kiambu County on the outskirts of the capital city of Nairobi providing specialized care in Orthopedic, Reconstruction and rehabilitative services.
- Patients are seen in the outpatient clinics and outreach clinics (who are referred to the main center for further evaluation). Every year approximately 10000 patients pass through their outpatient center either as Self referral or via referrals from other hospitals throughout the country.

Population

Inclusion criteria

- All consenting adults aged between 18-65 years of age coming to the KORC out-patient Clinic

Exclusion Criteria

- Previous History of Foot Surgery
- Non Consenting Adults
- Any form of Lower limb amputation
- Related psychiatric diseases such as dementia e.t.c
- Known congenital anomaly of the lower limb
- Other forms of foot deformities (Charcot etc)
- Pregnant Females

Sample Size Calculation

The sample size was determined by the Fisher et al (1998) formula:

$$\boldsymbol{n_o = \frac{Z^2 pq}{d^2}}$$

Where:**n** is the sample size, **Z** is the Standard normal deviate corresponding to 95% level of confidence = 1.96, **p** is Estimated prevalence of characteristic of interest, since the variability in the proportion is unknown, therefore, it is assumed p=0.5(maximum variability), **q**=1-p,

d = Level of precision (set at ± 5%).

Therefore:

$$\boldsymbol{n_o = \frac{1.96^2(0.5)(1-0.5)}{0.05^2} = 384}$$

In KORC an average of 800 patients are seen per month. To obtain the sample size for this study the adjustment formula was used as follows:

$$n = \frac{n_o}{1 + \frac{(n_o - 1)}{N}}$$

Where: ***N*** is the population size

Therefore:

$$n = \frac{384}{1 + \frac{(384 - 1)}{800}} = 259.4 \approx 259$$

A sample size of 259 was used.

Recruitment & Consenting procedures

Patients within the age bracket coming to the outpatient clinic for related or non- related conditions during the study period were selected using a simple random sampling method (every even number of patients). A brief history was taken to screen patients who satisfied the inclusion criteria. From this, 259 patients were recruited and enrolled upon signing of the consent.

Data Collection Procedures

A face to face interview with each patient was conducted using a standardized questionnaire given to each recruit to collect data on:

Demographics (Age, Sex, Weight in Kilograms, Height in meters, Residence, Occupation)

Related Etiology (Family history of HV, Foot wear Characteristics (Flat vs Heel, Open vs Closed) & duration of use. Data on associated pain and use of inserts was also recorded.

Foot history (Foot pain, its characteristic and location, Bunion history).

The questionnaire contained modified extracts from the ACFAS and HVMIS scoring systems. Care was taken to maintain validity as explained by Weiss et al in their review of the ACFAS guide[82].

They then proceed to the second phase of the data collection where a clinical examination of the feet by the principle investigator/ research assistant was done. Parameters assessed included:

Position of the foot (Cavus, pronated, supinated, equines, combination)

Presence or absence of **Hammer toes** and **callosities** that represent muscle imbalances or shoes that don't fit well such as narrow toe box shoes. Hammer toes were defined as toes that have a bending deformity at the interphalangeal joint.

Bunion characteristics if present such as tenderness (using VAS Scoring), overlying skin (ulceration, inflamed etc)

Pes Planus clinical assessment included two notions; the medial arch that was assessed visually and noted as high arch or low arch. This was then measured with a tape measure. A perpendicular distance from the level of the ground of less than one centimeter denoted presence of pes planus[88] on weight bearing. Also the foot was observed from the posterior aspect where the hind foot was brought in alignment with the midline of calf. Three or more toes seen on lateral aspect depicted pes planus clinically[88]

Shape of the foot as per Morton's theory was noted as Egyptian, Greek or Square (See Figure 10)

Sensation over medial side of 1st MTPJ was determined with the aid of a Semmes – Weinstein 5.07 monofilament[71]. A 10 gram force applied by the filament was focused around the medial border of the 1st MTPJ and recorded as present, diminished or absent as compared to the dorsal aspect of the mid foot.

The patients were then asked to step on a white paper with a straight line drawn where they placed their most medial side of the 1st MTPJ and the heel. The Clinical measurement of the Hallux Valgus was done by a hinged 360^{o} clear plastic goniometer. The center was at the most medial part of the 1st MTPJ with one arm parallel to the medial side of proximal phalanx and the

other along the medial side of 1st Metatarsal. This is a standardized way described by the American Academy of Orthopedic Surgeons first in 1988[89,90] and then by a number of authors in the coming years.[8,44,91–93]. Those who demonstrated an angle of 15° or greater qualified for a weight bearing radiograph. An illustration of the HVA measurement is seen in Appendix 6

Finally Radiographic angles were measured using a Goniometer. These Weight bearing radiographs were done with the patient in a standing position and the beam aimed at the midfoot (navicular region) at an angle of 20° from the vertical following the dorsoplantar direction. This was done from a standard height of 150cm and by the same radiographer throughout the study for validity purposes. The above has been described by Schneider et al[90,94], Cavanagh et al[95] and recently Nix et al[96,97]. Recordings of the Hallux Valgus Angle (HVA), Intermetatarsal Angle (IMA), Sesamoid positioning and Joint congruency was done using a standardized way described by Schneider et al[94,97] and Srivastava et al[98] and augmented by Coughlin et al[8,50]. Presence or absence of Pes Planus was made by calculating the Meary Angle on a Lateral weight bearing x-ray of the foot as described by Coughlin et al (See text in literature review). An objective scoring system out of 50 was calculated (check appendix 5) and lower scores indicate worsening cases of the condition.

Training Procedures

Clinical Officers recruited were trained on how to carry out foot assessment and x-ray assessment (angles etc)

A dummy run was conducted on 10 patients with the principle investigator in order to further enhance the training on selected patients presenting to the clinic who were not included in the study.

Quality Control

Randomly selected X-rays were sent to a single radiologist to carry out angle measurements and correlate with those of researchers in order to verify and limit errors.

The questionnaire was pre-tested on 5 patients with special attention paid to sensitivity and acceptability of the questions. They were also put through the clinical assessment and foot sketch measurements. All of them were excluded from the study to avoid bias.

Data Management, Statistical Analysis and Presentation

Data from the collection sheets was entered into Microsoft Excel and stored under a password. These were then exported to SPSS version 20 for analysis with the help of a statistician. Data was then presented in the form of charts, tables and graphs.

ETHICAL CONSIDERATIONS

The Study got its approval from the Kenyatta National Hospital/ University of Nairobi Ethics and Research Committee. In addition, permission was also sought from the PCEA Kikuyu Rehab Centre where the study was based.

All Participants received the necessary information pertaining to the study before signing of the consent and had the full authority to decline participation at any point.

The Participants did not bear any extra costs for participating in the study. All costs pertaining to the study were borne by the principal investigator.

All patient information was treated with utmost confidentiality to ensure privacy of the participant.

The radiation dose from the x-rays to be done is calculated at 0.0015 rem (Bradford et al) which is almost negligible to the patient. Moreover, a single radiograph of the affected foot was done which further limited exposure rates to a minimum

Participants had the right to withdraw from the study at any given point. Extra care was taken to ensure that this did not affect their care in the hospital. No penalties were imposed.

None of the participants were given monetary incentives to take part in the study. This was a voluntary based study.

Chapter 5

RESULTS

1. Basic Population Characteristics

Two hundred and fifty nine (259) subjects were assessed after having consented to the study during the period of data collection from 27th December 2016 to 30th January 2017. Of these, 53% (n = 137) were female and 47% (n = 122) Male.

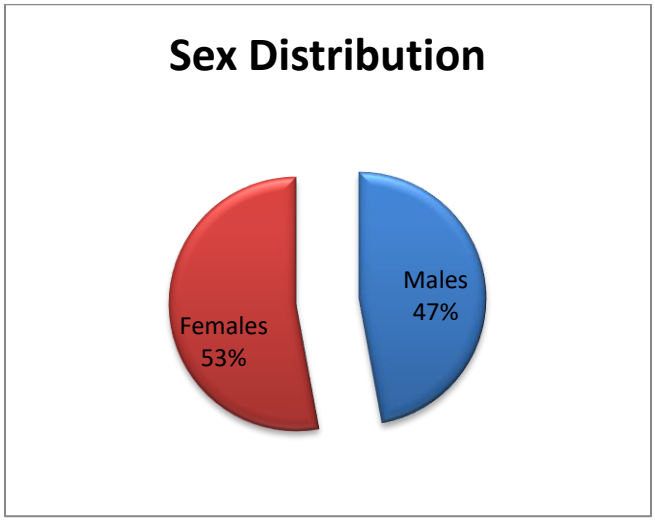


Fig 21: Sex Distribution in the sample population

The Mean age of the sample was 38.3 (SD ± 12.2) with frequencies according to age brackets shown in figure 22. From the data, 30.5% of the subjects fall in the 28-37 age bracket with 24.3% of the population in the 38-47 age range. The least frequency was seen in the 58-67 age range with 10.4% of the population placed here.

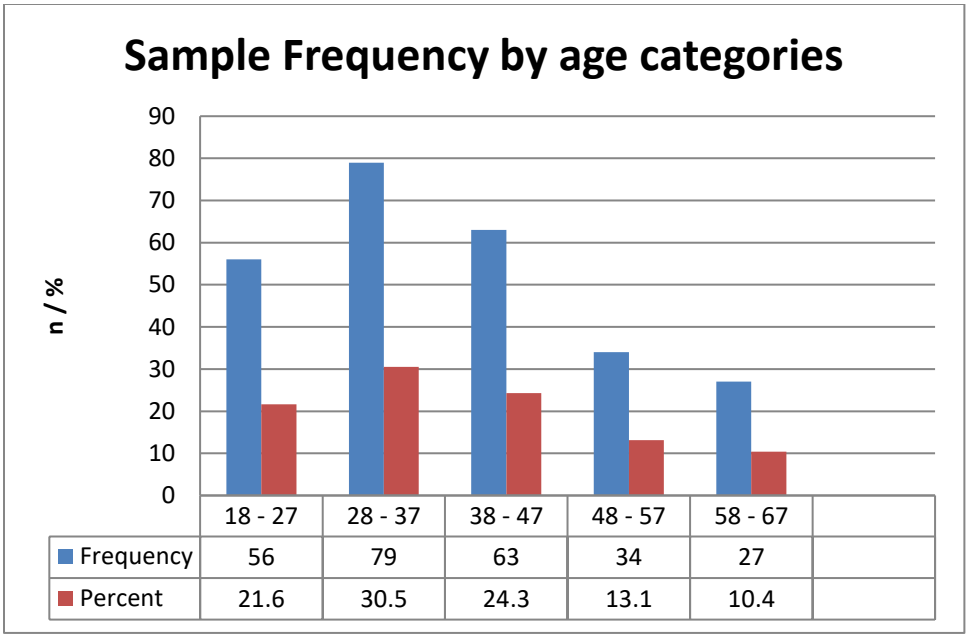


Fig 22: Graphical representation of age categories in the sample population

2. Prevalence of Hallux Valgus

69 of the 259 feet that were assessed demonstrated presence of Hallux Valgus. The prevalence of Hallux Valgus in our population is therefore **26.6%.**

a) Prevalence and Sex

On further analysis of the prevalent population, 55.1% were female (n = 38) while 44.9% were Male (n = 31). There was no statistical significance seen between Sex and presence of Hallux Valgus (p=0.76).

b) Prevalence and Age

The Prevalence was also compared with the Age to ascertain which age group had the most cases of Hallux Valgus. This is tabulated in the Figure 23 below.

