THE RELATIONSHIP BETWEEN LUMBAR RADICULOPATHY AND NEUROPATHIC HEEL PAIN

A DISSERTATION IN PART FULFILMENT OF THE REQUIREMENTS OF THE UNIVERSITY OF NAIROBI FOR AWARD OF THE DEGREE OF MASTER OF MEDICINE (MMED) IN ORTHOPAEDIC SURGERY

By

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CERTIFICATE OF AUTHENTICITY

This is to certify that this thesis is my original work.

This research was carried out at Kenyatta National Hospital, Orthopaedic Clinic and the Accident and Emergency Department

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DECLARATION

I hereby declare that this study is my original work and has not been presented for dissertation at any other university.

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DEDICATION

- *"What appears to be the end of the road may simply be a bend in the road."* - Robert H. Schuller

This work is dedicated to my parents Mr and Mrs Were Olonde who taught me discipline, honesty and hard work.

To my fiancée Kate who is usually there for me at both the good and the bad times.

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"The germ is nothing; the terrain is everything." -Louis Pasteur

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LIST OF ABBREVIATIONS

A&E : Accident and Emergency

KNH : Kenyatta National Hospital

MRI : Magnetic Resonance Imaging

VAS : Visual Analog Scale

Abstract

Background

Back pain and plantar heel pain are both common problems in the general population with one in ten people experiencing inferior heel pain at some time[1]. Radicular pain is defined as a type of referred pain caused by nerve root compression. Typically, it is described as a sharp, shooting pain in a relatively narrow band of tissue[23].

Among the sources of foot pain, nerve entrapment is frequently underrecognised despite being an important source[2].An association has been reported between radiculopathy and plantar heel pain secondary to nerve entrapment making it a double crush syndrome. A study has, however, not been carried out locally, either clinically or electrodiagnostically to confirm this.

Upton and Mccomas, in 1973, initially described the double crush syndrome in patients with carpal tunnel syndrome and lesions of the ulnar nerve around the elbow in association with more proximal cervical root lesions[19]. Subsequent studies have shown a less favourable outcome with surgery for the distal lesion alone.

Objective: The aim of this study was to establish the relationship between lumbosacral radiculopathy and heel pain secondary to nerve compression. It further sought to establish if heel pain was more likely to occur in plantar fasciitis if a patient had radiculopathy.

Methodology: A prospective cross-sectional study based at KNH, A&E Department and the Orthopaedic Clinic over six months from November 2012 to April 2013. One hundred and two Patients seen at the A&E and the Orthopaedic clinic with heel pain were recruited into the study. Those with a history of trauma and one who presented with cellulitis following intralesional steroid injection were excluded. Demographic data was extracted and pain was scored using the visual analog scale. Presence or absence of prior or current radicular low back pain and laterality was established and imaging was reviewed for those patients who had.

Results:

At least 57% of patients with heel pain in all age groups had symptoms of radiculopathy. The prevalence was high in all occupation groups and presentation was not influenced by age.

Conclusion:

A high prevalence of radiculopathy in was found patients with plantar heel pain. In patients who had prior MRI, the root compression was at levels of $L_{4/5}$ disc to L_5/S_1 discs.

1.0 Introduction

Both low back pain and plantar heel pain are quite common in the general population. Nerve entrapment occurs when nerves passing through confined spaces are pressed upon and disabled. Lumbosacral radiculopathy occurs due to nerve root impingement and/or inflammation producing symptoms in the areas supplied by the nerve root(s). Nerve pain often presents as diffuse and poorly defined pain with symptoms such as burning, tingling, numbness and cramping pointing towards a neuropathy[2]. Pain due to nerve entrapment especially of the

first branch of the lateral plantar nerve may occur around the heel and should be considered a differential when dealing with plantar fasciitis[3].

Plantar fasciitis is the most common cause of plantar heel pain, accounting for up to 80% of the cases as reported by Lemont et al[5]. Pain from plantar fasciitis is worse in the morning and on taking the first few steps. It also occurs on standing after sitting for long. On examination, there is tenderness at the medial tubercle of the calcaneus. Most pains resulting from nerve entrapment do not present this way though pain from the medial plantar nerve is felt on the medial side of the heel and ankle.

There is evidence in literature of an association between lumbosacral radiculopathy and plantar fasciitis[24]. However, there are no good quality studies to link the two. Most involve expert opinion and case reports. This study aims to evaluate if indeed there is an association. As Lauder, T.D. emphasizes in Physical Medicine and Rehabilitation Clinics of North America, recognition of double crush syndrome is essential for effective treatment of these conditions and avoidance of unnecessary evaluations and procedures[24].

