



THESIS

A descriptive study of the prevalence of Acute Foot and Ankle complaints/injuries of adults attending a public sector secondary hospital orthopaedic clinic in South Africa over a 12-week period.

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LIST OF ABBREVIATIONS

A&E	ACCIDENT AND EMERGENCY
ADL	ACTIVITIES OF DAILY LIVING
ANOVA	ANALYSIS OF VARIANCE
AO/OTA	ARBEITSGEMEINSCHAFT FÜR OSTEOSYNTHEFRAGEN/ ORTHOPAEDIC TRAUMA ASSOCIATION
AP	ANTERIOR-POSTERIOR
BMI	BODY MASS INDEX
CEO	CHIEF EXECUTIVE OFFICER
CM	CENTIMETRES
COVID-19	CORONA VIRUS DISEASE 2019
CT SCAN	COMPUTED TOMOGRAPHY SCAN
DOH	DEPARTMENT OF HEALTH
EBHC	EVIDENCE BASED HEALTH CARE
FAAM	FOOT AND ANKLE ABILITY MEASURE
GCP	GOOD CLINICAL PRACTICE
ICF	INFORMED CONSENT FORM
ICTS	INFORMATION AND COMMUNICATION TECHNOLOGY SERVICES
IQR	INTER-QUARTILE RANGE
KG/m ²	KILOGRAM/HEIGHT (IN METRES) SQUARED
MIN/WEEK	MINUTES PER WEEK
MRI	MAGNETIC RESONANCE IMAGING
MTPJ	METATARSO-PHALANGEAL JOINT
NRSP	NUMERICAL RATING SCALE FOR PAIN
OA	OSTEOARTHRITIS
ORIF	OPEN REDUCTION INTERNAL FIXATION
POPIA	PROTECTION OF INFORMATION ACT
PRO	PATIENT REPORTED OUTCOME
RICE	REST, ICE PACK, COMPRESSION BANADAGE, ELEVATION

RTA	ROAD TRAFFIC ACCIDENTS
SD	STANDARD DEVIATION
UCT	UNIVERSITY OF CAPE TOWN
WHO	WORLD HEALTH ORGANIZATION

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ABSTRACT

TITLE

A descriptive study of the prevalence of Acute Foot and Ankle complaints/injuries of adults attending a public sector secondary hospital orthopaedic clinic in South Africa over a 12-week period.

BACKGROUND

Orthopaedic trauma places a substantial cost burden on health systems around the world, and may also lead to mobility impairment, disability, and chronic pain in patients, especially when affecting the foot and ankle. The epidemiology of foot and ankle injuries has previously not been well reported in South Africa. In order to gain a greater understanding into the degree of health burden represented by conditions of the foot and ankle as well as the associated risk factors and types of injury, we aimed to describe and evaluate the patient population presenting at a public health hospital over a specified time period. Insights into the epidemiology specific to the South African context may aid health care resource planning and contribute to improved patient care.

METHODS

A prospective, descriptive study was conducted to determine the prevalence, characteristics and risk factors of adults presenting to the orthopaedic acute clinic at Prince Mshiyeni Memorial Hospital with acute foot and ankle complaints/injuries between December 2022 to March 2023 (12-week period). Demographic (sex, age, height, weight, BMI) and clinical (type of injury, pain scores, management) data were collected and analysed using percentages, Mann-Whitney U Test, t test and Chi-square analysis.

RESULTS

During the 12-week period, 14% of the 615 lower limb cases were referred for Foot and Ankle injuries specifically. The cohort comprised 80 participants with an average age of 43 years with 64% (n=51) (being) female.

Ankle fractures were the most common presenting injury (54%), with females more affected than males, 31 (61%) vs.12 (41%) respectively. Males suffered more foot fractures than females, 12 (41%) vs. 5 (10%) respectively (p< 0.05). Foot fractures represented 21% of all

foot and ankle injuries. Ankle sprains made up 15% of all injuries which interestingly was similar to that of midfoot sprains (15%). The highest number of injuries were noted within the age range 30-39 (34%) with no significant difference noted between sex and age presentation, but a significant difference was noted for mechanism of injury and sex ($p < 0.01$).

Despite males being significantly taller and heavier than females ($p < 0.001$), no significant differences were noted for BMI between the sexes with a median of 25 kg.m^2 for both. Low energy fall was the most common mechanism of injury described affecting 66% of all participants and 74% (39) of females. Road traffic accidents (RTA) accounted for 21% (17) and direct trauma/assault 6% (5) of all mechanisms of injury. Fifty percent (40) of participants were managed conservatively by means of plaster of Paris, 40% (32) with plaster backslab, and 6% (5) admitted for surgical intervention.

CONCLUSION

Foot and ankle pain is a prevalent problem which constitutes a high number of traumatic bony and soft tissue injuries. Within this cohort, more females presented with ankle fractures and males with foot fractures, with the 30-39-year age group most affected. Low energy fall mechanisms were most commonly reported within females, while males suffered more direct trauma and sports injury-related mechanisms. Only a small percentage of patients were admitted for surgery. The researchers recommend more epidemiological studies across major trauma centres with greater participant numbers and longer follow up to give a better scope into the full extent of the burden of foot and ankle pain/injuries in South Africa, and expand database registrations, hereby impacting policy making and budget allocation to improve patient care and outcomes.

PART 1: LITERATURE REVIEW

1.1 Introduction

Acute foot and ankle injuries encompass a large spectrum of diagnoses. Foot and ankle injuries have been reported to negatively impact health-related quality of life. (2) Disabling foot and ankle pain has a prevalence of approximately 30% among the general population in addition to the physical challenges, psychological factors have also been found to arise from disorders producing foot and ankle pain(1). Depression, emotional distress and anxiety are more commonly found in people with persistent foot/ankle pain than in pain free controls(2). Ankle sprains encompass one of the most common musculoskeletal injuries presenting to hospital emergency departments with far reaching physical and economical burdens. In the United Kingdom, ankle sprains account for 3-5% of all Emergency Department presentations, equating to approximately 5600 incidences a day(3), with the worldwide incidence of ankle sprains approximately one ankle sprain per 10,000 person-days. This amounts to an estimated two million acute ankle sprains occurring annually in the United States alone, resulting in an annual aggregate health-care cost of \$2 billion(4). Foot and ankle conditions can therefore have far-reaching sequelae for the patient as well as an economic and social impact.

There are currently no published epidemiological data on foot and ankle pain from South Africa. Epidemiological studies provide valuable insight into the distribution and impact of morbidity (in this case foot and ankle pain) in population groups, which is important to the policy designs and provision of adequate and quality health services(5) as well as social and economic support.

1.2 Anatomy and Biomechanics of the foot and ankle

To appreciate the large spectrum of diagnoses related to the foot and ankle, a basic understanding of the anatomy and biomechanics of this anatomical area is essential. The foot and ankle together form a complex structure comprised of twenty-six individual bones, numerous ligaments, tendons and muscles, and together with the distal ends of the tibia and fibula, constitute a total of thirty-three joints(6) (Figure 1). The ankle joint is comprised of the distal articulations of the tibia and fibula, as well as the articulation between the talar dome and the distal tibia articular surface (plafond). The complexity of the foot and ankle and their structures support the weight of the entire body, supports our ability to stand, and provides a stable base for bipedal gait(7).

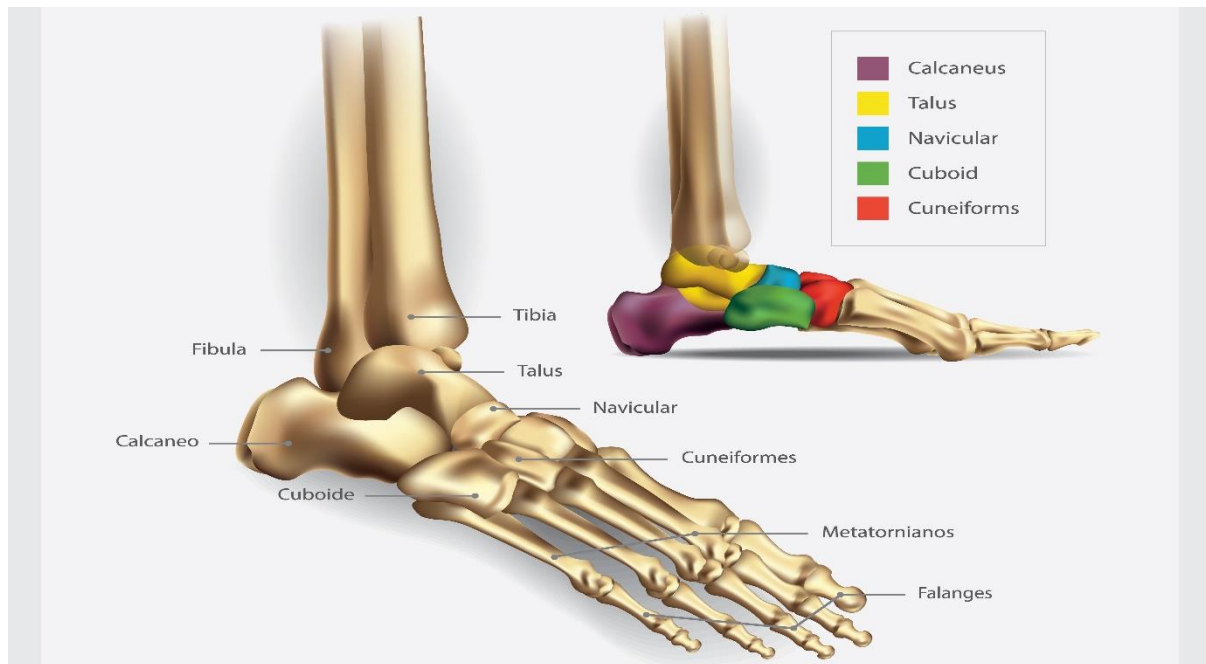


Figure 1 Anatomy of the foot and ankle bones.

Image Source: https://www.freepik.com/free-vector/foot-bone-anatomy-illustration_9500494.htm#fromView=keyword&page=1&position=1&uuid=4f8319ac-b9a4-457d-b9e3-41a0606d10a0". Image by pongpongching on Freepik. Accessed 17 November 2024.

The foot is the portion of the lower limb distal to the ankle joint, and is comprised of the hindfoot, midfoot and forefoot. The forefoot comprises the phalanges, metatarsals, and sesamoid bones. The big toe has a proximal and distal phalanx, and the rest of the toes have proximal, middle/intermediate, and distal phalanges. The midfoot comprises five tarsal bones; the navicular, which is on the medial aspect of the foot, the cuboid on the lateral border of the foot and the three cuneiform bones (medial, middle, and lateral) in-between. The hindfoot is made up of the calcaneus (heel bone) and the talus which forms part of the ankle joint with the distal tibia and distal fibula(8). The articulation of the hindfoot with the midfoot is regarded as the Chopart joint, and the articulation of the forefoot with the midfoot considered the Lisfranc joint. These are important landmarks in relation to specific pathology.

The talus and calcaneus play an important role in our ability to weight bear. The subtalar joint, the articulation between the talus and calcaneus, is integral to the biomechanics of gait. The talus articulates with the distal tibia superiorly and medially, the lateral malleolus laterally, the calcaneus inferiorly (subtalar joint), and the navicular anteriorly. Approximately 80% of the talus is covered in cartilage for articulation with these surrounding bones, and the rest of the surface leaves entry for blood supply from the posterior and anterior tibial

arteries. This feature predisposes the talus to avascular necrosis and non-unions following injury.

The calcaneus is the most frequently fractured tarsal bone making up approximately 60% of foot fractures. The anatomical parts of the calcaneus include the body, tuberosity, the anterior and medial processes, and sustentaculum tali. The calcaneus articulates with the cuboid anterolaterally, and the talus superiorly as part of the subtalar joint(8).

Nerve supply to the foot and ankle is derived from branches of the superficial and deep fibular/peroneal, saphenous, lateral and medial plantar, and calcaneal nerves(9). The tibialis posterior nerve provides sensation to the heel and the sole of the foot through the medial calcaneal and lateral plantar nerves, respectively. Sensation to the first web space between big toe and second metatarsal arises from the deep peroneal nerve, which is an extension of the L5 nerve root from the sciatic nerve(10).

While the muscles of the compartments of the lower leg are responsible for most of the movements at the ankle joint, there are twenty-nine muscles associated with the human foot; of these 19 are intrinsic and 10 are extrinsic. The intrinsic foot compartments are medial, interosseous, central superficial, central deep, and lateral. The medial compartment comprises the abductor hallucis muscle and flexor hallucis brevis muscle. The interosseous compartment has 7 interossei muscles. The central superficial comprises the flexor digitorum brevis, adductor hallucis, and the lumbrical muscles. The central deep (calcaneal) compartment has the quadratus plantae muscle. Lastly, the lateral compartment comprises the flexor digiti minimi brevis, abductor digiti minimi, and opponens digiti minimi muscles(8).