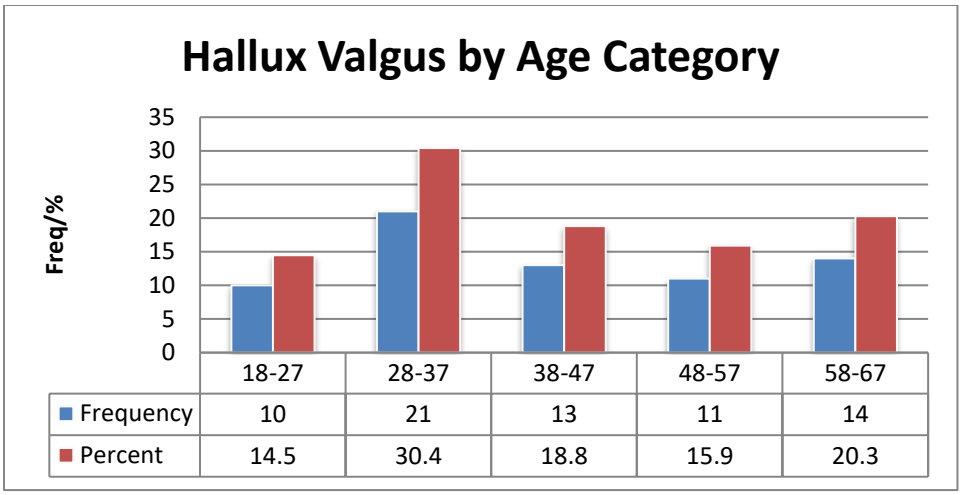


Fig 23: Graphical representation of Prevalence of Hallux Valgus in the age categories

From the representation below, it can be deduced that most of the population was found in the 28-37 age category (n=21, 30.4%) with the 58-67 category having 20.3% (n = 14). Statistically no significance was found between presence of Hallux Valgus and Age (p = 0.067)

A comparison of the proportion of people who had Hallux Valgus in the Age Brackets was done as shown in Figure 24 below. This was calculated by dividing the Hallux Valgus Population by the Sample Population (Hallux Valgus pop/Sample Pop).

	Sample Pop.	**Hallux Valgus Pop.**	**Proportion (%)**
18 – 27	56	10	17.9
28 – 37	79	21	26.6
38 – 47	63	13	20.6
48 – 57	34	11	32.4
58 – 67	27	14	51.9
TOTAL	**259**	**69**	

Fig 24: Proportion of people with Hallux Valgus in the age categories compared to the sample population.

From the data above, it can be seen that the proportion of people with Hallux valgus in the population increases as the age increases. This is shown with steadily increasing values of 20.6%, 32.4% and 51.9% as the age increases. This is further depicted in the pictorial representation seen in Figure 25:

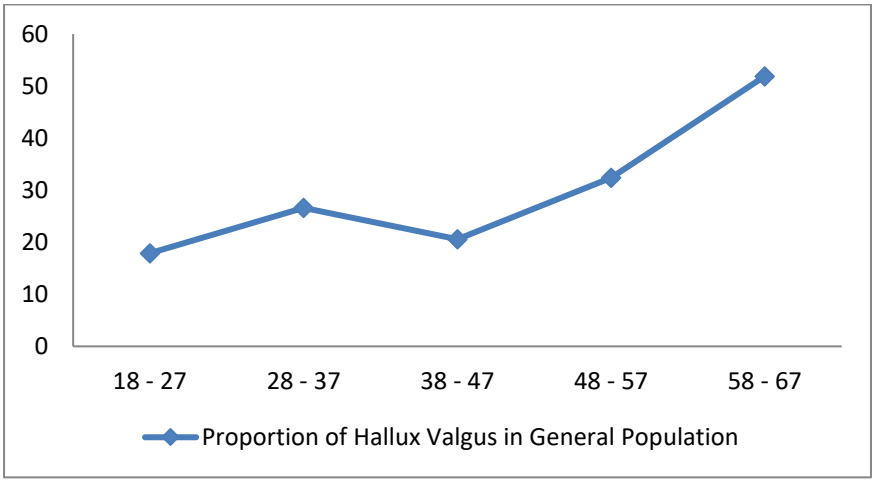


Fig 25: Line Graph showing proportion of Hallux Valgus in the Sample population

c) Prevalence and Body Mass Index (BMI)

Prevalence was also compared to Body Mass Index (BMI) that was calculated using the formula

$$\text{BMI} = \frac{(\text{weight in kilograms})}{\text{height in meters}^2}$$

BMI categories were divided according to the Centre for Disease Control & Prevention classification as follows:

< 18.5	**Underweight**	25 – 29.9	**Overweight**
18.5 – 24.9	**Normal**	>30	**Obese**

Based on the above, a graphical representation shows the frequency of hallux valgus according to the BMI Categories. From the data, Hallux Valgus was most prevalent in the Normal BMI category with 40.6% (n=28) followed by 34.8% in the overweight category (n = 24). The Mean BMI calculated in the prevalent population was 26.2 (SD ± 4.9) with a minimum value of 16.4 and a maximum value of 40.8

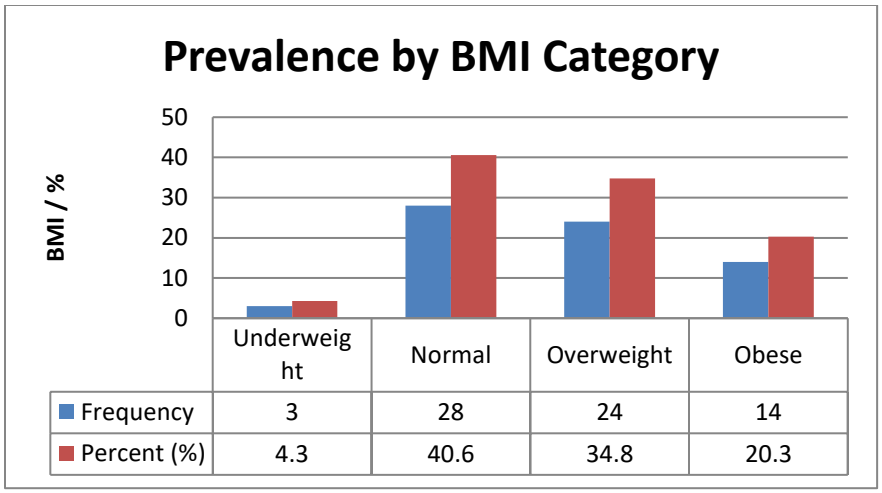


Fig 26: Prevalence of Hallux Valgus as per the BMI categories

Statistically, no significance between BMI and Hallux Valgus was seen (p = 0.97)

d) Prevalence and Family History

From those who had clinical Hallux Valgus, 40.6% (n = 28) mentioned presence of Hallux Valgus in a family member while 59.4% (n = 41) denoted no presence of hallux valgus. To further strengthen this association, a comparison was made with the sample population (n = 259) and tabulated in Figure 29 below.

Family History & Presence of Hallux Valgus

		HV Presence		Total
		Present	Absent	
Family History	Yes	28	27	55
	No	41	163	204
Total		69	190	259

Fig 27: Table showing Presence of Family History in those with Hallux Valgus

From the above data, 49.1% (n = 27)of those who did not have Hallux Valgus showed a positive family history of the condition while 50.9% (n = 28) had a positive History and presence of

Hallux Valgus. No statistical significance was seen between the presence of Hallux valgus and Family history.

Data Analysis was also carried out on family members affected with 35.7% (n = 10) of those who had Hallux Valgus mentioning their Mothers as having the same condition with 28.8% (n = 8) mentioning a sibling while 25% mentioned seeing their father with the condition (n = 7).

e) Prevalence and Flat Foot

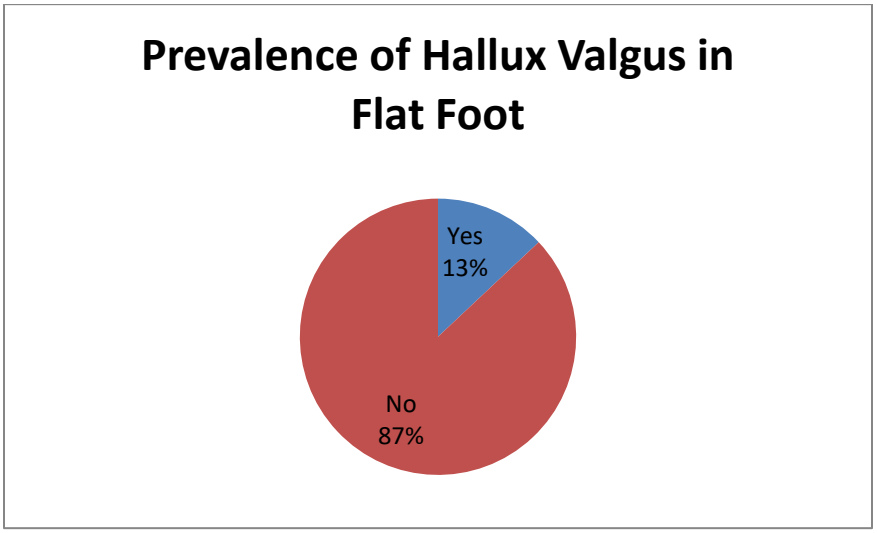


Fig 28: Prevalence of Hallux Valgus in Flat feet

The sampled population was assessed for the presence or absence of flat foot. The Overall Sample population depicted the following characteristics

Flat foot compared with Presence of Hallux Valgus

		HV Presence		Total
		Present	Absent	
Flat foot	Yes	9	18	27
	No	60	172	232
Total		69	190	259

Fig 29: Table showing comparison of Flatfeet in the Sample and affected population