2.0 Literature review

Heel pain is a common complaint in the general population. According to Crawford et al, 10% of the general population will experience heel pain at some point in their life[4]. Many authors report plantar fasciitis to be the most common cause of heel pain. Lemont et al reported this to have been as high as 80% of patients with symptoms[5]. The diagnosis of plantar fasciitis is based on the patient's history and clinical examination. The pain is usually gradual in onset, worse in the morning or after prolonged standing, lessens with activity but worsens by the end of the day[3].Moreover; the pain usually is nonradiating and not commonly associated with paraesthesias[12].

Despite this, there are other important causes of heel pain[3]. Entrapment syndromes are important since the management is markedly different from that of plantar fasciitis. The first branch of the lateral plantar nerve to the abductor digiti minimi is especially important in this respect due to the proximity to the inflammation associated with plantar fasciitis. Baxter et al reported it to have been the cause of heel pain in up to 20% of patients with chronic heel pain[6]. Kaplan and Kernahan reported the lateral plantar nerve to be most vulnerable to entrapment[7]. This may be due to an oblique course taken by the nerve in a

separate and more proximal tunnel[1]. Baxter et al further identified isolated entrapment of the first branch of the lateral plantar nerve[8]. It is now referred to as Baxter's nerve[3].This also presents as plantar heel pain which may be resemble plantar fasciitis. Chang et al, however, showed an association between medial calcaneal neuropathy and plantar fasciitis[18].

According to Alshami et al, contribution of nerve entrapment to plantar heel pain is well documented but the pathophysiology, diagnosis and management is still controversial[14].

Keck[9] and Lam[10] independently described tarsal tunnel syndrome in 1962. This causes ankle and foot pain either arising from a space occupying lesion or constriction of the tarsal tunnel. Proximally, it may affect the entire posterior tibial nerve while distally it affects 1 or more of the terminal branches. Jogger's foot was described by Rask in a case series as a local entrapment of the medial plantar nerve associated with valgus foot and long distance running. This results in exercise induced neuritic pain at the medial arch that radiates to the toes in the distribution of the medial plantar nerve[11].

According to Raikin et al, nerve entrapments can manifest as pain or dysfunction in the foot or ankle with entities like tarsal tunnel syndrome (tibial nerve),

jogger's foot (medial plantar nerve), first branch of the lateral plantar nerve and medial dorsal cutaneous nerve[15].

Radiculopathy of the L5-S1 nerve root may also present with plantar heel pain. This may be excluded by a history of symptoms radiating to the leg and a thorough neurologic examination[3]. Peri in a cadaveric study found "critical zones" of entrapment of terminal branches of the lumbosacral plexus[16]. These provide a topographical anatomical basis for compression syndromes.

Upton and McComas described double crush syndrome in 1973 following a study of patients with carpal tunnel syndromes or lesions of the ulnar nerve at the elbow[19]. They found electrophysiological evidence of neural lesions in the neck, often with accompanying clinical symptoms and attributed it to serial constraints of axoplasmic flow in nerves. The proximal lesion in this case renders the distal nerve more susceptible to compression.

Schon et al provided electrodiagnostic support for nerve entrapment in patients with neuritic heel pain. Two of their patients had electrophysiologic evidence of active S_1 radiculopathy with active plantar nerve entrapment suggesting a double crush syndrome[13]. Oztuna et al, however, found that nerve entrapment may play a role in the early rather than recalcitrant cases of the painful heel syndrome[17].

Osterman showed that with a more proximal root lesion, less involvement of the median nerve across the carpal tunnel produced symptoms. There was further evidence that patients with double crush syndrome had a less favourable outcome following surgery[20]

Parry et al in a retrospective study in Zimbabwe carried out in a clinical neurophysiology laboratory found carpal tunnel syndrome in 73% of 128 patients with non-traumatic peripheral nerve lesions. 18 of these individuals had evidence of double crush syndrome[21].

Wood and Biondi studied 165 patients who had thoracic outlet syndrome, 142 of who had undergone first rib resection. They found that 73(44%) had distal nerve compression on electromyography and nerve conduction studies. Thus, they came to the conclusion that proximal compression lessens the ability of a nerve to withstand more distal compression[22].

Plantar fasciitis or heel pain has also been associated with longitudinal foot arch disorders. Young et reported an increased risk of development of plantar fasciitis in patients with pes planus or pes cavus[25].

Also, seronegative spondyloarthritis is associated with heel pain[26, 27, 28.]Gerster in 1980 reported painful heel, including plantar fasciitis and Achilles tendinitis in 33 of 150 patients suffering from seronegative spondyarthritis[28].

3.0 Justification

Plantar heel pain is common in the general population and causes significant morbidity. Radiological evaluation may not improve the understanding of its aetiology. Radiculopathy arising from the lumbosacral spine is known to cause pain in the plantar aspect of the heel and other parts of the foot. This study aimed to show if previous or current radiculopathy predisposes to plantar heel pain. If plantar heel pain is ipsilateral to the radiculopathy, this would point to a double crush syndrome. Treatment for the distal lesion alone is associated with a less than favourable outcome[20]. It is, therefore, important to recognize the double crush syndrome both to counsel the patients on the outcome and to plan for surgery on both the proximal and distal lesions. Moreover, in the presence of double crush syndrome, a back care program would be effective in mitigating symptoms of heel pain.