These are also aided by the plantar fascia and accessory bones(sesamoids), and together they influence the shape and posture of the foot, transmit muscle tension, and manage mechanical vectors of the foot(11). The plantar fascia is an aponeurotic membrane/sheath that originates from the medial tuberosity of the calcaneus and spans the transverse tarsal, tarsometatarsal, and metatarsophalangeal joints to insert on the plantar plates of the metatarsophalangeal and collateral ligaments and the sesamoid bones. Traction is placed on the plantar fascia through dorsiflexion of the metatarsophalangeal joints which causes elevation of the medial longitudinal arch during the gait cycle through a mechanism known as the "windlass effect". During the stance phase of the gait cycle, 'toe off' results in passive dorsiflexion of the metatarsophalangeal joints as the body passes over the foot and tightens the plantar fascia which results in a shortened distance between the heel and the metatarsal heads, thus elevating the arch. The arch supports the foot both actively and passively. There are two known models that describe the medial longitudinal arch of the foot: the beam model and the truss model. The beam model illustrates the arch as a curved beam made up of interconnecting joints whose integrity depends on ligamentous and joint interconnections

for stability. Compressive forces are concentrated on the superior surface of the beam, and tensile forces on the inferior surface. The truss model illustrates the arch as a triangular structure with two struts connected at the base with a rod. The rod is under tension and the struts under compression. Both models have been validated and can be demonstrated clinically. The plantar fascia and the posterior tibialis muscle/tendon contribute the most to arch stability through toe dorsiflexion and active/dynamic arch support, respectively. Of interest, shoe wear reduces peak heel pressure by causing an even distribution of pressure under the heel. Conversely there is a medial shift of forefoot load distribution with shoes, with increased pressures under the first and second metatarsal heads and the toes(10, 12).

The primary movements of the ankle joint complex are plantar- and dorsiflexion, occurring in the sagittal plane (Figure 2). Abduction/adduction occur in the transverse plane and inversion/eversion occur in the frontal plane. Combinations of these motions across the tibiotalar and subtalar joints create three-dimensional motions referred to as supination and pronation, movements vital for efficient gait(13).

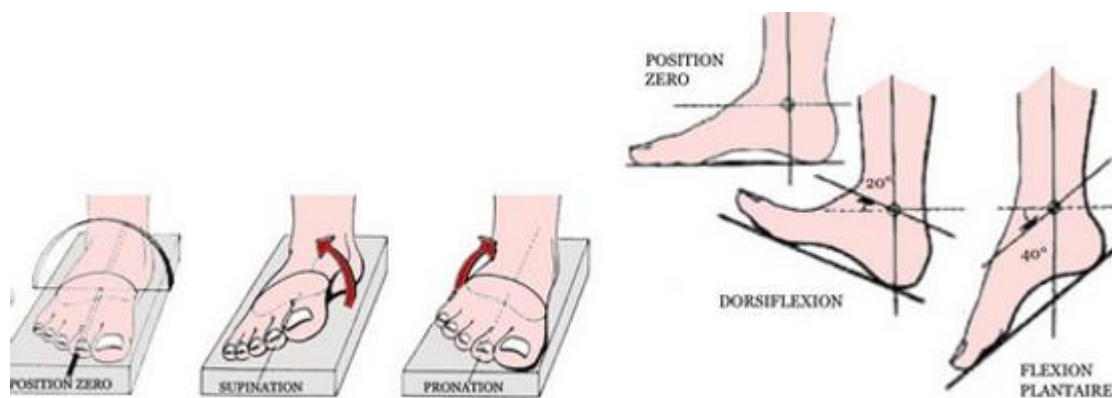


Figure 2. The motions of the Foot and Ankle

Image source: *Foot & Ankle, Current Concepts and Evidence Base.*
<https://www.ankleinfo.net/biomechanics>. Accessed 6 November 2024.

The walking/gait cycle comprises a stance phase (approximately 62% of gait cycle) and swing phase (approximately 38% of gait cycle). Running gait cycle comprises stance phase (40% of cycle), first float phase (15% of cycle), swing phase (30% of cycle) and second float phase (15% of cycle). In normal gait the stance phase is divided into heel-strike, foot flat, heel-off, push-off, and toe-off. The swing phase is subdivided into acceleration, toe clearance, and deceleration phases. Double limb support occurs when both feet are on the ground during the first and last 12% of stance phase. Running is defined as the speed at which double limb support disappears (i.e. presence of float phase) and is typically at speeds exceeding 200 metres/min(12).

The foot is thus considered a complex anatomical structure which acts to transmit force between the lower limb and the ground, allowing stable locomotion and stance(14). During normal gait, the foot initially functions as a flexible shock-absorber, accommodating to uneven surfaces before undergoing a series of biomechanical changes allowing it to subsequently act as a rigid lever to exert force and propel the lower limb segment forward(6, 14). As a result, forces through the ankle joint complex during normal walking are approximately five times body weight, and up to thirteen times body weight during running activities(6). The ankle has a relatively large surface area for load bearing, ($\pm 11-13 \text{ cm}^2$), resulting in lower joint stresses as compared to the hip and knee(12).

The foot and ankle therefore function together as dynamic structures and rely on the intrinsic and extrinsic muscles and ligaments of the foot to play a significant role in stabilizing all these joints facilitating co-ordinated propulsion(13). It is also these attributes that predispose the foot and ankle to injury and degenerative conditions.

It is clear that the foot and ankle are integral to efficient functional mobility and impairment of their normal function can result in marked disruption of activities of daily living, occupation, and sport. Hence foot and ankle musculoskeletal conditions are considered an important public health burden due to not only their adverse impact on patient's quality of life, but also because of their rising incidence in clinical practice (2). The estimated prevalence of foot pain in the general population ranges from 13 to 36%, with positive associations linked to female gender, obesity and older age(15). In addition, foot pain has also been found to be an independent risk factor for impaired balance, increased risk of falls, locomotor disablement, loss of independence and reduced quality of life, collectively increasing the burden on the health sector (3).

1.3 Epidemiology of foot and ankle pain

Pradana et al described patients with foot and ankle injuries presenting at a tertiary hospital in Indonesia and found that most of these patients, (93%) attended because of road traffic accidents. In this study the most common traumatic related injuries for foot and ankle were fractures at 50%, with the forefoot commonly injured at 61% of foot fractures(16). This is opposed to sports-related injuries which are predominantly ligamentous injuries.

As previously mentioned, the prevalence of foot and ankle pain the general population is about 30%. More specifically, the estimated point prevalence for foot pain is 13-36% and the ankle 9-15% (2). Foot pain has several potential risk factors including female gender, increased age, high BMI, diabetes mellitus, osteoarthritis and inappropriate footwear(17). In the general population females report higher levels of general foot/ankle pain compared to

males. Risk factors with statistical significance (p value <0.05) for ankle pain and chronic ankle instability are female gender and young adult age group(18).

Several large population-based studies show a common trend of women being more affected by ankle fractures (53-56%) compared to males (44-47%)(19). In the male group, the highest incidence was in the young age group with a mean age of 35 years, and women were typically affected evenly across age groups with a mean age of 46 years(19, 20).

The most common mechanisms associated with foot and ankle injuries or clinical presentations include low energy falls, road traffic accidents, direct assault, falls from heights, sports related injuries from direct and indirect contact, and intrinsic processes such as degenerative and inflammatory disease(20, 21). In sports related foot and ankle injuries the common mechanisms are direct contact from tackling or being tackled, and indirect mechanisms(22).

Houchen-Wolloff et al found that of patients with foot and ankle pain, 64.4% were employed, compared to 35.6% who were unemployed and/or retired from work. Hence foot and ankle injury may lead to high productivity costs and economic consequences for and per patient(23). Interestingly, Tojo et al in their study (Japan, 2018) reported that 58% of hospital nurses with foot and ankle pain were younger than 30 years of age, and 17% of participants had disabling foot pain on most days affecting their daily living and/or work duties. Only 9% of participants had a raised BMI above 25kg/m² (1), suggesting that the majority presenting with pain were not considered overweight. In a paediatric hospital in Brisbane, 43.8% of nurses reported foot and ankle pain during the seven preceding days and 16.7% reported the pain to impair their physical activity(24). The mean age of this study group was 37 years(24). It is possible that younger individuals have a higher than reported incidence of foot and ankle pain as the above two studies sampled nursing staff which in itself has the potential to create an age bias, but more studies including the general population are required to support this. Of interest in clinical practise, there has been no evidence of a direct relationship between radiographic findings and a person's experience/intensity of foot and/or ankle pain(25).

1.4 Sports related foot and ankle problems

Twelve percent of all orthopaedic cases presenting to emergency department are sports related injuries according to data from Fong et al (Hong Kong China)(26).

Regarding sports-related ankle-only injuries presenting to orthopaedics department, ligament injuries comprise 81% of cases and fractures occurring in 10% of case's(26). The

majority of these sports-related ankle injuries were sustained during basketball and soccer, with a predisposition within younger males.

Different sports are associated with different risk of injury including type of injury to the foot and ankle. In soccer, ankle sprains account for 80% of all foot and ankle injuries, then bruises (9 to 49%), tendon injuries (2-23%), and fracture (1%)(27, 28). Foot and ankle injury incidence in elite soccer competitions is approximately 3 and 9 injuries per 1000 player-hours of competition respectively(27).

In college and high school jumping sports (basketball, volleyball and gymnastics), the combined foot and ankle injury rate is 1,85 per 1000 athlete-exposures, with ankle sprains making up 63.7%, and of these, the lateral ligament complex is injured in 77.1%(29). A recent systematic review found no difference in the incidence of lower limb injury between males and females in basketball(30). Basketball players are at a higher risk of re-injury of the foot and ankle with reported risk factors such as abnormal plantar loading and/or excessive foot motion during high-level deceleration activities like changing direction, jumping and landing(31). Although ankle sprains are largely regarded as benign injuries with a predictable course towards complete healing, the economic, occupational, and psychosocial burden cannot be understated in this younger active group of individuals.

Long distance runners/endurance athletes have a reported injury incidence of 30-80% per year, with foot and ankle injuries making up 15% of these. Reported injuries include stress fractures of the navicular, calcaneus and sesamoids, ankle inversion injuries, impingement syndromes and peroneal tendinitis(32). Footwear has also been implicated in both causing and prevention of foot and toe problems(33). Overuse injuries cause significant morbidity to the athletic population accounting for 30 – 50% of all sport related injuries(34).

Stress fracture incidence in the general athletic population is approximately 1% but may be as high as 15% in runners(35). In the military population incidence rates are 3% for men and 9,2% for women(35, 36). Risk factors for stress fractures include older age, female sex, poor nutrition, low bone mineral density, hormonal imbalance, poor vascular supply and skeletal malalignment(37, 38). Cross-country and track had the highest rates of stress fractures, and the anatomical areas most affected are foot, ankle, and tibia(38). Low risk stress fractures include fibula, calcaneal, and metatarsal shaft stress fractures, whereas high risk (less propensity to heal untreated, with higher progression) include medial malleolus, navicular, talus, 5th metatarsal proximal shaft, and hallux sesamoid bones stress fractures(35, 38). Athletes at highest risk are those that abruptly increase training load (frequency, duration, intensity) without adequate rest periods(39). Stress fractures affects 1.54 per 100 000 athletes and make up approximately 10% of all sports medicine injuries(38).

Foot and ankle injuries account for 23% of all injuries in professional rugby. Reported injury incidence rates in South African rugby are 83.3 injuries per 1000 hours, and 91 per 1000 hours in English rugby(21).

The foot and ankle is the most commonly injured region in dancers, with ankle sprains, impingement syndromes and stress fractures being the most common(40). Among pre-professional dancers, the prevalence of foot and ankle pain within a calendar year was highest in ballet dancers (84%), 79% in Chinese dancers, and 70% in contemporary dancers(41). The incidence of foot and ankle injury in pre-professional dancers is reported to be 1,42 injuries per dancer, with a 76% injury risk over 12 months period(40, 42). One of the major risk factors for injury in the pre-professional ballet group are the high training loads/exposure that are higher than recommended ranges for their age(40, 42). It is also of note that with the rise in participation in combat sports since the 1980's, the general incidence of acute and overuse injuries related to martial arts is expected to increase during training and competition consequently 8% of young individuals discontinue sporting activities due to injuries(43). Orthopaedic injuries including dislocation, fractures and sprains made up 15% of all injuries in this group(43).