In the local population, prevalence of Hallux Valgus was seen in 13% of those with Flat feet as compared to 87% of those who had Hallux Valgus and absence of Flat feet. It was seen that 9.5%

of those without Hallux Valgus had Flat feet. No Statistical significance was found with the presence of Flat foot and Hallux Valgus (p = 0.4)

f) Prevalence and Shape of Metatarsal Head

The metatarsal head was assessed using radiographs and categorized as Chevron, Flat or Oval. From the analysis, 45% (n = 31) of the feet with Hallux Valgus had Chevron heads while 42% (n = 29) had Oval. Only 13% (n = 9) had flat metatarsal heads. This is shown below:

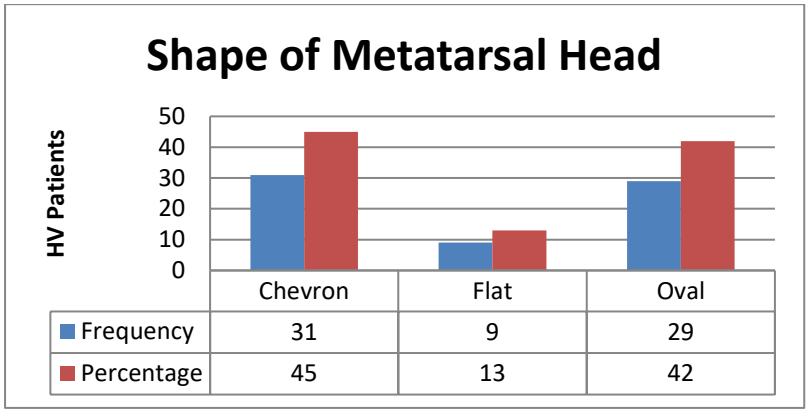


Fig 30: Graphical representation of shape of metatarsal heads in the HV population

g) Prevalence and Shape of Foot

The shape of the foot was divided into three categories as Egyptian, Greek and Square. In the whole sample, 63.7% (n = 165) had Egyptian feet compared to 27.8% (n = 72) for Greek and 8.5% (n = 22) for Square. When comparing for those who had Hallux Valgus, 62.3% (n = 43) had Egyptian feet, 30.4% (n = 21) had Greek while 7.2% (n = 5) had Square. This is represented in the Figure 31 below:

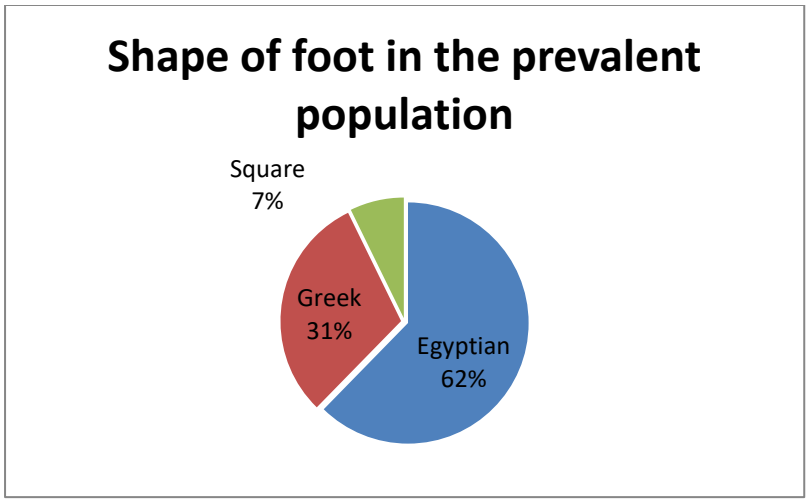


Fig 31: Pictorial representation of the shape of feet in the prevalent population

Figure 32 below shows that 62% of those with Hallux Valgus had Egyptian feet while 64% of those who did not have Hallux valgus presented with Egyptian feet. The Relative Risk calculated for this was 0.93 showing a reduced risk of having Egyptian feet and getting Hallux Valgus. Greek feet were seen in 31% of those with Hallux Valgus while 26.8% of those without Hallux Valgus presented with Greek feet. The relative risk calculated was 1.1 showing an increased risk of Hallux Valgus in Greek feet. This was not the case with Square feet that had a relative risk of 0.8

Shape of Feet	Presence of HV	Absence of HV	Relative Risk
Egyptian	62%	64%	0.93
Greek	31%	26.8%	1.1
Square	13%	8.9%	0.7

Fig 32: Table showing Relative Risks for the shape of feet

h) Prevalence and Medial Sensation

For those who had Hallux Valgus, 58% had a normal Sensory perception on examination. However, 42% of those with Hallux Valgus had diminished perception and none had no sensation. Based on the chi square test, a p value <0.001 was deduced showing a strong association between presence of Hallux Valgus and Altered sensation on the medial aspect.

i) Foot wear and Hallux Valgus

A comparison of footwear characteristics was made between the overall sample population and those affected with Hallux Valgus. This was tabulated in the Figures 33 & 34 below.

FOOT WEAR CHARACTERISTIC IN THOSE WITH HALLUX VALGUS

		FLAT		HEEL <6CM		HEEL >6CM	
		n	%	N	%	n	%
CLOSED	ROUND	41	59.4	12	17.4	0	0
	NARROW	1	1.4	8	11.6	1	1.4
OPEN	ROUND	3	4.3	3	4.3	0	0
	NARROW	0	0	0	0	0	0

Fig 33: Table showing Footwear characteristics in those with Hallux Valgus

FOOT WEAR CHARACTERISTIC IN THE TOTAL SAMPLE POPULATION							
		FLAT		HEEL <6CM		HEEL >6CM	
		N	%	n	%	n	%
CLOSED	ROUND	151	58.3	41	15.8	0	0
	NARROW	8	3.1	19	7.3	3	1.2
OPEN	ROUND	19	7.3	14	5.4	2	0.8
	NARROW	0	0	2	0.8	0	0

Fig 34: Table showing Footwear Characteristics in the total sample population

No statistical significance was seen between wearing a certain footwear and Hallux Valgus. Most of our population wore Closed Flat Round shoes (59.4% for those with Hallux Valgus compared to 58.3% in the general population). Constrictive foot wear (Narrow toe box) with Heels (Heel <6cm or > 6cm) was uncommon in our population and a comparison between the two populations (Overal Sample and Hallux Valgus) showed no difference.

3. Severity of Hallux Valgus in the Population

The severity of Hallux Valgus was categorized into Mild, Moderate & Severe. This was based on the universally agreed radiological classification by AOFAS. Based on this, the following analysis was done.

In our population, 56.5% (n = 39) of those with Hallux Valgus had the mild form with 37.7% (n = 26) having moderate Hallux Valgus. Severe Hallux Valgus was only seen in 5.8% (n = 4) of the population. This is represented in Figure 35 below.

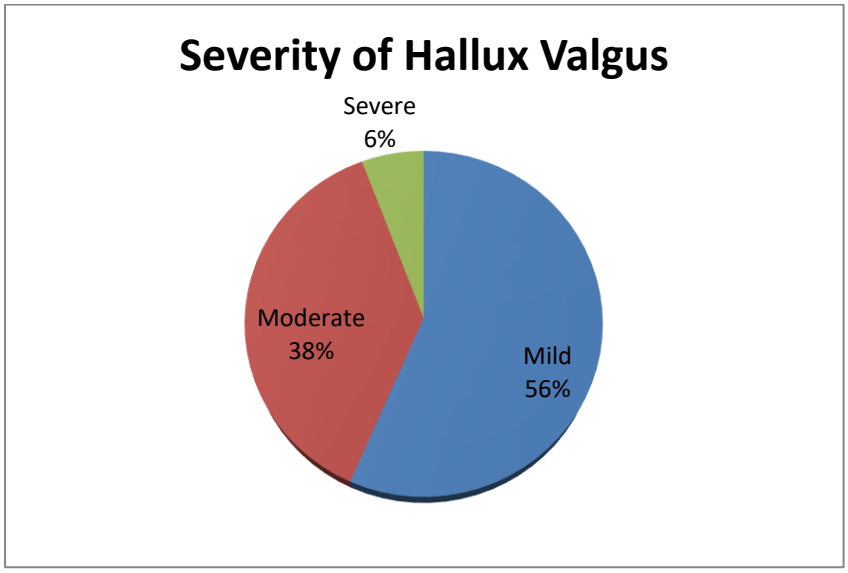


Fig 35: Pictorial representation of the Severity of Hallux Valgus in the population

a) Severity compared to Age

A comparison between the severity of Hallux Valgus and Age was done. The table below highlights the frequency distribution.

Severity of Hallux Valgus According to age categories

		HV Severity			Total
		Mild	Moderate	Severe	
Age Bracket	18 - 27	7	3	0	10
	28 - 37	15	5	0	20
	38 - 47	7	7	0	14
	48 - 57	6	4	1	11
	58 - 67	4	7	3	14
Total		39	26	4	69

Fig 36: Table showing Severity of Hallux Valgus according to age categories

The highest frequency of Mild Hallux Valgus was seen in the 28-37 age category (n = 15 – 38.5%) with the least in the 58-67 age bracket (n = 4 – 10.3%). The highest frequency of Moderate Hallux Valgus was shared between two age categories, 38 - 47 and 58 – 67, with 26.9% (n = 7) in each category. The least was seen in the 18-27 category (n = 3 – 11.5%). Severe Hallux Valgus was mostly seen in the 58 – 67 category with 75% (n = 3).