Regarding the adolescent population, studies show wide variability in injury patterns but generally find that males have a higher injury incidence than females, and previous injury is a risk factor for future injury(44). The lower extremity is reported as the most injured region (40% of all injuries), with sprains and strains accounting for the highest number of injuries(44).

The National Athletic Injury Registration System of the United States, and the Union of European Football Associations Medical Committee, categorize the severity of musculoskeletal injuries into 4 levels based on layoff time from sports/soccer participation; i.e. Minimal/Slight injury (0-3 days missed), Mild injury (4-7 days missed), Moderate injury (8-28 days missed), Severe injury (>28 days missed)(27). Severe injury can thus have significant implications for the sporting individual(27).

1.5 Specific foot and ankle disorders

As evidenced from the discussion above, there are a plethora of foot and ankle conditions across different age groups and athletic and non-athletic populations presenting to the clinician and hence below we expand on some of the more common foot and ankle conditions and their associated epidemiology.

1.5.1 Ankle and Foot sprains

Ankle sprains alone have been associated with a high economic burden. For example, in 2001, the Netherlands reported the total cost of treating a single ankle sprain to be around 360 Euros, with a total annual cost of 82,240,000 Euros for their population(45). In addition, increased absenteeism, reduced productivity and quality of life have also been linked with ankle sprains as a result of chronic reduced productivity and prolonged treatment regimens leading to increased time off work(45, 46). Ankle sprains are historically classified into 3 grades, with increasing severity from grade 1 (mild), grade 2 (moderate) to grade 3 (severe) (Figure 3).

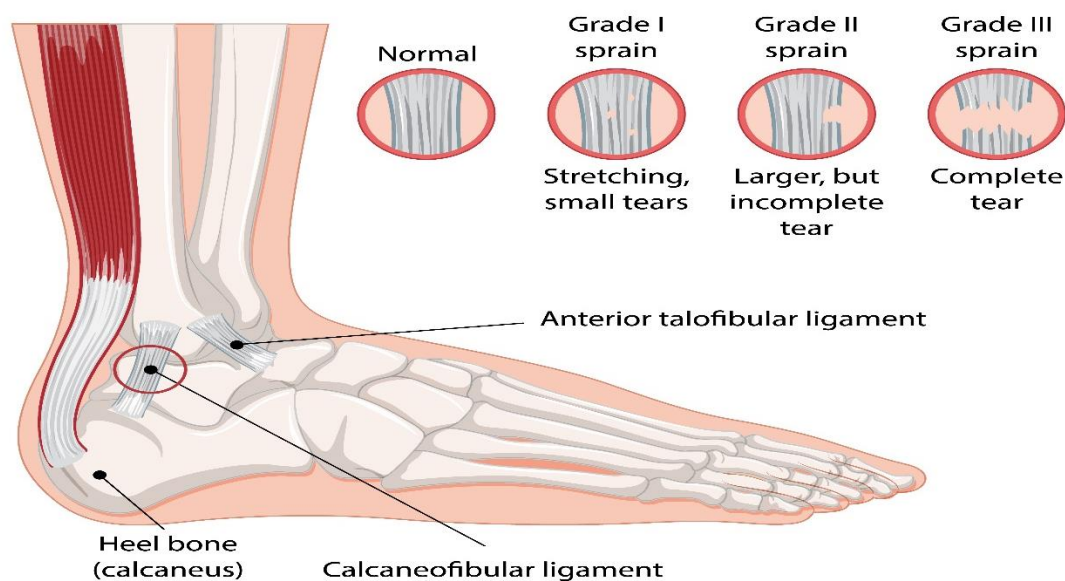


Figure 3. Ligament sprain grading

Image Source: https://www.freepik.com/free-vector/ankle-sprain-injury-illustration_221830833.htm#fromView=keyword&page=1&position=23&uuid=8bba99d0-90a3-4514-bb73-5738217bfee8". Image by brgfx on Freepik. Accessed 17 November 2024.

Grade 1 ligament sprains typically involve a contusion of the ligament with no or minimal functional loss and no instability; grade 2 entails an incomplete tear of the ligament(s) with moderate functional impairment, and grade 3 is a complete tear of the ligament(s) with loss of integrity of the ligament/instability(47). Ankle ligamentous injuries are further classified depending on the degree of ligamentous injury as well as the number of ligaments injured in the ankle joint complex.

Ankle syndesmosis injuries (high ankle sprain) are often associated with prolonged pain, disability, and an unpredictable time away from sports depending on the severity(48). Clinical diagnosis of high ankle sprain can be made with a positive squeeze test (fibular

compression test for syndesmosis injuries), positive cross-over leg test and ankle dorsiflexion-external rotation stress test(49). Unstable syndesmosis injuries can be seen radiologically as separation of the distal tibio-fibula syndesmotic articulation on weight-bearing, for which surgical intervention may be required(50).

Treatment of ankle sprains has become more individualized rather than following a blanket approach, although the RICE protocol (Rest, Ice pack placement, Compression bandage, Elevation) in the first few days post injury, with or without a brace, cast or crutches, followed by early range of motion with or without supervised physiotherapy is the accepted initial management(51). The traditional RICE acronym has seen an evolution over the years with better understanding of injury and management principles, with newer acronyms PRICE (Protect, Rest, Ice, Compression and Elevation), POLICE (Protection, Optimal Loading, Ice, Compression and Elevation), and most recently 'PEACE and LOVE' (Protection, Elevation, Avoid Anti-inflammatories, Compression, and Education. Load, Optimism, Vascularisation, and Exercise)(52). The 'PEACE AND LOVE' paradigm aims to address the acute, subacute and chronic stages of healing, and incorporates patient education to address psychological and social factors to improve clinical outcomes(52).

There is not much available data with specific emphasis on foot soft tissue injury epidemiology. Most of the data available reports on sports related foot injuries. The common reported foot injuries in sports were midfoot injuries, plantar fascia injuries, foot/toe contusions, turf toe, and metatarsal fractures(53). Lis franc injuries account for 0.2% of all fractures in the general population but are common in sports such as American Football and Rugby. Because of their subtle nature and difficulty in diagnosis, dynamic imaging, weight bearing X-ray/ CT scan, stress views and MRI are advocated to detect evidence of midfoot instability caused by Lis franc injury(21, 53).

Ponkilainen et al (Indonesia) report the forefoot was found to be most commonly injured part of the foot in general population studies, while midfoot disorders have been described as occurring at an incidence of 12.1/100,000 person years, with 75.9% affecting the tarsometatarsal joint area (Lisfranc joint), 18.2% affecting the talo-navicular and calcaneo-cuboid joint area (Chopart joint) with combined or miscellaneous injuries to the foot making up the remaining 5.9%(23, 54).

1.5.2 Foot and ankle fractures

Fractures of the ankle rank third behind hip and distal radius fractures(55) and account for up to 10% of all osseous injuries(56). Ankle fractures make up 56% of fractures within the foot and ankle complex(57). Hindfoot fractures contribute 17%, forefoot fractures 17%, and the

midfoot (9%) has the lowest prevalence of all foot and ankle fractures(57). Twenty percent of all foot and ankle fractures are open fractures(57).

Ankle fractures have a high incidence of associated intra-articular lesions and ligamentous injuries, with reported incidences of 72% for chondral/articular lesions, 39% for intra-articular loose bodies, and 92% syndesmosis ligament injury, found during arthroscopically assisted open reduction and internal fixation (AORIF) of both supination and pronation type ankle fractures(58). There is a bimodal pattern of incidence for or foot and ankle fractures across the age groups, with the first peak around adolescence/early adulthood and the second peak in the elderly, for both male and female sex(59). Interestingly, increased risk of falls and obesity are believed to be the main risk factors for ankle injury in the elderly, and not osteoporosis as previously thought(52).The incidence rates (per 10,000 person-years) for foot and ankle fractures combined were very similar between the sexes with 25.85 and 25.88 for males and females, respectively(59). The costs associated with treatment of foot and ankle fractures can be substantial and involves prolonged period of immobilization to allow for fracture healing, use of walking aids, pharmacological agents, follow up consultations, physical therapy and re-integration to society and the workspace. There is currently no international consensus on best management of all types of ankle fractures, although unstable ankle fractures including trimalleolar fractures are generally treated surgically(55, 60).

Fractures of the ankle are comprehensively classified using the OA/OTA (Arbeitsgemeinschaft für Osteosynthesefragen/Orthopaedic Trauma Association) system, an expansion of the Denis-Weber classification (infra-syndesmotic, trans-syndesmotic and supra-syndesmotic fractures). The Denis-Weber classification is a radiographic classification and was recently revised in 2018(61). The Lauge-Hansen classification is also widely used and considers the position of the foot during injury (supination/ pronation) and the direction of the deforming force across the ankle (external rotation, abduction/ adduction)(62). This produces 4 main injury patterns that can be subdivided into stages depending on the magnitude, propagation and duration of force applied. The four patterns are Supination External Rotation (SER) which is the most common, then Supination Adduction (SAD), Pronation External Rotation (PER) and lastly Pronation abduction (PAB). Between the AO/OTA and Lauge-Hansen classifications, the AO/OTA classification shows greater reliability and reproducibility(63).

Regarding foot fractures, one population-based epidemiological study over a period of 5 years found an overall incidence of 142.3/100,000/year, with a mean age of 36.1 years and concluded that foot fractures account for 40% of all fractures in the lower extremity(64).

1.5.3. Osteoarthritis

With a worldwide prevalence of 23.9%, osteoarthritis is the fifth most commonly managed disorder by Australian general practitioners(65). Recent population prevalence data of foot osteoarthritis in the United Kingdom indicate 16.7%, which is similar to knee osteoarthritis(66). Foot and ankle osteoarthritis is a very disabling condition, with nearly 75% of patients reporting disabling pain on most days(65). Reduced range of motion in the elderly population could be explained by increased cross-linkages between collagen fibres, reduced water content of cartilage, proteoglycans and the synovial fluid volume(67). It is estimated that 1 in 6 adults over age 50 have symptomatic radiographic foot osteoarthritis(68). The diagnosis of foot/ankle osteoarthritis may be done with the Kellgren-Lawrence system, which relies on the presence of joint space narrowing and of osteophytes for higher grades of OA(69). A more extensive system is the La Trobe Foot atlas, which scores individually osteophyte and joint space narrowing at the first MTP joint and four midfoot joints(69, 70). A better understanding of the pathogenesis, diagnosis, progression, risk factors, and universal classification of Foot and Ankle OA is still required for more uniform prevalence studies and management guidelines.

1.5.4. Hallux valgus

Hallux valgus is a common forefoot condition where the first metatarsophalangeal joint is progressively subluxated due to lateral (valgus) deviation of the phalanx and medial deviation of the first metatarsal, and the resultant prominence referred to as a 'bunion'(71). Hallux valgus is the most common foot deformity in adults and its prevalence increases with age(72). One in 5 adults (20.1%) are affected by the condition and is associated with foot pain, baseline age and use of shoes with narrow-toe box shape between ages of 20 and 29 years(73). The condition is progressive in 33,6% of individuals(73). Hallux valgus can be measured on the foot x-ray AP (anterior-posterior) view as a hallux-valgus angle more than 15 degrees, although considerable individual variation may exist and other individual factors need to be taken into account(74). Marked deformation impairs weight bearing and balance, increases the risk of falling, and worsens physical performance and quality of daily life(17). The cause of hallux valgus is not well understood although there is some evidence of an autosomal dominant trait cause, since 90% of people with hallux valgus report a positive family history(17). Association to hallux valgus include age and gender, big toe pain, family history, footwear, body mass index (BMI), first metatarsal head shape and length, flatfoot, race, knee pain, osteoarthritis, and ligamentous laxity(72). Some of the clinical and radiographic parameters used to assess different types of hallux valgus include tarsometatarsal joint hypermobility, hallux valgus angle and distal metatarsal articular angle(75). Non-surgical management may assist in pain alleviation, but surgery is often required for deformity correction(74).

1.5.5. Impingement syndromes

Impingement refers to abnormal contact or entrapment of soft tissue and/or bony structures leading to pain or reduced range of motion(76). Ankle impingement syndromes encompass a wide range of chronic degenerative and post-traumatic changes and present with pain and limited range of motion(76-78). The impingement syndromes of the ankle may be categorized into anterior, anterolateral, anteromedial, posteromedial and posterior(77). These conditions affect both the athletic and non-athletic population. Symptomatic posterior ankle impingement from os-trigonum syndrome was found in 5.5% of individuals with females and age between 18 and 35 years having the higher incidences(79). Anterior ankle impingement may be caused by bony osteophytes at the anterior rim of the distal tibia and sulcus of the talus, as a result of direct trauma or repetitive ankle dorsiflexion(80). The general incidence of anterior impingement is not known(80).The diagnosis can be made clinically, with adjunctive imaging (ultrasound, computed tomography, magnetic resonance imaging) to confirm the diagnosis or plan management(81). Treatment includes conservative measures and surgical interventions (arthroscopic or open approaches) which have been found to be safe and effective(76, 81, 82).