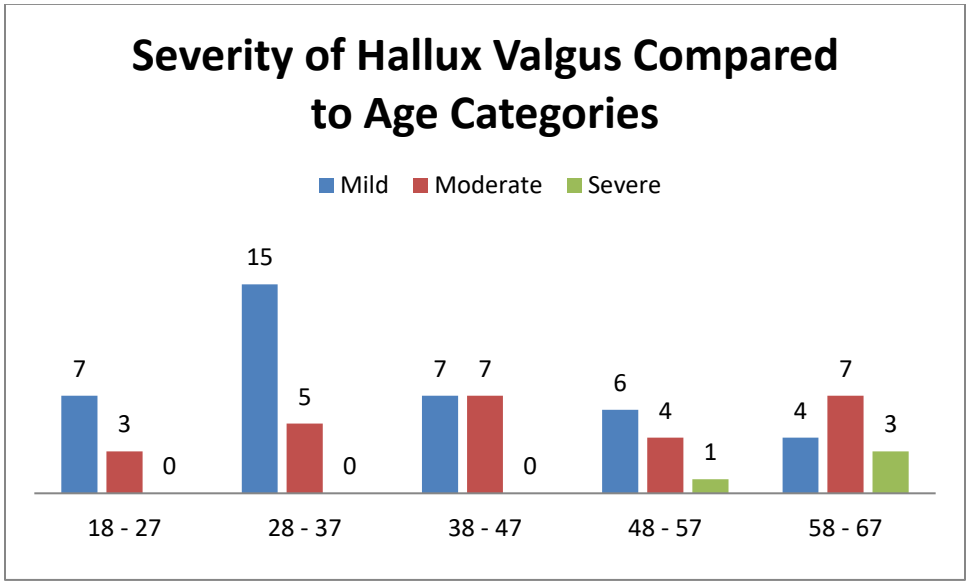
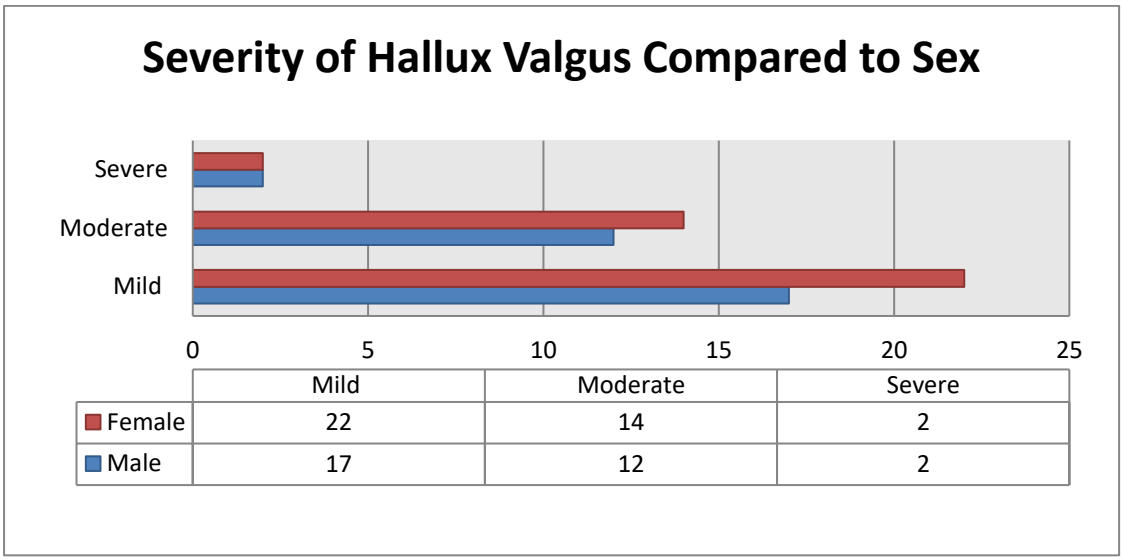


Fig 37: Pictorial representation of severity of hallux valgus compared to age categories

The Pearson's Chi square test demonstrated a p value of 0.072 which shows that not enough data was present to show any statistical significance between the two.

b) Severity compared to Sex.



	Mild	Moderate	Severe
Female	22	14	2
Male	17	12	2

Fig 38: Graphical representation of Severity of Hallux Valgus compared to Sex

Females showed a 56.4% (n = 22) presence in the Mild Hallux Valgus Category compared to 43.6% (n = 17) for Males. This was closer in the Moderate category with 53.8% (n = 14) for females and 46.2% (n = 12) for Males. Both demonstrated equal presence in the Severe Hallux Valgus category with 50% each.

The Pearson's Chi Square analysis was carried out on the above data and no statistical significance was noted (p = 0.96)

c) Severity Compared to Body Mass Index

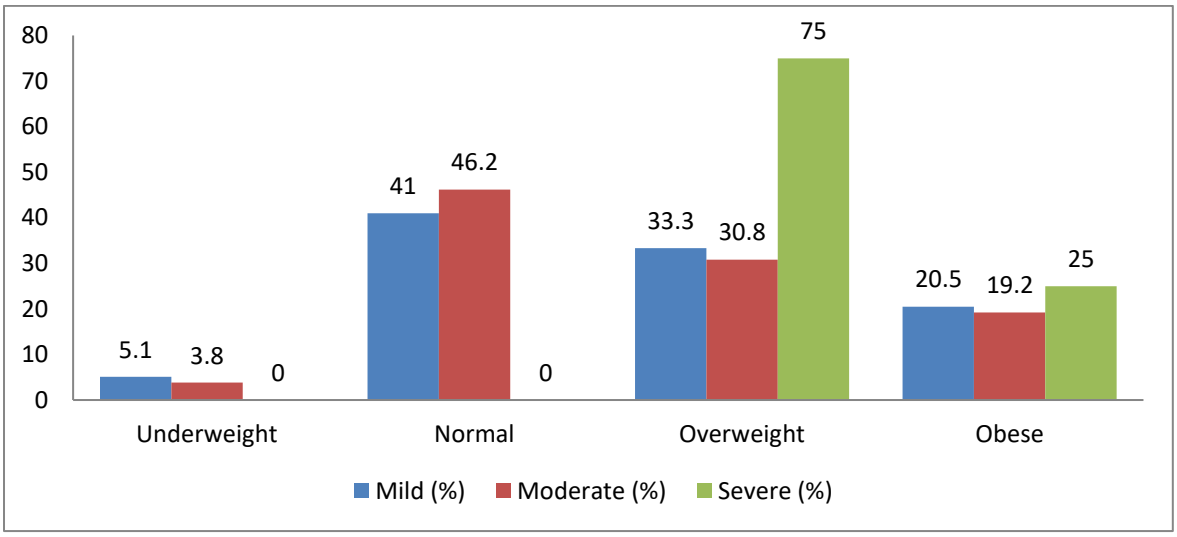


Fig 39: Graphical representation of Severity of Hallux Valgus compared to Body Mass Index

When categorized for BMI, 75% (n = 3) of those with severe Hallux Valgus were overweight with a further 25% Obese. Most of those with Moderate Hallux Valgus had a normal Body Mass Index (46.2% - n = 12) while others were overweight (30.8% - n = 8). Those with Mild Hallux Valgus were comparable in the Normal and Overweight categories with 41% (n = 16) & 33.3% (n = 13) respectively. Data was not significant to make a comparison in the underweight category. A p value of 0.66 was achieved by the Pearson Chi square analysis that translates to lack of significance between the two parameters.

d) Severity Compared to Presence of Family History of Hallux Valgus

Data was analysed to see whether Presence of Hallux Valgus in the family had an impact on the severity of Hallux Valgus. A significant pattern was observed where Presence of Family history increased as the severity of Hallux Valgus increased. 71.8% (n = 28) of the affected individuals had no family history of Hallux Valgus compared to 28.2% (n = 11) for Mild Hallux Valgus. However, 57.7% (n = 15) had a positive history compared to 42.3% (n = 11) for those with moderate hallux valgus. A 50% (n = 2) chance was seen in severe hallux valgus for both.

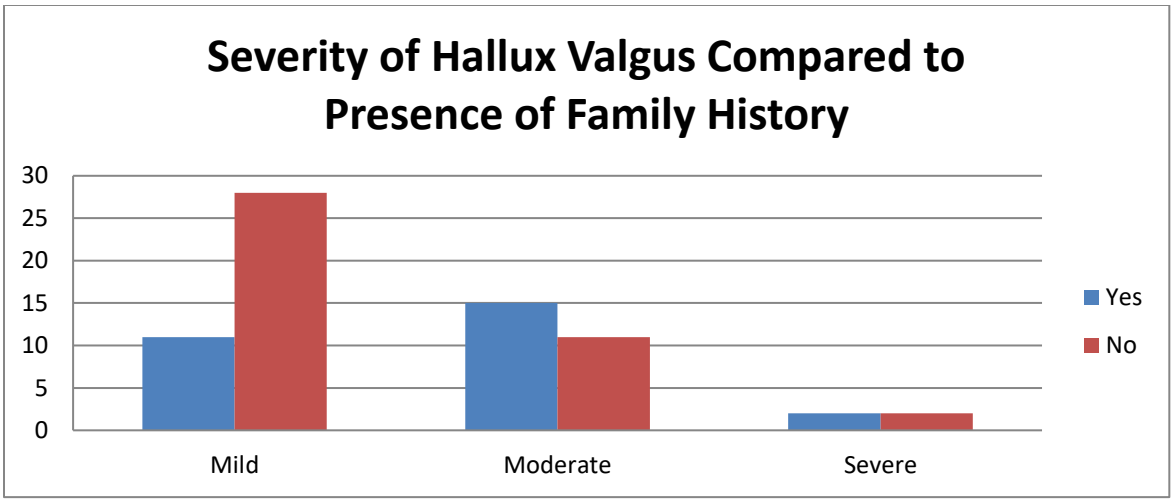


Fig 40: Chart showing Severity of Hallux Valgus compared to presence of family history

From a statistical point of view, a weak association was seen between family history and severity of hallux valgus with a p value of 0.056. Relative risks were also evaluated for the above and a similar pattern was seen with the RR = 0.58 for Mild Hallux valgus, 1.99 for Moderate Hallux Valgus and 1.45 for Severe Hallux Valgus. Hence the risk of having moderate and severe hallux valgus was more in those with a positive family history.

e) Severity Compared to Shape of Feet

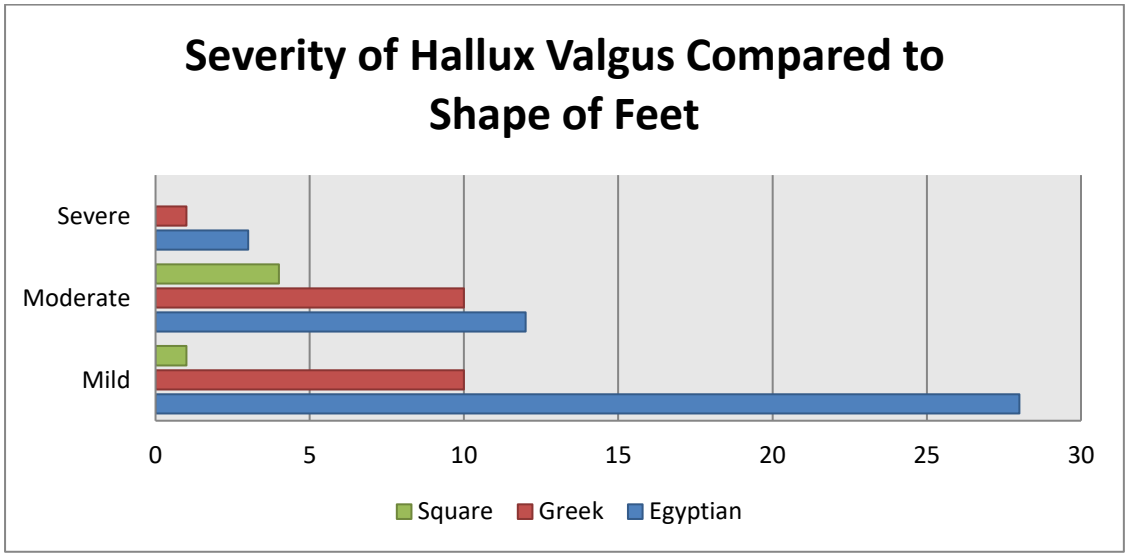


Fig 41: Chart showing Severity of Hallux Valgus compared to shape of feet

The three types of feet were analyzed and it was found that Egyptian feet were present in 71.8% (n = 28) of those with Mild Hallux Valgus compared to 26.6% (n = 10) and 2.6% (n = 1) for Greek and Square respectively. For Moderate Hallux Valgus, 46.2% (n = 12) were Egyptian feet compared to 38.5% (n = 10) and 15.4% (n = 4) for Greek and Square respectively. No Square feet were seen in the severe cases while there were 75% (n = 3) Egyptian and 25% (n = 1) Greek feet.