1.6 The cost of managing foot and ankle problems.

It is thus evident that different types and severities of foot and ankle injuries may require different treatment and management resources, with subsequent varying economic costs and burden. De Boer et al evaluated the population-based attendance to hospital for foot and ankle injuries over 24 years in the Netherlands to detail the health costs related to these patients(83). Their key findings included a peak in attendance from adolescent up to adults of 45 years of age, with a greater predisposition towards males. As might be expected, hospital admission rates were found to increase with increasing age as well as bony/osseous injuries as opposed to ligamentous. The greatest medical costs/main cost determinants in this setting associated with foot and ankle injury were related to in-hospital care, contributing over 50% of the cost, with nursing care and physical therapy contributing to a lesser extent. Available hospital and medical resources as well as hospital treatment guidelines may also play a significant role in which medical intervention is applied(83).

In Wales, under National Health Service (NHS), the estimated costs of orthopaedic care and devices were as follows: fracture clinic visit cost between 25-50 pounds, an X-ray 10-25 pounds, pair of crutches between 20-35 pounds, a plaster around the leg cost 10-30 pounds, an arm sling less than 10 pounds, and a physiotherapy session 20-35 pounds, with a total increase in expenditure by the NHS for musculoskeletal care of 13,11%(84). According to the KwaZulu-Natal Department of Health Amended Fees Manual for orthotics, these are the costs of each item or each pair of items (in South African Rands): wooden stick R189, walking frame R542, wooden axillary crutches R429, elbow crutches R480, ankle foot orthosis R1789,

hinged ankle foot orthosis R2500, ankle guard R586, heel raise R293, and a moulded insole R1132(85). Unemployment in South Africa is at 32,9% representing 7,8 million people without any formal income(86). KZN DoH MEC Ms Nomagugu Simelane reported that the annual Budget received by KZN health dropped by R16 billion over the past three years, leading to considerable strain in the day-to-day running of the department of health KZN and implementation of health programs(87).

In a survey conducted by Bridgman et al, in which they described the epidemiology of patients attending A&E in England for management of ankle sprains between April 2000 and March 2001, it was found that tubigrip was used for management of patients in 55% of cases. Below knee casts and braces were only used in 3% and 2% of cases respectively in this health care setting, but more such aids may have been distributed at follow up appointments. This may reflect that there is no universally accepted consensus on the most appropriate and cost-effective management and follow up protocol for these types of injuries(88).

Given the evident resource limitation in low-middle income countries, there is an urgent need for quality economic evaluation of service delivery including interventions and a need for standardization of methods of reporting to facilitate the use of this information to aid policy and decision makers(89). The potential costs as outlined above are significant and patients with foot and ankle musculoskeletal conditions often require combination treatment modalities such as taping, bracing, casting, orthoses and footwear, crutches, manual, occupational and physical therapy (non-surgical management modalities(90).

There is currently very limited information on acute and chronic musculoskeletal foot and ankle disorders in developing countries. In Sri Lanka it was reported that 14% of the community were affected by chronic ankle disorders mainly caused by ankle sprain and arthritis (21.7%). There was also a high percentage of self-reported pain at 66% (39).

In a study conducted in Cape Town South Africa, they reported that the average cost of management 1441 patients with orthopaedic gunshot injuries was R37031 (2986 US Dollars), with a total care cost of R53,568,537 (4,320,043 US Dollars)(91).

For South Africa's health policy makers to have a better scope of foot and ankle pain problems, more studies are required to report their prevalence which will allow for practical economic allocation of resources and treatment aids such as crutches, braces, compression bandages, plaster of Paris, patient education and physical therapy, all of which contribute to better patient injury outcomes. These findings could assist the South African Department of Health's (DOH) strategic document "Outcome 2", published in 2010, which pronounced the

nation's health targets for vision 2030, and included emphasizing a healthy life for all by year 2030 through six objectives, one of which was to achieve "a significant shift in equity, efficiency and quality of health"(92). This can be facilitated through quality clinical research and involvement of stakeholders and policymakers to foster efficient allocation and utilization of resources and budget. There has been significant growth in various initiatives to promote evidence-based health care (EBHC) in Africa, including primary and secondary research and reporting, research training development and support, access to information and partnering with decision makers. Evidence based health care (EBHC) and policy is a productive way of describing shifting from research into public health and clinical practice(93) and hence the purpose of this study, with the following aim and objectives below.

2. AIM AND OBJECTIVES

2.1 Aim

To determine the prevalence and types of acute foot and ankle injuries and/or complaints/pain attending a public sector orthopaedic clinic at a secondary hospital in South Africa over a 12-week period.

2.2 Objectives:

- i. To determine and describe the prevalence and type of acute foot and ankle injuries and complaints/pain presenting to an orthopaedic department (all new referrals) as well as the percentage of the total acute orthopaedic disease burden they represent. Information collected included the documented diagnosis (i.e., type and exact site of injury) as well as the method of diagnosis (clinical or use of imaging such as X-ray, CT scan).
- ii. To characterize the demographics (age, gender, occupation, employment status, access to the clinic - easy or difficult) and prevalence of associated comorbidities within this population, specifically the presence of diabetes mellitus, hypertension, and obesity (as determined by the body mass index (BMI)).
- iii. To describe additional factors associated with the presenting injury or complaint including the mechanism of injury as well as a history of prior injury to the foot and/or ankle. Also encompassed are the methods of clinical management e.g., conservative (non-surgical) or surgical intervention, as well as the use of mobility aids etc. to gauge the use of resources.

- iv. To formulate a clinical tool, namely the Research Record Tool, with all the patient characteristics (objective ii), additional factors (objective iii) and diagnosis information including the first post-injury Numeric Pain Rating Score and Foot and Ankle Ability Measure Score, for ease of record keeping and referencing.
- v. Depending on the presentation findings (gender differences, mechanisms of injury differences, types of injury differences), further investigations/analysis to be undertaken to understand the presentation of the study population.
- vi. To briefly describe the findings of the injury effects on activities of daily living as well as the current level of pain, by means of the Foot and Ankle Ability Measure (FAAM scale, Appendix A) and the Numeric Pain Rating score (scored 0 to 10, Appendix B), respectively.
- vii. To give a brief overview of the economic cost and health systems burden of treating musculoskeletal trauma within this cohort, including the costs of materials such as crutches, plaster of Paris, and splints where necessary.

PART 3: METHODOLOGY

3.1. Study Setting

Eighty participants (N=80) were recruited for this study, comprising both males (n = 29) and females (n = 51) from the age of 18 and older, presenting with foot and/or ankle pain at a public health district level hospital. All participants were first contact presentations to the Orthopaedic acute room at Prince Mshiyeni Memorial Hospital in the southwest Durban Metropolitan area, Kwa-Zulu Natal. Participants were recruited on referral by word of mouth (face to face consultation) at the orthopaedic department clinic. Participants were excluded if they were under the age of 18 years, if there were any underlying medical or psychological condition hindering the individual from giving informed consent, individuals with central and/or peripheral nervous system disorders which could adversely affect the interpretation of the Foot and Ankle Ability Measure (FAAM) scoring system (Appendix A), and any clinically unstable individuals requiring concurrent emergency medical and/or surgical intervention.

All participants were informed of the purpose of the study, aims, risks, and benefits, and they all gave written informed consent showing their willingness to participate in the study. The study was approved by the KwaZulu-Natal Department of Health and National Health

Research and Development (NHRD Ref KZ 202211 011), and the University of Cape Town Faculty of Health Sciences Human Research Ethics Committee (HREC Ref 617/2022). Current Covid-19 regulations were adhered to.

3.2. Study design and overview.

In this prospective descriptive study, all participants had a Research Record Tool completed by the principal investigator and medical officer on call (Appendix C) after providing informed consent as part of the clinical consultation. A Numeric Pain Score and FAAM (Foot and Ankle Ability Measure score) were also documented. The data collection was done over a 12-week period between December 2021 – March 2022. All data collection was done at the Orthopaedic Acute Room in Prince Mshiyeni Memorial Hospital in Durban. Where a definitive diagnosis could not be reached on the first consultation, a provisional diagnosis was documented in its place, as all participants cases were reviewed by the Orthopaedic specialist consultant.

3.3. Detailed testing procedures

3.3.1. Research Record Tool

The Research Record Tool (RRT) was designed specifically for this study to record data routinely collected as part of a clinical consultation. All data collected were de-identified and only the investigator had access to the master spreadsheet. The information collected for the RRT can be grouped into 4 subgroups; participant information, injury details, treatment, and follow up. The participant information included date seen, informed consent status, patient demographics (age, gender, weight, height, body mass index), smoking and alcohol consumption history, exercise habits, employment status, and lastly underlying medical conditions. The participants' weight and height were measured by the investigator, and the body mass index calculated using the universal formula weight in kilograms divided by the square of the height in meters (kg/m^2). Exercise habits listed included running, brisk walking, field sports, and contact sports, and the amount of time spent exercising per week.

Injury details collected included date of injury, mode of injury, which foot/ankle was affected, where the patient was referred from, imaging investigations conducted (i.e. X-ray, Computed Tomography Scan, and Magnetic Resonance Scan), and the provisional or final diagnosis. Specialized imaging such as CT scan was used to delineate and classify complex fractures, e.g. calcaneus fractures, and this aided in definitive decision making. The modes of injury were categorized as either a road traffic accident, low energy fall, assault of any kind (i.e. gunshot, blunt force trauma, penetrating trauma), and lastly injury on duty at work.

The scores from the Numerical rating scale for Pain and FAAM were documented at the end of the RRT. The RRT makes it easy to have all relevant information for each participant on one sheet and allows quick reference of information where required.

The Follow Up plan section describes if the patient was admitted for observation or surgical intervention or immediately discharged with or without a follow-up date to the Orthopaedics outpatient's department clinic. Treatment details included if any of the following were administered as part of the clinical management i.e. crutches, plaster of Paris, plaster backslab, crepe bandage, physiotherapy, and other modalities such as splints and occupational therapy.

3.3.2. Numerical Rating Scale for Pain (NRSP)

The Numerical Rating Scale for Pain is a validated scale used to describe pain with a subjective scoring range (patient reported) from zero to 10 with 0 representing no subjective pain and 10 representing the worst possible pain(94). None of the participants were under the influence of moderate-strong analgesic medication at the time of giving feedback on the NRSP. The score is aimed to provide feedback on the relationship between degree of injury and perceived or subjective level of pain.

3.3.3. Foot and ankle ability measure

The FAAM is a patient reported outcome (PRO) scale used for disorders and injuries of the foot and ankle and was administered in an interview format. Where required, a translator was utilized. The FAAM is a 29-item questionnaire divided into two subscales: The Foot and Ankle Ability Measure with 21 items for 'Activities of Daily Living (ADL) Subscale' and the Foot and Ankle Ability Measure with 8 items for the 'Sports subscale'. The Sports subscale is more population specific for athletes as it assesses more difficult tasks/activities essential for sporting activity. Each question is scored on a 5-point Likert scale (4 to 0) ranging from 'no difficulty at all (4 points)' to 'unable to do (zero points)'. Item score totals, which range from 0 to 84 for the ADL subscale and 0 to 32 for the Sports subscale, are then transformed to percentage scores. The score total is divided by the highest potential score (84 if all questions answered) and then multiplied by 100 to get a percentage. Higher scores represent higher levels of function for each subscale, with 100% representing no dysfunction. There is very good evidence for the validity and reliability of the FAAM (ADL and Sports scores(95-97). The FAAM has also been validated for use in individuals with diabetes mellitus and foot and ankle injuries/disorders(95). The FAAM was administered by the investigator at the orthopaedic acute room/clinic on consultation. The FAAM is an excellent tool and gives a baseline of the participants functional level post injury/pain at presentation,

3.3.4. Injury classification

In this study, we used the Association of Osteosynthesis/ Orthopaedic Trauma Association (AO/OTA) Classification system from the 2018 Fracture and Dislocation Classification Compendium, which is based on imaging findings/diagnosis. This is an internationally standardized classification system for orthopaedic musculoskeletal trauma (fractures and dislocations)(61) (Table 1).

Table 1. AO/OTA diagnostic codes for foot and ankle fractures/dislocations.