The relative risk for the feet was calculated and it was deduced that a greater than 50% chance exists for one to have Egyptian Feet and develop mild Hallux Valgus (RR = 1.55). For Severe Hallux Valgus, the chance was even more with a Relative Risk of 1.83. For moderate Hallux Valgus, A clear pattern was not seen for Greek feet which has a relatively low risk of 0.80 for mild Hallux Valgus but a significantly higher risk for moderate hallux valgus of 1.42.

f) Severity compared to Flat feet

No significant conclusion was achieved as related to an association between Flat feet and the severity of Hallux Valgus. The P value derived from the Pearson's Chi Squared test was 0.14

g) Severity compared to Altered Medial Sensation

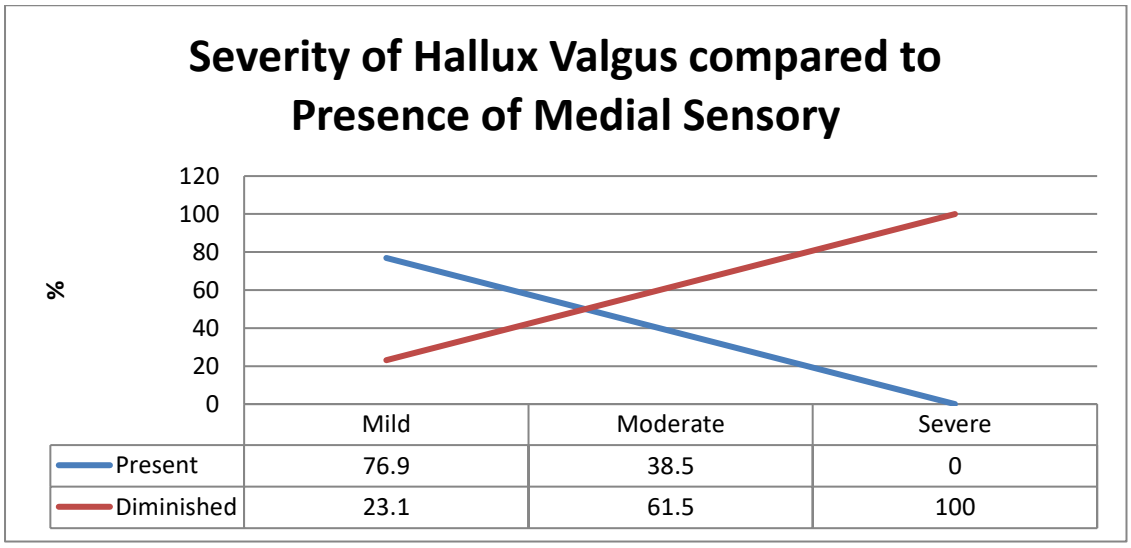


Fig 42: Line Graph showing Severity of Hallux Valgus compared to presence of medial sensory

A positive association was seen between the two with a p value of <0.001. Medial Sensory function decreased as the severity of hallux valgus increased as shown above with 76.9% (n =

30) in Mild, 38.5% (n = 10) in moderate and none in the severe form as compared to an increasing trend for those with diminished sensation. (23.1% (n = 9) for mild, 61.5% (n = 16) for moderate and 100% (n = 4) for severe Hallux Valgus).

4. Radiological Analysis

Angles measured were Hallux Valgus Angle (HVA) and 1-2 intermetatarsal angle (IMA). Sesamoid Subluxation was also checked for as well as the shape of the metatarsal. Finally for those with clinical flat feet, a meary angle was determined. The table below summarizes the above.

	Category	Frequency	Percentage (%)	
HVA Range	15 - <20	39	56.5	Mean = 21.8 SD ± 6.99 Mode = 17 Min (15), Max (45)
	20 - <40	26	37.7	
	>40	4	5.8	
IMA Range	0 - <9	8	11.6	Mean = 10.2 SD ± 1.8 Mode = 9.1 Min – 5.6 Max – 17.7
	9 - <11	42	60.9	
	11 - <16	18	26.1	
	>16	1	1.4	
Sesamoid Subluxation	<50%	28	40.6	
	50 – 75%	31	44.9	
	>75%	10	14.5	

Fig 43: Table summarizing Radiological Analysis

The highest frequency for the Hallux Valgus Angle (HVA) was seen in the 15 - <20 category with 56.5% (n = 39) while IMA range frequency of 60.9% (n = 42) was seen in the 9 - <11 category. Sesamoid Subluxation was comparable at 44.9% (n = 31) in the 50 – 75% category and 40.6% (n = 28) in the <50% category.

The mean value for HVA range was 21.8 SD ± 6.99 with a mode of 17^{o} and a minimum value of 15^{o} & a maximum value of 45^{o}. The mean value for the IMA range was 10.2 SD ± 1.8 with a mode of 9.1^{o} and a minimum value of 5.6^{o} & and a maximum value of 17.7^{o}.

Spearman Correlation was carried out between the above radiological parameters. From the results in the table below, a positive correlation was seen between the three values.

	IMA	Sesamoid Subluxation
HVA	r = 0.67 p <0.01	r = 0.62 p <0.01
Sesamoid Subluxation	r = 0.61 p <0.01	

Fig 44: Table showing Correlations between the radiological parameters

Chapter 6

DISCUSSION

Hallux Valgus is the commonest discussed forefoot problem in the world. In Kenya, a gap exists in its identification and management. This study was based at the PCEA Kikuyu Hospital, Orthopedic & Rehab division that receives patients from all over Kenya with numbers around 800 every month.

The Prevalence of Hallux Valgus in this study is 26.6% with the target population between the ages of 18-65 years. The study involved the use of both clinical and radiological analysis. This is comparable to Nix et al[20] who conducted a meta-analysis in 2010 and deduced a prevalence of 23% for a similar age group. Roddy et al[19] showed a prevalence of 28% that targeted a population over 30 years and used questionnaires only. Wu et al[22] in 2010 noted a prevalence of 36% amongst Chinese females aged 18 – 65 while Okuda et al[21] in 2014 had a prevalence of 12.8% amongst Japanese females less than 20 years of age. A prevalence study conducted by Owoeye et al in Nigeria in 2011 showed a prevalence of 15.4% amongst secondary and undergraduate students. It is worthwhile to note that the above studies have varied sample characteristics and different modes of data collection with no study having exactly identical characteristics to our study. However, certain individual characteristics from various studies can be evaluated to come up with a comparison as done above.

A greater proportion of the sample population had Mild Hallux Valgus with 56.5% (n = 39) falling in this bracket with 37.7% (n = 26) and 5.8% (n = 4) in the Moderate and Severe category of Hallux Valgus respectively (See Fig. 35). This was based on the classification by AOFAS as described earlier[6,8,9,73,74] and involved confirmation by radiological studies. A positive correlation between HVA, IMA and sesamoid subluxation was seen (see Fig. 44) that confirms similar findings by Coughlin, Hardy & Clapham et al[6,8,79].

Females have generally been shown to have a higher chance of having Hallux Valgus[3,4,8,20,21]. This study showed a similar trend with 55.1% of those with Hallux Valgus being female while 44.9% being Male. However, no statistical significance using the Chi square test (p value = 0.76). A possible explanation can be the random sampling that was done in our case. Majority of

the other studies have been done in specialty clinics whose patients are mostly women. Some studies such as Okuda et al and Wu et al were done exclusively in females. The overall sample population had 53% females and 47% males and eliminated the aspect of cosmetic bias or chronic illness bias that affects health seeking behavior. When it came to severity of Hallux Valgus, similar characteristics were seen (see Fig 38) with no association between sex and severity of Hallux Valgus ($p = 0.96$).

This study was inconclusive on Hallux Valgus and the presence of it in the family. It had 40.6% (n=28) of those with hallux valgus mention a family member with the same while 59.4% (n=41) did not mention any presence (See Fig 27). For those who mentioned a family member, 35.7% (n = 10) mentioned their mothers as affected while 28.8% (n = 8) mentioned a sibling and 25% (n = 7) stating their father as the affected one. Other studies have shown a strong association with Hardy et al[5,6] citing 63% of their patients having a parent with HV while Coughlin et al[50] stating that 94% of mothers whose children had Hallux Valgus also had a bunion themselves. Okuda et al[21] had 48% of their population having a positive family history with a 60.4% chance of a child having a mother with Hallux Valgus. Finally, Coughlin & Jones[8] also showed that 83% of their patients had a positive family history. Presence of Hallux Valgus in the family was also seen to have a weak association with the severity of hallux valgus in the local population. A relative risk of 1.99 for Moderate Hallux Valgus and 1.45 for Severe Valgus was seen suggesting that the risk of having moderate and severe valgus was more in those with a positive family history (See Fig. 40). This may need further exploration in future studies. Possible explanation to inconclusive associations for the above is that this was based on recall by the patients. Bunion knowledge is low amongst the local population and most consider it normal and even admitted to not being keen enough to notice in their family members. This may have affected the data above. However, those with moderate and severe Valgus were more certain of the family presence of Valgus as compared to those with Mild Valgus.

This study had a mean Body Mass Index (BMI) of 26.2 (SD ± 4.9) in the prevalent population with 40.6% of those with Hallux Valgus found in the 'Normal' Category according to the Centre of Disease Control & Prevention classification while 34.8% were found in the 'Overweight' category. As BMI increased, the prevalence of Hallux Valgus decreased (See Fig. 26). This is consistent with studies by Nguyen et al[17], Menz et al[12] and Golighty et al[49] which illustrated that

an increase in BMI was associated with a decrease in prevalence of Hallux Valgus. The reason was related to wearing of more fashionable shoes amongst people with normal BMI. No statistical significance between BMI and Prevalence of Hallux Valgus ($p = 0.97$) was seen which is consistent with studies by Frey et al[2,48] and Roddy et al[17,19]. Only Cho et al[26] showed an increase in prevalence of Hallux Valgus with an increasing BMI. When BMI was compared to Severity of Hallux Valgus, it was noted that 75% of those with severe Valgus were overweight with 25% obese. This can be related to a possible explanation that most of the population with severe Valgus were in the 58-65 age category, retired and experiencing pain in their feet which may limit mobility. However a p value of 0.66 confirmed that there was no statistical significance between the two and larger numbers are required to make any meaningful conclusions.

The sample population was between the ages 18 – 65 years with the mean age being 38.3 (SD ± 12.2). In contrast, the mean age of the local population with Hallux Valgus was 42.1 (SD ± 13.6). A greater proportion of the local sample population was found in the 28-37 age bracket (30.5%) with the least in the 58-67 age bracket (10.4%). In contrast, 30.4% was found in the 28-37 category for those with Hallux Valgus and 20.3% in the 58-67 category (See Fig. 23). No statistical significance was seen between the two ($p = 0.0067$). Most studies have shown that the prevalence of Hallux Valgus increases with age. Menz et al[11] showed a 74% prevalence in the elderly population as supported by Roddy et al[19], Nix et al[20] and Golightly et al[49]. The study did not conclusively support this, a fact attributed to a smaller sample size and a lesser proportion of elderly patients in this population since most of these studies had patients up to 80 years of age. However, it was noticed that there was an increasing proportion of people with Hallux Valgus as age progressed which is in keeping with studies around the world (See Fig 25). The sample population also demonstrated increasing severity of Hallux Valgus with advancement of age. No association between age and gender was seen ($p = 0.2$)

Flat foot and its association with Hallux Valgus has been a controversial topic. The study showed no association with Hallux Valgus with 87% of those affected not having flat foot compared to 13% with Hallux Valgus and Flat foot. Other studies have also had varied conclusions. Kilman and Wallace[59], Coughlin and Jones[8], Grebing et al[60] and Okuda et al[21] all showed no association. Hohman et al[61] and Westbrook et al[62] showed an association with the two. Nguyen et al[17] went

further to say that men with pes planus were twice likely to get hallux valgus. In this study, females with flat feet are twice more likely to get hallux valgus (66.6% for females compared to 33.3% for males).

This study showed no association between footwear and development of Hallux Valgus. Constrictive wear had no role in development of Hallux Valgus in this study. This is in keeping with studies by Coughlin et al[28], Barnicat et al[30] and Gottschalk et al[31]. Wu et al also found no association between high heels and hallux valgus[22]. However, some authors such as Kato & Watanabe, Nguyen, Al Abdulwahab et al[17,29,43] have found a positive correlation between footwear and Hallux Valgus though most of their populations were female. One possible reason for the findings in this study was the fact that the local population's footwear characteristics may not have been similar to those of the western world. A very small proportion of the population wore constrictive foot wear and most wore a variety of footwear with constrictive and high heel wear reserved for occasions and weekends. The study concludes that footwear does not play a role in Hallux Valgus. However further biomechanical studies are recommended to support this.

Shapes of feet were classified into Egyptian, Greek and Square. Viladot et al[4,66] in 1973 cited Egyptian feet as more likely to develop Hallux Valgus with 73% of his population having that. Only 23% of Greek feet had hallux valgus. Magee et al[88,99] in 1997 assessed that 69% of the population had Egyptian feet while 22% had Greek and 9% had Square. This study had a similar pattern with 63.7% having Egyptian, 27.8% having Greek and 8.5% comprising Square feet. For those who had Hallux Valgus, 62.3% had Egyptian feet, 30.4% Greek and 7.2% had Square feet (See Fig. 32). There is a slight increase in greek feet and presence of Hallux Valgus as compared to other studies. A comparison was made to our overall sample population and an interesting finding was noticed where greek feet had a higher risk of developing some degree of Hallux Valgus compared to the rest (RR = 1.1). This matches the Mortons theory[60,65] which revolved around the Morton's foot characterized by a short 1st metatarsal relative to the 2nd. When the 1st Metatarsal is short the 2nd one takes on the job of weight acceptance with foot impairment and occasional abnormal pronation. When compared to severity of Hallux Valgus, a clear pattern was not seen with the greek foot with varied relatives risks as compared with Egyptian feet which had a consistently increasing risk (See Fig. 41). A possible explanation for this finding can be the fact that most studies haven't compared the general population with the Hallux Valgus population.

The overall sample population is deemed to have more people with Egyptian feet hence the numbers will be reflected on the Hallux Valgus Population. However, the comparison of greek feet has not been done and the few who develop Hallux Valgus represent a significant value. Higher population samples and biomechanical studies are needed to prove this aspect.

Oval Metatarsal Heads have been shown to be more common in Hallux Valgus with Chevron and Flat thought to be more congruent[67]. Heden et al[68] cited a 90% incidence of round heads in hallux valgus while Piggot et al[67] showed that only 9% of his sample had congruent metatarsal heads. Some authors have written against this arguing that it is not clear if the described heads are truly discrete anatomical entities and may be misleading as apparent shapes vary with metatarsal pronation and inclination. They point out that there is no accurate way of measuring this[53,100]. This study was inconclusive showing 45% of those with Hallux Valgus had Chevron heads compared to 42% with Oval heads and 13% with Flat.

The study showed a positive correlation between Hallux valgus and altered sensory nerve function along the dorsomedial cutaneous nerve pathway with a p value of 0.047. 42% of those with Hallux valgus demonstrated altered sensation and this was seen to increase with severity of hallux valgus. This concurs with other studies done on the same by Jastifier[71], Hetherington[35] and Coughlin et al[4,25].

Chapter 7

CONCLUSIONS

This Study projected the prevalence of Hallux Valgus at 26.6% in the local population between the ages of 18-65yrs.Using Radiological analysis, 56.5% had mild hallux valgus while 37.7% and 5.8% had moderate and severe valgus respectively. A positive correlation was seen between HVA, IMA and sesamoid subluxation. A correlation was also seen between Hallux Valgus and altered dorsocutaneous sensory nerve function. No statistical significance was noted when it came to associated factors like Sex, Family History, BMI, Age, Footwear, flat feet, Shape of foot or shape of metatarsal head.

However, interesting trends were noticed in this study. Females are more affected than males with no association between sex and severity of Hallux Valgus. BMI was inversely related to the prevalence of Hallux Valgus and an increasing proportion of people with Hallux Valgus seen as age increased. Hallux Valgus severity also increased with age. Greek feet had a higher risk of developing Hallux Valgus though most of the population had Egyptian feet. A greater risk was seen in getting moderate and severe valgus with the presence of a positive family history.

RECOMMENDATIONS

- Future studies with a larger sample population with development of registries
- Use of biomechanical studies to acertain the role of foot wear in development of Hallux Valgus.
- Create more awareness of the disease and to limit its progression via various local and government policies
- Study incorporating the quality of life in patients with hallux valgus
- Longer surveillance periods

Chapter 8

STUDY LIMITATIONS

The study had a few limitations. A larger sample size would have been preferred for a more comprehensive analysis. We also had some patients who refused to take part in the study since they had sought attention for other conditions and were unwilling to spend more time on the study. Some also declined out of fear for radiation or being told that they have a disease despite going through the explanation and consent procedures.

Patient recall was also a limitation factor in our study since most had poor knowledge of the condition and may have not been accurate in their descriptions. Footwear assessment was also a challenge since duration of a particular footwear could not be ascertained and sample population had various foot characteristics that bore no statistical significance. Hence future studies with more specific parameters as regards the needs of our population need to come up to effectively analyze this parameter.

Chapter 9

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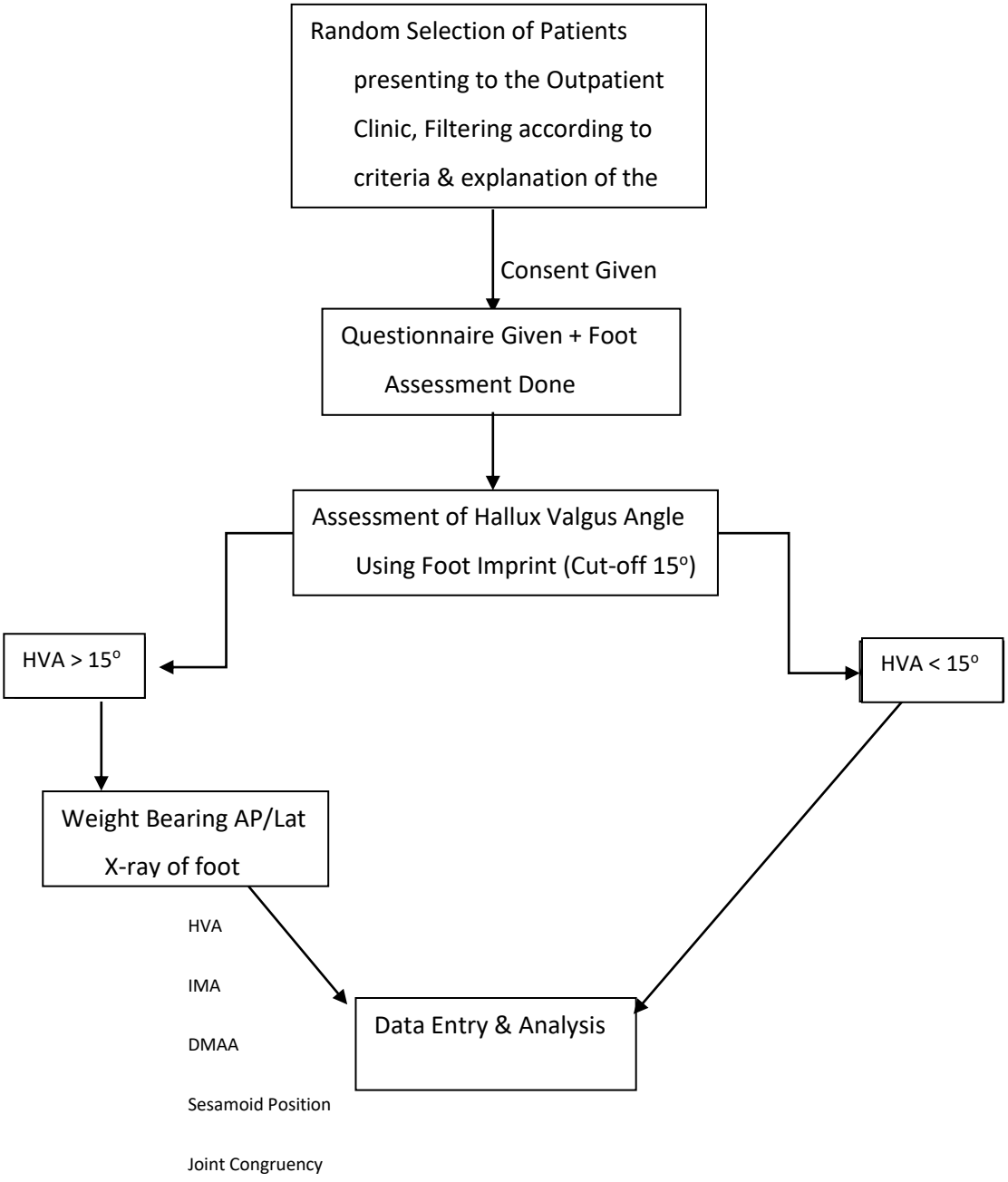
Chapter 10

APPENDIX 1

Patient Data Flow Chart



APPENDIX 2

AMERICAN COLLEGE OF FOOT & AND ANKLE SURGEONS SCORING SCALE

MODULE 1

ACFAS Scoring Scale
Module 1: First MPJ & First Ray

Page 1: Patient Questionnaire

Patient: _____

Date: _____

Patient # _____

INSTRUCTIONS to the Patient:
Please answer the following questions honestly with regard to the condition of your foot.