AO/OTA diagnosis	Diagnostic Codes
Lateral malleolus fracture	44B
Medial malleolus fracture	43B
Bimalleolar fracture	44B2
Trimalleolar fractures	44C
Calcaneus fracture	82C
Navicular fracture	83A
Cuboid fracture	84B
Toe phalanx fractures (foot)	88
5th Metatarsal fracture + Jones Fracture	87.5.1A
Lis franc fracture	Eponymous name
Tibiotalar dislocation	80B
Toes interphalangeal joint dislocation	80E

Table 1. Relevant diagnosis with associated AO/OTA diagnostic code. Note that Lis franc is kept as its eponymous name due to it not being represented in AO/OTA classification.

The classification assigns each bone in the human body a numeric code, then a further morphological designation is made using alphabetic codes; Type A represent simple fracture and extra-articular fractures, Type B represents wedge type fractures and partial articular fractures, Type C represents multi-fragmentary fractures and complete articular fractures. There are then specific Groups and subgroups, qualifications, and universal modifiers if they apply to the fracture one is dealing with. Of relevance to our study, the ankle region is designated the numeric code 44. Infra-syndesmotoc segment is designated alphabet code A, trans-syndesmotoc assigned B, and supra-syndesmotoc assigned code C. It is of note that the progression in alphabetic code represents increased severity of fracture and higher energy mechanisms. The ankle fractures in our study are designated as follows as per the AO/OTA system; Lateral malleolus 44B, medial malleolus 43B, bimalleolar fracture 44B2, and trimalleolar fractures 44C. The tarsal bone fractures in this study are designated as follows; Calcaneus 82C, Navicular 83A, Cuboid 84B. The metatarsal fractures in this study are designated as follows; 5th metatarsal/Jones fractures 87.5.1A, and the Lis Franc fracture dislocation is named eponymously. Fractures of the foot phalanges are designated as numeric code 88. The tibiotalar dislocation is designated as 80B, and the dislocation of the interphalangeal joint of the toe is designated 80E.

With regard to soft tissue injuries, ankle sprains were graded using 3 grades; grade 1 is a mild contusion to the ligament with all fibres intact, grade 2 sprain is a partial tear of the ligament, and grade 3 sprain is a complete tear of the ligament(47).

3.4. Statistical Analysis

Numerical data (e.g. anthropometry) are presented as mean \pm standard deviation or median and categorical data (e.g. diagnoses) as count (%). Normality of the data distribution were determined by use of the Shapiro-Wilks test. Between-group comparisons were performed using Fishers' Exact, Chi-Squared, Mann-Whitney U or independent t-tests. Data obtained was entered into Microsoft Excel (Office 365 2023). IBM SPSS software version 28.0.1.1 (2021) was used to perform statistical analysis. Statistical significance was set at $p < 0.05$.

PART 4: RESULTS

4.1. PARTICIPANTS: DESCRIPTIVE CHARACTERISTICS

A total of 1300 patients were referred to the orthopaedic clinic from the emergency department during the 12-week study period, December 2022 – March 2023. Of these, a total of 615 lower limb cases (47,3%) were referred to the orthopaedic unit/clinic with only 85 patients referred for Foot and Ankle injuries specifically, comprising only 14% of the total lower limb referrals.

Of the 85 patients referred to the Foot and Ankle clinic, four did not meet the study inclusion criteria and one patient declined consent to be included in the study. The study sample thus comprised a total of 80 participants who consented to participate, representing 94% of the referred sub-group of foot and ankle injuries. Of the 80 participants in the study, there were 51 females (64%) and 21 males (36%). The mean age for this cohort was 41.3 years (± 14.3 SD). The female group had a mean age of 43 years (± 15 SD), slightly older than the males at 37.4years (± 12 SD). (Table 2)

Table 2: Participant Characteristics (N=80) for Sex, Age, Weight, Height, BMI, Occupational Status and Smoking

SEX	Females		51 (63,8%)
	Males		29 (36,2%)
AGE RANGES (YEARS)	18-29		16 (20%)
	30-39		27 (33,8%)
	40-49		16 (20%)
	50-59		11 (13,8%)
	60-79		10 (12,5%)
WEIGHT (KG)	Females		65 (± 8.1 SD) *
	Males		76 (± 7.0 SD) *
HEIGHT (CM)	Females		160 ($\pm 4,5$ SD) *
	Males		175 ($\pm 6,1$ SD) *
BMI (KG/M2)	Females		25 (± 2.9 SD)
	Males		25,3 (± 1.5 SD)
OCCUPATIONAL STATUS	Employed		25 (31,3%)
	Unemployed		41 (51,2%)
	Scholar		6 (7,5%)
	Pensioner		8 (10%)
SMOKING	Current	Female	3 (3,8%)
		Males	14 (17,5%)
	Non-smoker	Female	48 (60%)
		Males	15 (18,7%)

Table 2. Data presented as median, standard deviations (SD)) or count (n, Percent (%)). Sex, Age ranges, Occupational status, Smoking reported as median values with percentage (%) of total number in brackets. Weight, Height, BMI reported as median values with standard deviation values in brackets. BMI; Body mass index. Males and females n values with percentage of total. * significant/statistical difference between genders, men and women for height and weight $p < 0.001$.

To better understand the age distribution of injury within this study, participants were grouped according to the following age groups. (Figure 4). The largest proportion of both the female and male cohort fell within age group 1 (i.e. those between 30-39 years of age). The gender groups were analysed as a percentage against the same age groups within respective genders (e.g. age group 1 males were analysed as a percentage within the male gender group, and age group 1 females were analysed as a percentage within the female gender group). This is important so as to avoid bias, due to the disproportionate numbers of female participants vs. male participants.

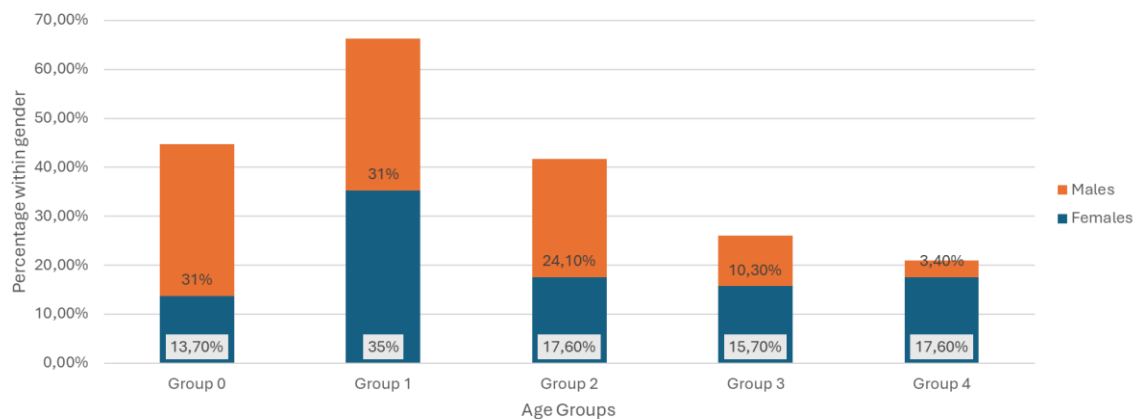


Figure 4. Age of presentation within Gender analysis

Data presented as Age groups in years; Group 0 (18-29), Group 1 (30-39), Group 2 (40-49), Group 3 (50-59), Group 4 (60-79). Numeric data presented as percentage (%). Orange bars = Males, Dark teal bars = females. Percentage (%) = Age group percentage within Gender group.

The median BMI for females was 25kg/m² (± 2.9 SD) and for male participants was 25.3kg/m² (± 1.5 SD). Females were shorter and had a median height of 160cm (± 4.5 SD) with the median height for males being 175cm (± 6.1 SD). Female participants had a median weight of 65kg (± 8.1 SD), and males had a median weight of 76kg (± 7 SD). Our study showed a statistically significant difference between men and women for height and weight ($p < 0.001$), but there was no statistically significant difference in BMI between males and females ($p = 0.734$). (Table 2).

With regards to co-morbid conditions, 15 patients (20%) had pre-existing medical conditions and were all on treatment for their conditions. Six patients were known with Essential Hypertension, 4 had Human immune-deficiency syndrome (HIV), 2 patients had concurrent Hypertension and Type 2 Diabetes Mellitus, 1 patient was a known Young Hypertensive, 1

patient had asthma, and 1 was known to psychiatry outpatient clinic with bipolar mood disorder (clinically stable).

Only one patient reported prior/previous foot surgery, an open reduction and internal fixation for a Lis Franc injury (tarso-metatarsal fracture dislocation) in 2018. The study questionnaire focused only on previous foot and ankle surgery. As seen in Table 2, sixty-three (79%) of the participants were non-smokers and seventeen (21%) were smokers. Of the smokers' group, males accounted for 82% and females made up the remaining 18%. Eight (10%) participants were current alcohol users, with males representing 75% of this group. Within this group, all sustained fractures; ankle fractures (6) and foot fractures (2). Within the study cohort, a total of 51% (41) participants reported being unemployed and 31% (25) employed. Pensioners made up 10% (8) and scholars made up the remaining 8% (6)

4.2. CLINICAL FINDINGS AT PRESENTATION

Of the clinical presentations in the cohort including both fractures and sprains, ankle-only presentation comprised 65% (52), foot-only 33% (26), with 2 patients (3%) presenting with combined injuries of both foot and ankle sites (Figure 5). More specifically, the left ankle was involved in 31.3% (25), right ankle 33.8% (27), right foot 16.3% (13), left foot 16.3% (13), 1 case (1.3%) had concurrent right foot-and-right ankle involvement and one participant (1.3%) had both feet affected by hallux valgus. In the group titled 'Other', one participant had involvement of both the right and left foot and another presented with injury of the right foot and ankle.

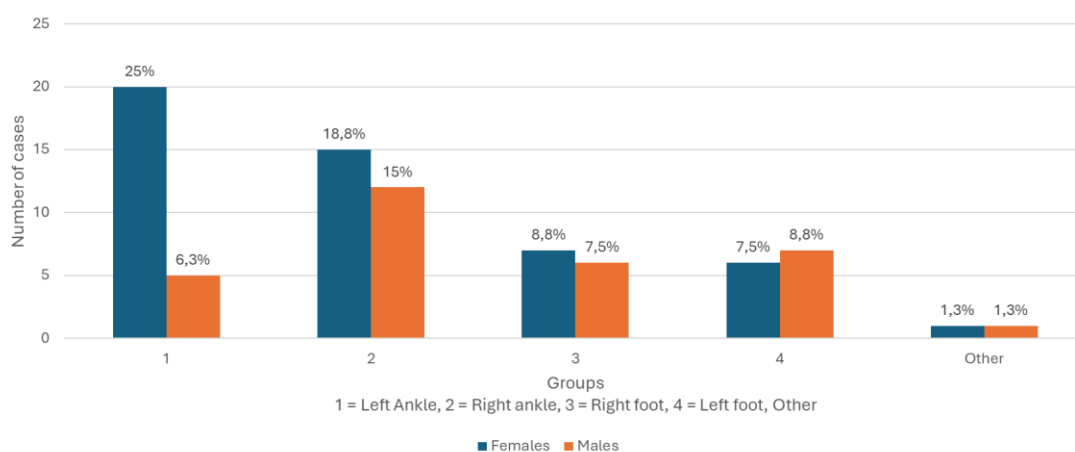


Figure 5. Anatomic area of injury: Female and Male groups

Dark teal bar represents females, the orange bars represent males. 1 = left ankle, 2 = right ankle, 3 = right foot, 4 = left foot, and 'Other' group where bilateral foot/ankle in same participant

When reviewing the more specific type of injury within each anatomical site (Table 3), ankle fractures made up the greatest percentage of this cohort at nearly 60% of injuries presenting to the clinic. Lateral malleolar fractures comprised nearly 23% of the cohort, with type 44.1.B being the most common type of lateral malleolar fracture. Similar numbers were reported for bimalleolar fractures at 20% of the total injuries, with far fewer cases of medial and trimalleolar fractures.