1. ***Pain (30 points)***
Over the past month, how much has your foot pain limited your daily activities?

- ❑ I have no pain with normal activities (30)
- ❑ I have slight or occassional pain but no limitation of activities (22)
- ❑ I have moderate pain limiting some activities (14)
- ❑ I have pain and significant limitation of activities (6)
- ❑ I have severe pain that limits almost all activity (0)

2. ***Appearance (5 points)***
How would you rate the appearance of your big toe joint?

- ❑ I like it very much (5)
- ❑ I mostly like it (4)
- ❑ I'm not sure either way - neutral (3)
- ❑ I mostly do not like it (2)
- ❑ I definitely dislike it (0)

3. ***Functional Capacities (15 points)***
How frequently do you have pain while wearing shoes?

- ❑ I am able to continuouly wear any type of shoe (15)
- ❑ I am able to wear any type of shoe most of the time (10)
- ❑ I am able to wear ***only*** walking, atheletic or causal shoes (5)
- ❑ I am able to wear ***only*** special order, orthopedic or custom-made shoes (0)

Total Points Page 1: _____

Total Points Module 1: _____

Extracted from Weil J, Thomas J, Christensen L et al. ACFAS Scoring Scale User Guide. Foot & Ankle Sx. 2005;Sept: Pg 316-335

ACFAS Scoring Scale
Module 1: First MPJ & First Ray

Page 2: Objective Parameters

Patient: _____

Date: _____

Patient # _____

4. Radiographic Evaluation ***(18 points)***

AP (Weight-bearing Dorsoplantar) View (6 points)

HA (Hallux Abductus) Angle (6 points)

- ❑ 0-20° (6)
- ❑ 21-30° (3)
- ❑ ≥ 31° (0)
- ❑ -1 to -3° (2)
- ❑ > -3° (0)

IM (Intermetatarsal) Angle (6 points)

- ❑ 0-10° (6)
- ❑ 11-19° (3)
- ❑ ≥ 20° (0)
- ❑ < 0° (0)

Lateral View (6 points)

First Metatarsal Declination Angle (6 points)

- ❑ 16-24° (6)
- ❑ 25-29° (3)
- ❑ ≥ 29° (0)
- ❑ 10-15° (2)
- ❑ < 10° (0)

5. Function **(32 *points)***

Hallux Purchase (Paper-pull out test) (10 points)

❑ Not Movable (10) ❑ Resistant (5) ❑ Easy (0)

Range of Motion: First Ray (17 points)

First MPJ Dorsiflexion (11 points)

- ❑ ≥ 60° (11)
- ❑ 45-59° (8)
- ❑ 36-45° (4)
- ❑ < 36° (0)

First MPJ Plantarflexion (4 points)

- ❑ ≥ 0° (4)
- ❑ < 0° (0)

Hallux IPJ Extension (2 points)

- ❑ Extend to 0° (2)
- ❑ < 0° (0)

Limp from Foot Pain (without shoes) (5 points)

- ❑ No (5)
- ❑ Yes (0)

Total Points Page 2: _____

Extracted from Weil J, Thomas J, Christensen L et al. ACFAS Scoring Scale User Guide. Foot & Ankle Sx. 2005;Sept: Pg 316-335

APPENDIX 3

Hallux Metatarsophalangeal Interphalangeal Scale[84]

Hallux Metatarsophalangeal-Interphalangeal Scale

I Pain (40 Points)

None	40
Mild, occasional	30
Moderate, daily	20
Severe, almost always present	0

II Function (45 points)

Activity limitations	
No limitations	10
No limitation of daily activities, such as employment	7
Limited daily and recreational activities	4
Severe limitation of daily and recreational activities	0

Footwear requirements	
Fashionable, conventional shoes, no insert required	5
Comfort footwear, shoe insert	3
Modified shoes or brace	0

MTP joint motion (dorsiflexion plus plantarflexion)	
Normal or mild restriction (75° or more)	10
Moderate restriction (30°-74°)	5
Severe restriction (less than 30°)	0

IP joint motion (plantarflexion)	
No restriction	5
Severe restriction (less than 10°)	0

MTP-IP stability (all direstions)	
Stable	5
Definitely unstable or able to dislocate	0

Callus related to hallux MTP-IP	
No callus or asymptomatic callus	5
Callus, symptomatic	0

III Alignment (15 points)

Good,hallux well aligned	15
Fair, some degree of hallux malalignment observed, no symptoms	8
Poor, obvious symptomatic malaliqnment	0

Total=100

Extracted from American Orthopedic Foot & Ankle Society (http://www.aofas.org/i4a/pages/index.cfm?pageid=3494)

APPENDIX 4

Consent To Participate In A Research Study

Principle Investigator

Dr. V Singh Chauhan, Post graduate, Department of Orthopedics, University of Nairobi

Research Topic

Severity of Hallux Valgus and its Associated Conditions in a Hospital Population in Kenya

What the Study entails

Hallux Valgus is an irreversible condition that's often overlooked by both the patient and the surgeon. It leads to pain in the forefoot and gait disturbances in the latter stages. Patient first notice it when the first metatarsophalangeal joint becomes deformed with formations of bunions with difficulties in wearing shoes and walking. By this time the condition has progressed tremendously. This study aims to project the prevalence of this condition in our population and also to determine a link with some associated conditions. It is hoped that this data will increase the awareness of this condition and aid in early diagnosis & management.

Role of the patient and Study Procedures

Once you have given us your consent to participate in the study, a questionnaire concerning the condition will be given to you after which a clinical foot assessment will be done with the help of the principal investigator or with a research assistant. You will then be asked to stand on a foot diagram where a clinical measurement of your Hallux Valgus angle will be done. If you surpass the cutoff angle, you will then be asked to proceed for axray of your foot with the findings recorded on a data sheet. Those within the cut-off angle will not proceed for the xray.

At no point during this exercise will you be asked to bear any costs. Radiation from the xrays are minimal hence do not interfere with the body therefore are deemed safe.

Confidentiality

The information collected will be kept confidential and only used for the purpose of this study. Once the study is concluded, all data collection tools shall be destroyed. At no point will you be identified as an individual.

Benefits from the study to you

A free foot assessment of your feet will be done and this can help diagnose conditions overlooked in the past. Moreover, this study will form the benchmark for policies for better understanding and care of this condition

Opting Out

You are allowed to decline your participation in this study at any stage of the study. Please note that this decision will not impact on your expected care in the hospital in any form.

Voluntary Participation

Please note that this exercise is a voluntary initiative by you. At no stage will you be forced to involve yourself in this study during your visit to the hospital.

In case of further queries concerning the above, please do not hesitate to contact the following:

Dr. V Singh Chauhan		The Chairman,
Tel no. 0721-549500	or	UON/KNH Ethics & Research Committee
Email :dr.chauhansingh@gmail		Tel no. 020-2726300 Ext. 44355

Consent / Assent Form - Patients

Patient Number…….. Date…….

I, the undersigned have read through the document and fully understand the information given to me concerning my involvement in this study as explained to me by Dr. V Singh Chauhan or his assistant

I hereby give my written and informed consent to allow myself or my …….to participate in this study on Hallux Valgus in a hospital population in Kenya. I understand that this consent is voluntary and I am at liberty to withdraw from the study at any point without my care being affected.

I understand that my rights will be respected and confidentiality maintained at all times. I will not be required to pay for any service directly related to this study.

I do assent to clinical and radiological investigations throughout this study.

Patient/ Guardian's Signature…….. Date…….

Investigator's Statement

I, the Principal Investigator, have fully educated the research participant on the purpose and implication of this study

Signed…….. Date……..

For any further clarifications, you may contact

Dr. V. Singh Chauhan
P.O. Box 3273-20100
Nakuru Kenya
Tel no. 0721549500
dr.chauhansingh@gmail.com

or

Dr. Edward Gakuya
P.O. Box 19676-00202
Nairobi, Kenya
Tel no.
kibaka62@gmail.com

or

The Chairman,
KNH/UON Ethics & Research Committee
P.O. Box 20723-00202, Nairobi
Tel no. 020-2726300 Ext. 44355

APPENDIX 5

Ruhusa kushiriki katika utafiti

Mtafiti: Daktari V. Singh Chauhan, Department of Orthopedics, University of Nairobi

Maelezo kuhusu utafiti huu:

Lengo la utafiti huu ni kubainisha hali ya ugonjwa unao athiri vidole gumba vya miguu na kuzifanya viegemee upande wan je wa miguu.

Utahitajika kufanya nini?

Ukikubali kushiriki katika utafiti huu, utaonekana na mtafiti ili kubainisha hali ya vidole gumba vya miguu yako. Kama utapatikana na swala ambalo linahusiana na utafiti huu, utaulizwa kufanyiwa x-ray ya miguu yako. Picha yako ya x-ray itangaliwa na mtafiti na matokeo kujazwa katika dodoso.

Hakuna mahali popote kati utafiti huu utaulizwa kungaramia chochote kifedha.

Usiri

Taarifa yoyote utakayo tupatia itawekwa kisiri na itatumiwa kwa utafiti huu pekee. Katika matokeo ya utafiti, hakuna chochote kitawekwa ambacho kinaweza kutambulisha wewe au mgonjwa.

Manufaa ya utafiti huu kwako

Utafanyiwa uchunguzi wa bure kubainisha kama uko na shida ya miguu.

Kukataa kushiriki

Una haki ya kukataa kushiriki huu utafiti. Aidha unaweza kuamua kuacha kushiriki katika huu utafiti wakati wowote. Haya yote mawili hayataadhiri huduma utakazozipata hospitalini.

Mawasiliano

Ikiwa una maswali, unaweza wasiliana na:

Dr. V. Singh Chauhan
Simu: 0721-549500
dr.chauhansingh@gmail.com

Ama

Chairman
KNH/UON Ethics & Research Committee
Simu: 020-2726300 Ext 44355

Fomu Ya Idhini/ Kubali - Wagonjwa

Idhadi ya Mgonjwa…….. Tarehe…….

Natoa idhini andishi na ninayoifahamu ili kuniruhusu au ……wangu kushiriki katika utafiti huu kuhusu ugonjwa wa kigeuko wa kidole ya kwanza ya mguu (Hallux Valgus) kwa wagonjwa wa hospitali ya Kenya

Nimepewa maelezo yanayofaa kuhusu utafiti kwa Dr. V Singh Chauhan na msaidizi wake. Ninaelewa kuwa haki zangu zitaheshimiwa, na suala la kuhifadhi utambuzi wangu utadumishwa wakati wote.

Pia ninaelewa kuwa idhini ya kushiriki ni ya kujitolea, na nina uhuru wa kujiondoa katika utafiti huu bila malezi yangu kuathiriwa. Nina kubali kupigwa picha yoyote ambayo itasaidia utafiti huu

Sahihi ya Mgonjwa……. Tarehe…….

Kauli Ya Mchunguzi

Mimi, Mchunguzi Mkuu, nimemuelimisha mshiriki wa utafiti kuhusu lengo kuu la utafiti na kinachodokezwa na utafiti huu.

Sahihi……. Tarehe……

Ikiwa una swali lolote, wasiliana na wafuato kwa:

Dr. V. Singh Chauhan
P.O. Box 3273-20100
Nakuru Kenya
Simu. 0721549500
dr.chauhansingh@gmail.com

ama

Dr. Edward Gakuya
P.O. Box 19676-00202
Nairobi, Kenya
Simu. 0721932799
kibaka62@gmail.com

ama

Mwenyekiti,
KNH/UON Ethics & Research Kamati
P.O. Box 20723-00202, Nairobi
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APPENDIX 6

DATA COLLECTION TOOLS

QUESTIONNAIRE

Patient No……... Date:……

Section A – Demographic Data

Age..... Sex ☐ M ☐ F

Body Weight .....……... Height……

Residence…….. Occupation……

Section B – Etiologic History

1. Has any member of your family been diagnosed with Hallux Valgus
   Yes ☐ (Please Indicate relation)……. No ☐
2. Foot Wear
   a. How often do you wear shoes?

      Never ☐ Sometimes ☐ Always ☐

   b. How frequently do you have pain while wearing shoes?

      None/ Can wear any Shoe ☐
      Can wear all types of shoes most of the time ☐
      Can only wear walking/Athletic/ Casual Shoes ☐
      Can only wear Custom shoes/Special Orthopedic shoes ☐

   c. Select the Characteristic of your foot wear

      Sandals/ Open Shoes ☐ Heel shoes <6cm ☐
      Closed Flat Shoes ☐ Heel Shoes > 6cm ☐
      Toe box round/wide ☐ Toe box sharp/narrow ☐

   d. If Heels > 6cm (2¾ inch) worn identify duration
      Occassional .... ☐ Every Day ☐

e. Do you require any inserts or modification to the shoe for comfort?

YES(mention type)…… NO ☐

Section C – Foot History

1. Over the past month how much has your foot pain limited your daily activity?

No Pain with Activity	☐
Slight/ occasional pain but no limitation of activity	☐
Moderate Pain limiting some activity	☐
Pain and significant limitation of activity	☐
Severe Pain that limits almost all activity	☐

Kindly indicate where pain (if present) is located

Front foot: ☐ 1st Toe Joint ☐ Middle foot ☐ Hind foot ☐

2. Have you noticed a bunion on any of your foot? Yes ☐ No ☐

If Yes, when did you notice and for how long has the pain persisted?.....

Exacerbating Factors: Shoes ☐ Walking ☐ Others……

CLINICAL ASSESSMENT OF FOOT

1. **Position of the foot**

   Cavus ☐ Pronated ☐ Equinus ☐ Supinated ☐ Combo ☐

2. **Gross Changes**

	1st	2nd	3rd	4th	5th	None
Hammer toes	☐	☐	☐	☐	☐	☐
Plantar Callosities	☐	☐	☐	☐	☐	☐

3. **Bunion Assessment**

   Tenderness Present ☐ Absent ☐

   Sensation Absent ☐ Reduced ☐ Increased ☐

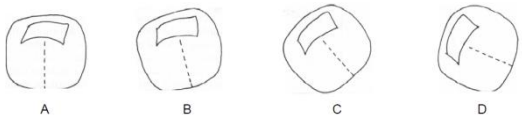
   Overlying skin Normal ☐ Inflamed ☐ Callus ☐ Ulcerated ☐

4. **Pes Planus Assessment**

   Medial Arch (on wt bearing) : Maintained (>1cm off ground) Yes ☐ No ☐

   Toe sign (3 or more lateral toes seen): Positive ☐ Negative ☐

5. **Toe Positioning** (Tick under most likely picture)



6. **Shape of Foot**

   Egyptian ☐ Greek ☐ Square ☐

7. **Sensory Assessment Medial MTPJ**

   Present ☐ Diminished ☐ Absent ☐

8. **Goniometric measurement of HVA**

   0 - <15 ☐ 15 - <20 ☐ 20 - <40 ☐ >40 ☐

Does Patient qualify for X-ray?.....

OBJECTIVE EVALUATION (MODIFIED OBJECTIVE MODULE 1 ACFAS SCORING SYSTEM)

- Radiographic Evaluation (18 Points)

	HV Angle (6 pts)		**IM Angle (6 pts)**		**Sesamoid Subluxn (6 pts)**	
(6)	0 - <15	☐	0 - <9	☐	None	☐
(3)	15 – <20	☐	9 - <11	☐	<50%	☐
(1)	20 - <40	☐	11 - <16	☐	50 – 75%	☐
(0)	>40	☐	>16	☐	>75%	☐

- Functional Evaluation (32 Points)

Hallux Purchase (Paper – Pull Out test) (10pts)

Not Movable ☐ Resistant ☐ Easy ☐

Range of Motion (15 Pts)

First MTPJ Dorsiflexion (11 pts)			**First MTPJ PlantarFlexion (4 Pts)**		
(11)	>60	☐	(4)	>0	☐
(8)	45-59	☐	(0)	<0	☐
(4)	36 – 45	☐			
(0)	<36	☐			

Limp From Foot (Without Shoes) (5Pts)

(5) No ☐ (0) Yes ☐

Pain at MTPJ on Range of Motion (2)

(2) No ☐ (0) Yes ☐

TOTAL (out of 50)……

ADDED EVALUATIONS RELEVANT TO THE STUDY

Meyers Angle $<4^{o}$ ☐ $>4^{o}$ ☐

Shape of Distal 1st Metatarsal Articulation Oval ☐ Flat ☐ Chevron ☐

APPENDIX 7

DODOSO

Nambari ya mgonjwa…….. Tarehe:……

Kifungu Cha Kwanza – Takwimu za wakaazi

Umri_____ Kiume ☐ Kike ☐

Uzito_____ Urefu_____

Makaazi_____ Aina ya Kazi_____

Kifungu Cha Pili – Chanzo za Ugonjwa

1. Kuna mtu yeyote wa familia yako ana kidole cha kwanza cha mguu kuangalia kombo (Hallux Valgus)?
   ☐ Ndio (uhusiano na yeye?)_____Hapana ☐

2. Historia wa mguu

   a. Unavaa viatu wakati gani?

Huvai Kamwe ☐ Wakati mwingine ☐ Kila wakati ☐

   b. Je, kawaida una maumivu kwa mguu wakati umevaa viatu?

Hakuna. Naweza kuvaa viatu vyo vyote ☐

Naweza kuvaa aina zote za viatu kwa muda tu ☐

Naweza tu kuvaa viatu vya kawaida au vya riadha au vya kutembea ☐

Naweza tu kuvaa viatu ilioundwa maalum kwa shida yangu ☐

   c. Chagua aina ya viatu yako

Kiatu wazi/ 'patipati' ☐ Kiatu Kisigino < 6cm ☐

Kiatu imefungwa na bila visigino ☐ Kiatu Kisigino > 6cm ☐

d. Unavaa viatu kisigino > 6cm muda gani?
Mara kwa Mara .☐ Kilasiku ☐

e. Je, viatu vyako vinahitaji muundo maalum ili vivaliwe vizuri?

Ndiyo(Taja Aina)_____ Hapana ☐

Kifungu Cha Tatu – Historia Ya Mguu

1. Kwa mwezi uliopita, maumivu ya mguu wako uliathiri shughuli zako ya kila siku kiasi gani?

Shuguli hazileti maumivu kwa mguu ☐
Maumivu kidogo lakini shughuli haziathiriki ☐
Maumivu kiasi na shughuli kuathirika kidogo ☐
Maumivu mwingi inayoathiri shuguli ☐
Maumivu makali inayothiri shughuli karibu zote ☐

2. Sehemu ya mguu iliyo na maumivu izaid ni ipi?

Mbele wa mguu ☐ Katikati mwa mguu ☐
Kiungo ya kidole wa kwanza ☐ Sehemu ya nyuma ya mguu ☐

3. Kuna wakati umeona uvimbe katika kiungo ya kidole wa kwanza ya mguu yoyote?

Ndio ☐ Hapana ☐

Kama ndiyo, ni lini uligundua na maumivu ulikaa kwa muda gani?_____

Vitu vinavyozidisha maumivu:

Viatu ☐ Kutembea ☐ Vituvingine_____

APPENDIX 8

Foot Diagram and AAOS goniometric technique

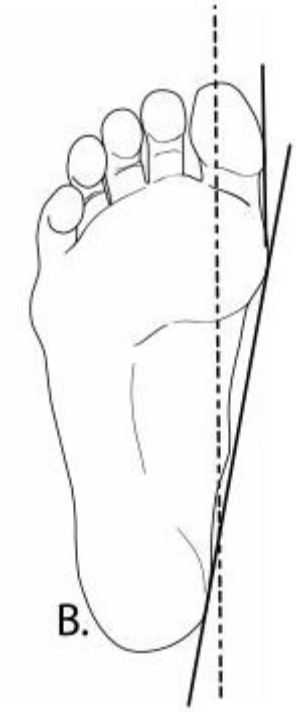


Illustration of a foot print. The intersection of the two lines is the HVA

Measurement of Hallux Valgus angle with a goniometer

APPENDIX 9

Implementation program

Proposal Writing.....March 2016 – July 2016

Proposal Presentation.....August 2016

Ethics Review Committee.....August 2016 – October 2016

Data Collection .....October 2016 – December 2016

Data Analysis & Dissertation writing.....January 2017

Presentation of Results.....February 2017

APPENDIX 10

Estimated Budget

ITEM	COST (Ksh)
Ethics Committee Fee	2,500
Statistician Fee	30,000
Research Assistants	15,000
Stationary & Printing	9,000
Weight Bearing Xrays 260 x 500	130,000
Contigencies	15,000
Transport to & fro PCEA Kikuyu Hospital Approx 500 per trip x 60 days	30000
TOTAL ESTIMATE	**231,500**