Table 3: Anatomical regions, diagnosis and classification of ankle/foot fractures and sprains

<i>Region</i>	<i>Diagnosis</i>	<i>Count (n)</i>	<i>AO/OTA/Grade</i>	<i>% of total cases</i>
<i>Ankle, fracture/dislocation</i>	Lateral malleolus	18	44B1.1 = 13(16.2%) 44B1.2 = 2(2.5%) 44A1.2 = 1(1.25%) 44C1.1 = 1(1.25%) 44C1.2 = 1(1.25%)	23%
	Bimalleolar	16		20%
	Medial malleolus	5		6%
	Trimalleolar	3		3.8%
	Tibio-talar dislocation	1		1.2%
	<i>Total</i>		43	
<i>Foot, fracture/dislocation</i>	Hindfoot	1	82C (N=1)	1.2%
	Midfoot	5	83A (N= 4) 84B.a (N=1)	6.2%
	Metatarsals	7	87.5.1A.a (N= 5) Lis franc (N= 2)	8.7%

	Phalanges (2 fractures, 1 dislocation)	3	88.2 (N=1) 88.3 (N=1) 80E (N= 1)	3.7%
<i>Total</i>		16		20%
<i>Ankle, sprain</i>	Lateral ligaments	10	Grade 1 (N= 6) Grade 2 (N= 4)	12.5%
	Medial/deltoid ligament	2	Grade 1 (N= 2)	2.5%
	Syndesmosis	1	Grade 2 (N=1)	1.2%
<i>Total</i>		13		16.2%
<i>Foot, soft tissue</i>	Midfoot sprains	6	Grade 1 (N=6)	7.5%
	Heel pain	1	(N=1)	1.2%
	Hallux valgus	1	(N=1)	1.2%
<i>Total</i>		8		

Table 3: Data presented as count (%) shows diagnostic codes for corresponding injury as per the AO/OTA Compendium Classification System 2018; Lateral malleolus fracture 44B, Medial malleolus fracture 43B, Bimalleolar fracture 44B2, Trimalleolar fractures 44C, Calcaneus fracture 82C, Navicular fracture 83A, Cuboid fracture 84B, Toe phalanx fractures (foot) 88, 5th Metatarsal fracture + Jones Fracture 87.5.1A, Lis franc fracture =Eponymous name, tibiotalar dislocation 80B, Toes interphalangeal joint dislocation 80E.

There were more fractures of the forefoot (i.e. metatarsals and phalanges) as compared to the mid-and hindfoot. There were 4 (5%) navicular fractures, 1 (1.25%) calcaneus and 1 (1.25%) cuboid fracture making a total of 7.5% fractures in the hindfoot-midfoot region. Seven metatarsal fractures accounted for 8.7% of all injuries; there were five 5th metatarsal fractures/Jones fractures (6% of all cases and 33% of foot fractures), and 2 Lis franc fractures making up 2.5% of all cases and 13% of foot fractures. There were 2 fractures of the phalanges (big toe and 4th toe) making up 2.5% of all cases and 13% of foot fractures.

There were also 2 dislocations of the forefoot (2,5% of all cases) and 1 ankle/tibia-talar dislocation (1.2% of all cases).

Our study identified sprains involving the ankle and the foot. Within this cohort, 10 (12.5%) lateral ankle ligament sprains, 2 (2.5%) medial ankle/deltoid ligament sprains, and 1 (1.2%) syndesmosis sprain were documented. Ankle sprains thus made up 16% of all injuries with lateral ligament ankle sprains being most common. Most of the ankle sprains were mild sprains classified as grade 1 (8), with 5 assessed as grade 2. The medial (deltoid) ligament and syndesmosis (high ankle sprain) were much less common making up 3.7% of all injuries. The foot had a total of 6 grade1 sprains accounting for 7.5% (6) of all foot and ankle injuries.

There was one case of bilateral foot hallux valgus and one patient with non-specific heel pain which was treated as a plantar fasciitis. One participant sustained an injury from a football match.

While fractures of the foot mostly affected the forefoot, foot sprains were commonly diagnosed in the midfoot, making up 7.5% of all injuries, and second to lateral ankle sprains in the foot/ankle sprain category. Clinical evaluation elicited tenderness on the midfoot area only in the patients diagnosed as midfoot sprains. Of interest, no significant differences were found within age-group categories for a specific type of injury ($p>0.05$).

There was however a borderline statistical significance between injury diagnosis and sex/gender (p value 0.049) noted. Some of these differences noted include the observation that the most common injury presentation within the female group were fractures of the lateral malleolus (27.5%) followed by bimalleolar fractures (23.5%). In contrast, lateral malleolar fractures were found in only 13.8% of the men. The leading injury within the male cohort were fractures of the foot (including navicular, calcaneus, metatarsals, and phalanges) at 41.4%, whereas fractures of the foot represented only 9.8% of the female group. Similar percentage presentations were noted within the gender groups for the bimalleolar fracture category, but no men and only three women presented with trimalleolar fractures.

Ankle sprains again were similarly represented within the gender groups, with the injury reported in 15.7% of women and 13.8% of men. Slightly more midfoot sprains were documented within the female cohort at 9.8% vs 3.4%. Lateral malleolus fractures in females accounted for 17.5% of all foot and ankle injuries, and in males accounted for 5% of all foot and ankle injuries. Bimalleolar fractures in females accounted for 15% of all foot and ankle injuries, and in males accounted for 6.3% of all foot and ankle injuries. As previously mentioned, females suffered all 3 trimalleolar ankle fractures, which represented 5.9% of injuries within the same gender group and 3.8% of all foot and ankle injuries combined. The most prevalent injury for males were fractures of the foot (excluding 5th metatarsal fractures) representing 66.7% (8) of all foot fractures and 10% of all foot and ankle injuries combined. Female participants' foot fractures (excluding 5th metatarsal fractures) accounted

for 33.3% (4) of all foot fractures and 5% of all injuries in foot and ankle combined. The foot fractures reported are Lis Franc fractures (2 cases, one with ipsilateral cuboid fracture), navicular fracture (4), calcaneus fracture (1), fractures of the 4th toe (1) and big toe phalanx (1), and dislocations of the big toe interphalangeal joint (2) and 5th toe metatarsophalangeal joint (1). Three male participants had medial malleolar fractures representing 3.8% of all foot and ankle injuries, and 10.3% of fractures in the same gender group. Comparatively, females had 2 presentations of medial malleolus fracture representing 2.5% of all foot and ankle injuries and 3.9% of fractures in the same gender group. Fractures of the 5th metatarsal accounted for 6.3% of all foot and ankle injuries (females 1.3% vs males 5%).

Regarding soft tissue injuries and apparent gender differences, female participants presented with 8 ankle sprains (66% of all ankle sprains) compared to males 4 presentations (33% of all ankle sprains). Ankle sprains were the third most common injury affecting females (15.7%) after lateral malleolus fractures (27.5%) and bimalleolar ankle fractures (23.5%). Comparatively ankle sprains in males were the third most common injury (13.8%) after combined foot fractures (41.4%) and bimalleolar ankle fractures (17.2%). Midfoot sprains affected females on 5 occasions representing 83.3% of all midfoot sprains and 6.3% of all foot and ankle injuries. In males there was one case of midfoot sprain representing 1.3% of all foot and ankle injuries. Among females, midfoot sprains were the 4th most common injury making up 9.8% of all injuries affecting females. Both chronic presentations were female, with one female presenting with bilateral hallux valgus and another female participant presenting with heel pain.

With regard to mechanisms of injury, low energy falls accounted for 66.3% (53) of the reported injury mechanisms. The second most common injury mechanism in our study was Road Traffic Accidents at 21.3% (17), followed by Assault at 6.3% (5), Spontaneous mechanism (non-traumatic cause accounting for hallux valgus and heel pain) 2.5% (2) and then Sports/Soccer, Fall from height and Accidental trauma at 1.25% each respectively. Of note was the finding of a strong statistical significance ($p < 0.01$) between mechanism of injury and gender involved for our cohort.

Furthermore, this apparent difference between genders was illustrated with finding that low energy falls accounted for 76.5% of injury mechanisms for females within the same gender followed by Road Traffic accidents at 17.6%. While low energy falls mechanism was also the highest among males, it accounted for only 48.3% of injury mechanisms, followed by a higher percentage of Road Traffic accidents (27.6%), Assault (17.2%) and sports related injury (3.4%) within the same gender. (Table 4).

Table 4. Mechanism of Injury, Foot/ Ankle affected for male and female groups.

MECHANISM OF INJURY	TYPE	SEX	N (PERCENTAGE OF TOTAL CASES)
	Low energy fall	Female	39 (76.5%)
		Males	14 (48.3%)
	Road traffic accident	Female	9 (17.6%)
		Males	8 (27.6%)
	Assault	Female	0 (0)
		Males	5 (17.2%)
	Sports related	Female	0 (0)
		Males	1 (3.4%)
	Accidental injury	Females	1 (2%)
		Males	0 (0)
	Spontaneous	Females	2 (3.9%)
		Males	0 (0)
FOOT/ANKLE AFFECTED	Left	Female	27 (52.9%)
		Males	11 (37.9%)
	Right	Female	23 (45.1%)
		Males	18 (62.1%)
	Both Feet	Female	1 (2%)

Table 4: Mechanism of injury and ankle/foot affected. Data presented as number/count and percentage of total cohort for mechanism of injury and affected foot/ankle across both sexes.

In this study, the mean Pain Score was 6.6 out of ten (± 1.2 SD). While no statistical differences were noted, pain scores within genders were reported as follows. Within the female gender group, 35.3% of participants rated their pain as 6 out of 10, 21.6% rated pain intensity of 8 out of 10, and one female participant rated her pain as 10 out of 10 for an ankle fracture. Among the male group, 7 out of 10 pain rating was the most reported by 37.9% of participants, followed by 24.1% (6 out of 10 pain intensity) and 17.2% (8 out of 10 pain intensity), and only one male reported pain intensity 9 out of 10, this being for an ankle

fracture and foot abrasion. The female participant with 10 out of 10 pain rating also had the lowest FAAM score of 30. The second lowest FAAM score (total 35) was reported by the male participant who reported a 9 out of 10 pain rating. The mean FAAM was 68,2 (± 12.1 SD). Seventeen (21.3%) participants reported a FAAM score of 75, followed by 12 participants reporting score of 80 and a further 12 participants reporting a score of 70. The majority of the cohort would be considered to have mild to moderate disability based on the FAAM, which would clinically correlate with their injury presentation.

4.3. SPECIAL INVESTIGATIONS

All the participants (N=80) already had X-ray investigations performed for their foot/ankle pain on arrival from the casualty department. It was not documented whether the Ottawa Ankle rules, applied to determine the need for imaging, were used for the traumatic cases. Pain and tenderness appeared to be the main/primary reason for a foot/ankle X-ray imaging. Seventy-seven (96%) participants required X-ray imaging only to make and/or exclude a diagnosis, while 3 (4%) participants required both X-ray imaging and CT scans to make and/or exclude a diagnosis. The fracture sites that required further imaging by means of CT scan to delineate the injury were calcaneus, cuboid, and Lis Franc fractures of the foot.

As seen in Table 3, in this study, the Association of Osteosynthesis/ Orthopaedic Trauma Association (AO/OTA) Classification system from the 2018 Fracture and Dislocation Classification Compendium, which is based on imaging findings, was used to classify fractures of the foot and ankle. (see also Table 1).

With regard to soft tissue injuries, ankle sprains were graded using 3 grades; grade 1 is a mild contusion to the ligament with all fibres intact, grade 2 sprain is a partial tear of the ligament, and grade 3 sprain is a complete tear of the ligament(47) (Refer Figure 3).

4.4. CLINICAL MANAGEMENT

Out of the 80 participants, only 6 (7.5%) were admitted to the orthopaedic ward. Five were admitted for open reduction and internal fixation, and one was admitted for limb elevation and CT scan for a calcaneus fracture. The other 74 (92.5%) participants were all discharged on the same day (not admitted) after the initial management was administered and followed up as outpatients.

Seventy-seven (96%) participants received crutches (n=72 as outpatients, n=5 as in-patients). The remaining three patients (3.7%) did not receive crutches for the following reasons: one patient had bilateral hallux valgus, the other had non-specific heel pain, and the last was admitted for surgery, but he did not have the base fee for crutches (fee determined by the hospital policy).

Regarding methods of treatment for the patients within this cohort, 40 (50%) were treated with closed reduction (under sedation in the orthopaedic acute room) and full plaster of Paris, 30 (37.5%) were treated with closed reduction and plaster backslab only, 2 (2.5%) were managed with buddy strapping and plaster backslab, and as mentioned earlier, 5 (6%) participants were admitted for surgery (open reduction and internal fixation) and 1 admitted for elevation and CT scan of calcaneus fracture. The remaining 2 participants were treated with orthotics (silicone-gel heel insert) and/or occupational therapy.

In total, 40 cases were managed with a full plaster of Paris (non-operative); all of these fractures. These were predominantly fractures of the ankle and included 18 lateral malleolus fractures, 16 bimalleolar fractures, 5 medial malleolus fractures and 1 navicular (foot) fracture (Table 3). The third type of lateral malleolus fracture (44C) is often regarded as unstable, but in our 2 cases, the position of the bony alignment was considered acceptable and hence conservative management with close follow-up was decided upon. In some cases, surgery may be warranted if conservative measures fail. There were however 5 cases managed surgically with open reduction and internal fixation (ORIF) (Table 5). These included three trimalleolar ankle fractures and 2 Lis franc fractures (one Lis franc case had an ipsilateral cuboid fracture).

Table 5: Clinical Management Procedures

	<i>Ankle</i>	<i>Foot</i>	<i>Total</i>
<i>Plaster backslab</i>	14	18	32 (40%)
<i>Plaster of Paris</i>	39	1	40 (50%)
<i>ORIF</i>	3	2	5 (6.25)
<i>Occupational/Physiotherapy</i>		2	2 (2.5%)
<i>RICE (as In-patient)</i>		1	1 (1.25%)
			N= 80 (100%)

Table 5. Management comparisons for ankle and foot injuries: Data presented as count with percentage of the total group. ORIF; Open reduction and internal fixation. RICE; Rest Ice Compression bandage and Elevation. CT; Computed tomography scan.

All 13 ankle sprains were managed with a plaster backslab and crutches as part of the departmental management policy for soft tissue injuries. Fractures of the 5th metatarsal (n=5) were also managed with a backslab in our setting, although they can be also managed with a full plaster of Paris. All six cases of midfoot sprain cases were managed with a plaster backslab. There were no associated fractures or dislocations noted on X-ray imaging and therefore a backslab was administered to assist with pain relief by preventing excessive motion at the foot. At follow up in the clinic 1-2 weeks later the slab is removed, and the foot is then reassessed, and further management decided following the clinical review.

The two fractures of the phalanges (4th toe and big toe) were minimally displaced and managed conservatively with a backslab for 4-6 weeks. One bimalleolar ankle fracture was managed with a backslab (U-slab). Typically these fractures are regarded as unstable, but if the post reduction position is acceptable and the institution has resource constraints, then conservative management with close follow up is done(98). The patient with tibio-talar dislocation was reduced under sedation in the orthopaedic acute room and placed in a backslab, and planned for admission, but they refused admission and opted for a conservative approach. In total 32 injuries were managed with a plaster backslab (Table 5).

In addition, as mentioned earlier, there were two cases of a more longstanding clinical nature. One case of bilateral hallux valgus was regarded as mild-moderate and given a trial of non-operative management, whereby they were referred to occupational therapy/podiatry for splinting and physiotherapy. The other patient with heel pain was also referred to occupational therapy for heel inserts and then physiotherapy. Long term outcomes following the above management is not available as this was not the purpose of the study.

PART 5: DISCUSSION.

This study aimed to evaluate the prevalence of acute foot and ankle complaints presenting to the department of orthopaedics at Prince Mshiyeni Memorial Hospital. Over the 12-week period, 85 patients were referred for foot and ankle injuries/pain, which comprised 14% of the total orthopaedic lower limb referrals from the casualty department. This is similar to the findings of Teyhen et al who reported an incidence of foot and ankle injuries of 20.5%, with the whole lower extremity accounting for just under 50% of musculoskeletal injuries(99) in a prospective observational study within a military setting. In another prospective study, the foot and ankle made up 29% of all musculoskeletal injuries presenting to the emergency department in an Australian cohort(100), somewhat higher than our study. It is possible that the slightly lower percentage observed in this study pertains to factors related/relating to the duration of the observation period, the time of the year or the community reviewed.

One of the most important findings in our study, though perhaps not unexpected, was the predominance of fractures (>70%) and more specifically, ankle fractures within this injury cohort (>50%). Soft tissue injuries made up 23.7% and dislocations 3.7%. Our findings were similar to those of Shibuya et al who found that ankle fractures accounted for 56% of all foot and ankle fractures seen in most major trauma centres in the United States. In their study, bimalleolar type ankle fractures were the commonest type, whereas in our cohort both lateral and bimalleolar types were the most common, presenting with 23% vs. 21% respectively. The calcaneus and navicular fractures within the US study made up 9.3% and 2% of foot/ankle fractures respectively(57), again similar findings to our study. These apparent similarities may suggest that the institution at which our study was conducted sees a relatively high number of musculoskeletal trauma.

Furthermore, within our cohort, women were observed to present to the orthopaedic department at a ratio of 1.7 to each man, with nearly 2/3 of those referred for foot and ankle injuries being women. While the trauma incidence in this study is slightly higher than that reported in the UK and Australia, similarly there were more females (54.4%) than male (45.6%) presentations(101). Our findings are however in contrast to an epidemiological study from Botswana, one of our neighbouring countries, which reported the opposite with males making up 68.9% of participants and females 31.1% in a Central/Tertiary Hospital, while in their District Hospital setting males made up 67.1% and females 32.8% of participants(102). Their study was slightly different in that they focused on orthopaedic admission cases only. A longer period of observation for our study might give greater insights into whether this apparent female predominance persists over time. The reason for this apparent predominance of women within our cohort is unclear but could result from a number of reasons i.e. a result of changes in societal norms allowing women greater freedom in public, improvements in employment rates meaning more women are accessing public transport systems going to work, and lastly early recognition and presentation to health care facilities, to name but a few. Further research is needed before specific conclusions can be drawn.

However, on analysis of the data, two sex-related differences in injury presentation were noted. The first pertained to the type of injury, whereby there were different injury predilections for men and women. The second related to the mechanism of injury.

Sixty one percent of women presented with an ankle fracture, while for men, ankle fractures made up only 41% of their foot and ankle injuries. Of further interest was the difference in type of ankle fractures experienced by the different sexes. Lateral malleolar fractures were far more common in the female cohort (28% vs, 14%) and also the most common fracture type in women. While a similar prevalence of bimalleolar fractures was noted in both gender groups (i.e. slightly more in women), these fractures were the most common in the male cohort. Interestingly, while a greater percentage of men sustained medial malleolar

fractures, the trimalleolar fracture group was comprised of women only. It is possible that there could be intrinsic factors between sexes (anthropometric differences) and extrinsic factors such as mechanism of injury that predispose to the particular fracture types as seen in our study. Further research is needed to better understand these findings, including the influence of alcohol, age of injury, and previous injury history, if any strong association exists.

In contrast, fractures of the foot comprised 41.1% of foot and ankle injuries in men as compared to only 9.8% in women. Men thus presented with a similar prevalence in foot and ankle fractures, whereas far more ankle fractures as compared to foot fractures were reported for women. However, the prevalence of ankle sprains was very similar between the two sexes. Slightly more midfoot sprains were reported in women.

As alluded to earlier, possible considerations for these apparent trends might relate to mechanism of injury. It is therefore very interesting that there was a significant difference in mechanism of injury found when comparing men and women in our study.

Low energy falls were the most common mechanism of injury overall (66%), but this mechanism was far prevalent in women at 76% as compared to 48% in men. Men sustained a higher percentage of foot and ankle injuries in road traffic accidents as well as assault and sports-related incidents than women. In Sweden, a 17-year population based study of 91410 patients (all ankle fractures) found low energy falls to account for 64% of injury mechanisms, road traffic accidents caused 20% of open fractures and 9% of closed ankle fractures, and fall from height mechanism caused 10% of ankle fractures(103), quite similar to our findings. In the Swedish study, in females over the age of 60, low energy falls accounted for 72% of cases(103). However, in our study, the median age of the cohort was nearly twenty years younger.

Shibuya et al reported that 53.5% of injuries occurred in the street, 26% at home, 5.5% from recreational activities, 4.4% from industrial locations and 3.5% from public buildings. They did not specify if they were a result of low energy falls, road traffic accidents or falls from a height(57). Pradana et al (Indonesia) in turn reported that road traffic accidents were the most common injury mechanism among young males, mainly due to use of motorcycles and risky driving habits, driving habits of young persons (age range 11-20, 20-30) in particular(16). In an epidemiological study conducted in South-East Australia, different findings were document with falls responsible for more than 575 of foot/ankle fractures. "Other accidents" such as striking against an object accidentally or strenuous movements accounted for 8-10% of injury mechanisms, and road traffic accidents followed with approximately 10% of incidents(59). The higher predisposition to injury to the lateral ligaments highlights that the common injury mechanism for low energy ankle sprains is the inversion type mechanism of injury.

A study by Amin et al reported following a 20-year study that moderate trauma (falls at same level, falls from <2 metre height) were found to account for 27.8% of foot fractures and 52% of leg (including ankle) fractures. Severe trauma (such as road traffic accidents, falls from >2 metre height, industrial accidents) accounted for 61.5% of foot fractures and 42.8% of leg (including ankle) fractures(104). This study thus suggests that a higher energy mechanism of injury is needed to sustain a foot fracture whereas a lower energy mechanism can lead to a high number of leg and ankle fractures. Perhaps this explains the higher number of ankle fractures within our cohort in relation to low energy falls making the greatest contribution to mechanism of injury. It is of note that common causes of foot/ankle pain seen in athletes/runners as well as sporting injuries were not encountered during our study period except for one football injury and one possible presentation of heel pain that may have been as a result of plantar fasciitis.

In view of the above as well as the different injury mechanisms observed on comparing men and women in our study, it might be suggested that these mechanisms may in fact partly explain the different types of injury presentations documented between the male and female cohort. It is however important to remember that these findings related to comparisons and while relationships may be inferred, correlations have not yet been confirmed.

While Thur et al (103), reported that low energy falls were a common cause of ankle fractures in women over 60, females in this study presented with an average age of 41 years, only 4 years older than the male average age (37 years). This slightly higher mean age for women is in keeping with most studies with Holloway et al reporting that females sustain foot/ankle fractures at a higher median age than males. However, the combined average age in our study was lower than most studies evaluating general foot and ankle pain. The systematic review by Cotchett looked at multiple quantitative studies of patients with foot and ankle pain and found that a range of age presentations depending on the condition reviewed. Shivarathre et al had mean age of 51.4 (range 20–70) and the control group 51.1 (range 21-67) in participants with foot/ankle pain in the specialist orthopaedic clinic. Briet et al showed a median age 26 (IQR 18) for patients with lateral ankle sprain, with no control group(105). Patients presenting with foot pain average 68 years of age (Butterworth), 56 years of age for plantar heel pain (Cotchett) and 75 years for hallux valgus (Palamo Lopez). Therefore, in our study, while these younger ages might not support the high number of low energy falls or RTAs, this age category likely represents quite an active population with regards to attending to activities of daily living. There was however no age group that appeared to predispose to a specific type of injury within this cohort.

Another possible consideration with regards to mechanism of injury might relate to anthropometrical factors. Men were significantly taller and heavier than women, but the median BMI was very similar for both groups (approximately 25kg/m²). This does represent an overweight category to the World Health Organization (WHO) BMI categories(106). Interestingly, most studies reported high mean/median BMIs across their cohorts. In a systematic review from 2022(105) assessing 14 quantitative studies on psychological factors in patients with foot and ankle pain the following observations were documented. Awale et al found a mean BMI of 29 (± 4.7 SD) for females and 28 (± 6.0 SD) for males presenting with foot pain. Butterworth et al had reported a mean BMI of 28 (± 4.3 SD) for the entire cohort presenting with foot pain. The control group for this study had a mean BMI of 27.1 (± 3.8 SD). Similarly, Cotchett et al documented a mean BMI of 29.3 (± 5.5 SD) across the whole cohort with plantar heel pain and the control group had a mean BMI of 25.7 (± 4.4 SD). Perhaps of more relevant comparison to our study, among a cohort of participants with lateral ankle sprain, the median BMI was 24 (IQR 5.1), and they had no control group. and lastly, Tojo et al reported 89 participants underweight (14%), 468 had normal BMI (74%) and 55 participants overweight (9%) in participants presenting with foot and ankle pain with no control group(1). It is therefore possible that individuals with slightly higher BMIs are at an increased risk of foot and ankle pain, and it is unclear from our study whether being taller for example, might predispose to certain mechanisms of foot and ankle injuries.

Only seventeen (21%) participants in our study were current smokers. However nearly 50% of the males were smokers, whereas 94% of females were not. Audet et al reported that current smokers have worse patient-reported functional score and are more likely to use prescription medications months after injury for torsional ankle fractures(107). A population-based cohort study by Ferguson et al found that non-smokers had more recorded foot and/ankle pain encounters to their local general practitioner than did smokers or ex-smokers (55.1% vs 17.4% vs 27.5%). Perhaps this might partially explain the larger female cohort, however causality could not be attributed as there was no control group. Our sample size and follow up period may be a limitation in this regard.

Our study found 8 (10%) of participants to be current alcohol users, 6 (7.5%) were male and 2 (2.5%) females, and all cases involved fracture as opposed to soft tissue injury possible indicating a higher injury mechanism or loss of protective measures during injury compared to sober participants. Ferguson et al reported that those who consumed alcohol had had a higher prevalence of foot and/or ankle pain than those who did not consume alcohol(101), but is not an independent risk factor for foot/ankle pain.

Regarding employment status, 32 (40%) of unemployed participants sustained low energy falls mechanism of injury, and only 15 (18.8%) of employed participants with the same injury mechanism. Of the 5 participants who were Assault mechanisms, 4 were unemployed. Road traffic accidents affected mostly employed participants (n=7) vs 4 unemployed, 4 scholars,

and 2 pensioners. It may be that road infrastructure and driving practises in township settings put all civilians at higher risk of injury than suburban settings. In a cross-sectional study by Hendry et al, it was reported that foot/ankle pain was increasingly prevalent among university-educated population, citing that having an education is not protective against moderate-severe foot/ankle pain(108). Wee Liang et al found that unemployment and functional limitation had a higher incidence of chronic pain, but that there was no statistical difference in the prevalence of pain between low-income earners and middle to high income earners(109).

According to Hendry et al, independent risk factors for moderate to severe foot/ankle pain are low occupational class, high body mass index >25kg/m², bunions, female sex, back pain, and hip pain. Age was not associated with increased severity of foot pain. Hypertension, peptic ulcer disease, mood disorders (depression), hip and knee pain and rheumatoid arthritis were not found to be significant independent risk factors for moderate-severe foot pain. Within our study, only 20% of the patients had pre-existing medical conditions and were all on treatment for their conditions, primarily hypertension (10%), HIV (5%), two patients with diabetes and one with asthma and one with stable bipolar mood disorder.

When assessing the need for additional resources that might be required in order to ensure good quality patient management and care, it was noted that most patients required a pair of crutches as part of their treatment, and this assists in preventing patients from weight bearing on the plaster backslab and plaster of Paris. The institution has stock of wooden axillary crutches and elbow-type crutches. The elbow-type crutches are reserved for the elderly and those who have difficulty using traditional wooden axillary crutches. In addition, all patients had undergone X-ray imaging for their injury. We are not certain of the number of patients seen in the Emergency Department who have X-ray imaging performed routinely or the number of patients discharged without imaging for presentations of the foot and ankle. As mentioned in the results section, it was unclear whether the referring medical staff had utilised the Ottawa rules to guide the indication for an X-ray, but rather used pain and/or swelling and difficulty walking as reported by the patient. It might be of value as a further study to determine if the medical staff within casualty do indeed utilise this tool and if not, whether outcomes are affected as compared to previous studies. It must however be noted that all patients referred who had had X-rays, required orthopaedic clinic follow up and from the diagnostic codes, it appears as if the clinical decision to arrange the imaging was indeed correct. It is thus evident that X-ray imaging was of great importance to the management of these patients and therefore remains an essential tool especially in a resource limited setting. Only 3 (3.8%) patients were referred to further CT imaging to ensure correct clinical management, suggesting that more costly resources are utilised with care. These were for fracture of the calcaneus and Lis franc fracture dislocation, which are usually complex fractures that require special imaging for fracture grading and decision making.

In settings where custom-made braces for specific limbs are utilised e.g. right-ankle brace, it was interesting to note that there were similar numbers of injuries to both the right and left ankle (about 33% each) and similar numbers for the right and left foot (approximately 16%). While the ankle had a higher number of injuries than the foot, there appeared to be no predilection of a specific side with similar injury numbers noted for the right and left side for each of the anatomical sites.

Plaster of Paris (gypsum) was primarily used as a means of immobilisation for patients with foot and ankle injuries. Fifty percent of patients seen received a complete Plaster of Paris and forty percent a plaster cast backslab as their injury immobilisation management. The decision for the above management is based on the clinical rationale that most of the lateral malleolus fractures were regarded as stable (44A and 44B) and closed reduction and plaster of Paris is the usual management(110). The sixteen bimalleolar fractures were also reduced adequately with closed methods and managed with plaster of Paris. All these bimalleolar fractures require weekly follow up in the first 3 weeks at this institution, to make sure they do not displace. If they do displace, either a repeat closed reduction or admission for ORIF is considered. The three medial malleolus fractures were minimally displaced and did not require surgery at presentation. As these fractures can be unstable, close follow-up is required as with bimalleolar ankle fractures.

The 13 ankle sprains were managed with a plaster backslab. These patients are then followed up in 1-2 weeks during which the plaster is removed and a reassessment of the ligament injury is done to elicit laxity or instability, followed by a course of physiotherapy without the backslab. Moonboots, although not without financial cost, are often considered first line immobilisation treatment for ankle sprains in particular. In this study, the hospital however does not routinely stock moonboots and plaster of Paris is the mainstay of immobilisation. Plaster backslab's can however get dirty and even weakened by contact with water, and patients sometimes complain of itchiness underneath the backslab on the skin, some of the disadvantages of this treatment option as compared to the moonboot. It is however more cost effective.

The 5 cases with fractures of the 5th metatarsal were managed with a plaster backslab. In these specific cases, there were concerns of excessive swelling, and as the fractures were minimally displaced, the decision was taken for conservative management with backslab only. These patients are then usually followed up in 4 weeks for repeat X-ray imaging to confirm that the fracture is still in an acceptable position and uniting. At 6 weeks, the plaster is removed, and physiotherapy commenced. In some cases, a non-union may result and may need surgery if symptomatic.

Large costs are associated with admission to hospital, and therefore again it was of note that only 7.5% of patients seen were admitted for surgery or observation and other treatment.

92.5% were discharged on the same day with orthopaedic outpatient follow up. We currently do not have sufficient data on the outcomes of conservative and surgical management at this institution, therefore long-term studies are required to address this shortfall. This would include administering the FAAM score and Pain Scores over this long-term period to monitor management efficacy to substantiate and support the current admission policies and hereby ensure that resources carefully managed.

Limitations of this study

We may not have a true description of the population point prevalence of foot and ankle pain/injury due to exclusion of patients under 18 years of age and the relatively short duration of data collection. The low number of non-traumatic foot and ankle problems may underscore the true incidence of these conditions. As this is a single centre study, population differences and disease profiles may not be truly represented. A long-term follow-up period of more than 12 weeks could furthermore give more insight into the long-term effects and outcomes of conservative management of foot and ankle fractures. There was a low number of sports-related injuries, but this could possibly be as a result of our study being conducted during the school holidays (December – January) and most school sports seasons beginning in February. The other consideration is that individuals participating in sports may be attending private medical care as the local government hospital does not have a dedicated sports injury clinic. This study therefore represents a very specific time period and hence conclusions must be drawn with care.

CONCLUSION

Musculoskeletal trauma is highly prevalent in our societies as seen around the world. From young age groups through middle-ages and late adulthood, active lifestyles, changes in behaviours and driving habits, the risk of injury is ever present. Foot and ankle pain is thus also a prevalent problem which constitutes a high number of traumatic bone and soft tissue injuries in the South African setting. Within this study, females were seemingly more affected, with low energy fall mechanisms being the primary mechanism of injury. Males suffered more RTAs, direct trauma, and sports injury mechanisms. Ankle fractures rank high among females, whereas males suffer proportionately more foot fractures. In addition, women also presented with a higher number of lateral and trimalleolar fractures than men. Admission rates were low, but all patients required radiological imaging, crutches, and a form of joint or limb immobilisation. While many studies have focused on epidemiology and injury stratification in other countries, the authors recommend more epidemiological studies across major trauma centres with greater participant numbers and longer follow up to give a better scope into the full extent of the burden of foot and ankle pain/injuries in South Africa, and this will improve database registrations, policy making and budget allocation to improve patient care and outcomes.

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APPENDIXES

Appendix A. The Foot and Ankle Ability Measure

Foot and Ankle Ability Measure (FAAM)
Activities of Daily Living Subscale

Please Answer **every question** with **one response** that most closely describes your condition within the past week.
 If the activity in question is limited by something other than your foot or ankle mark "Not Applicable" (N/A).

	No Difficulty	Slight Difficulty	Moderate Difficulty	Extreme Difficulty	Unable to do	N/A
Standing	4	3	2	1	0	
Walking on even Ground	4	3	2	1	0	
Walking on even ground without shoes	4	3	2	1	0	
Walking up hills	4	3	2	1	0	
Walking down hills	4	3	2	1	0	
Going up stairs	4	3	2	1	0	
Going down stairs	4	3	2	1	0	
Walking on uneven ground	4	3	2	1	0	
Stepping up and down curbs	4	3	2	1	0	
Squatting	4	3	2	1	0	
Coming up on your toes	4	3	2	1	0	
Walking initially	4	3	2	1	0	
Walking 5 minutes or less	4	3	2	1	0	
Walking approximately 10 minutes	4	3	2	1	0	
Walking 15 minutes or greater	4	3	2	1	0	

Because of your foot and ankle how much difficulty do you have with:

	4	3	2	1	0	
Home responsibilities	4	3	2	1	0	
Activities of daily living	4	3	2	1	0	
Personal care	4	3	2	1	0	
Light to moderate work (standing, walking)	4	3	2	1	0	
Heavy work (push/pulling, climbing, carrying)	4	3	2	1	0	
Recreational activities	4	3	2	1	0	

How would you rate your current level of function during your usual activities of daily living from 0 to 100 with 100 being your level of function prior to your foot or ankle problem and 0 being the inability to perform any of your usual daily activities.

_____ . 0%

Martin, R; Irgang, J; Burlett, R; Cozzi, S; VanSwearingen, J. Evidence of Validity for the Foot and Ankle Ability Measure. *Foot and Ankle International*. Vol.26, No.11: 968-983, 2005.

**Foot and Ankle Ability Measure (FAAM)
Sports Subscale**

Because of your foot and ankle how much difficulty do you have with:

	No Difficulty	Slight Difficulty	Moderate Difficulty	Extreme Difficulty	Unable to do	N/A
Running	4	3	2	1	0	
Jumping	4	3	2	1	0	
Landing	4	3	2	1	0	
Starting and stopping quickly	4	3	2	1	0	
Cutting/lateral movements	4	3	2	1	0	
Ability to perform activity with your normal technique	4	3	2	1	0	
Ability to participate in your desired sport as long as you like	4	3	2	1	0	

How would you rate your current level of function during your sports related activities from 0 to 100 with 100 being your level of function prior to your foot or ankle problem and 0 being the inability to perform any of your usual daily activities?

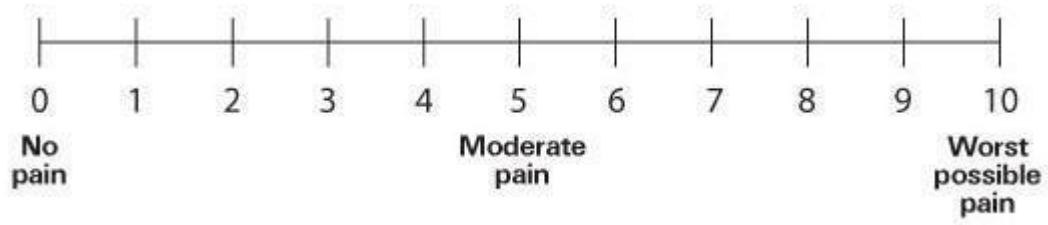
_____ . 0%

Overall, how would you rate your current level of function?

Normal Nearly Normal Abnormal Severely Abnormal

Martin, R; Ingarg, J; Dardett, R; Cressi, S; VanSwearingen, J. Evidence of Validity for the Foot and Ankle Ability Measure. Foot and Ankle International. Vol.26, No.11: 968-983, 2005.

Appendix B: Numerical Rating Scale for Pain



Appendix C: Research Record Tool

Patient details

Patient number		Date seen	
Informed consent given?		Yes	No
Diagnosis (even if provisional)			
Age		Gender	
Weight		Height	
BMI		Smoker	
Date/Time of injury		Alcohol user	
Mode of Injury	Road traffic accident		
	Low energy fall		
	Assault		
	Injury on duty		
	Other		
Employed/ Type of work	Employed/ Unemployed/ Scholar/ Pensioner		
Referred from?	Self-referred		
	Clinic/hospital		
	Ambulance		
Which foot/ankle affected?	Left		
	Right		
	Both		
Underlying conditions	Diabetes mellitus		
	Hypertension		
	Other/previous foot/ankle injury		
Was imaging used to diagnose? (X-ray, CT, MRI)? Tick appropriate	Xray		
	CT / MRI		
Sport/exercise activity	Less than 60min/week		
	60-150min/week		
	>150min/week		
Type of activity	Running	Brisk walking	
	Field sports	Contact sports	
	Other		

Treatment modality (tick appropriate)

Crutches		Plaster backslab	
Plaster of Paris		Crepe bandage	
Physiotherapy		Other (specify)	

Follow up plan (tick appropriate)

Orthopaedic Outpatients	
-------------------------	--

Discharged	
Foot & Ankle Ability Measure Score (Appendix A)	
Numeric Pain Score (Appendix B)	

Completed by (include rank)

Date.....

Dd/mm/yyyy

Signature.....