4. Objectives

4.1 Major objective

To study the relationship between radicular low back pain and plantar heel pain.

4.2 Specific objectives

1. To determine if there i s an association between radicular low back pain and neuropathic plantar heel pain.
2. To determine the effect occupation and age on heel pain accompanying radicular low back pain.

5. Material and Methods

5. 1 Study design, location and duration

The Kenyatta National Hospital (KNH) is the main referral centre in Kenya and is located at the heart of the capital, Nairobi. The study was based at this institution.

Study population:

The study population comprised patients who were managed for heel pain at KNH A&E department and the Orthopaedic Clinic from November 2012 to April 2013. A total of 102 patients were included.

Study design:

A six month cross sectional study was carried out. One hundred and two patients were recruited by purposive sampling. History was taken and the patients evaluated clinically. Pain was scored using the visual analog scale. Imaging was reviewed for the patients who had these previously, taking into account the radiologist report.

Sample size determination:

Sample size was calculated by the sample size for single proportion:

$$N \geq \left(\frac{Z}{w}\right) \times p(1-p)$$

Where:

N = the total sample size needed

Z = the confidence interval (e.g. the 95% confidence interval for the true proportion in the population). In this study we used a 95% confidence interval.

p = proportion of heel pain patients who also have lower back pains. This study assumed a prevalence of back pains of 70% in patients with heel pains.

w = the width of the 95% confidence interval. This study assumed a confidence interval no wider than 10% (0.1) on either side of the true proportion of the population of patients with lower back pains among patients with plantar heel pains.

$$N \geq \left(\frac{1.96}{0.1}\right) \times 0.7(1-0.7)$$

$$N \geq (384.16) \times 0.7(0.3)$$

$$N \geq (384.16) \times (0.21)$$

$$N \geq 80.67$$

The minimum sample size was thus 81 patients with heel pain.

5.2 Inclusion and Exclusion criteria

All patients over the age of 18 years presenting with neuropathic plantar heel pain who consented to be part of the study were interviewed. Those with diffuse heel pain and lack of specific point tenderness were included in the study. Previous history of back pain was sought and laterality of radicular pain was established.

The following groups were excluded:

1. Patients who declined to give consent.
2. Those patients who gave a recent or remote history of trauma to the foot or heel.
3. Those who gave a history of significant trauma to the back

4. One patient who presented with cellulitis of the heel following intralesional injection for heel pain.

5.3. Data collection techniques

The principal investigator and/or his assistants at the A&E department and the Orthopaedic Clinic collected data through purposive sampling. A questionnaire recording the presence of low back pain in association with plantar heel pain was used to collect the data (Appendix 3). The purposive sampling allowed the investigator to specifically include 37 patients with prior MRI.

5.4 Data analysis

All the patients recruited in the study were included in the analysis. Data analysis was done with STATA IC (version 11.0). Continuous variables including patient age and scores of the visual analogue scale were presented as means with SDs. Categorical variables including gender, prevalence and characteristics of plantar and lower back pain were presented as proportions using graphs, and frequency tables.

The alpha (α) level was set at 0.05 for interpretation of findings from statistical tests. Two sample means for age or VAS pain assessment were compared using the two-sample Student's *t*-test. The categorical variables were compared using the Pearson's chi square or Fisher's exact test.

5.5 Ethical considerations

1. Approval was sought and obtained from the Kenyatta National Hospital and University of Nairobi Ethics and Research Committee (Appendix 5).

2. Patients were enrolled into the study only after giving informed consent.

3. There was no discrimination against those who declined to give consent

4. The usual care and evaluation procedures were followed

5. Confidentiality was maintained for each patient and patient names were no used.

6. There was no harm for patients who participated in the study.

5.6 Study limitations

1. The results of this study cannot be generalized to the entire population since it was referral hospital based.

2. Many patients with low back pain do not have MRI done due to the cost even though this is the ideal method for picking compression neuropathies

RESULTS

A total of one hundred and two (n = 102) patients presenting to KNH with plantar heel pain and radicular low back pain were recruited in the study. The analysis of the characteristics of the participating patients showed the following:

Patients' age

The mean age of patients was 44.7 years (SD 9.7) with a range from 21 to 75 years. Figure 1 shows the age distribution of patients with heel pain and lumbar radiculopathy at KNH. The most frequent patient age group was between 40 and 49 years accounting for 38% of participants. Twenty nine (28.4%) patients were aged 30-39 years and 7 (6.9%) were 60 years and above.

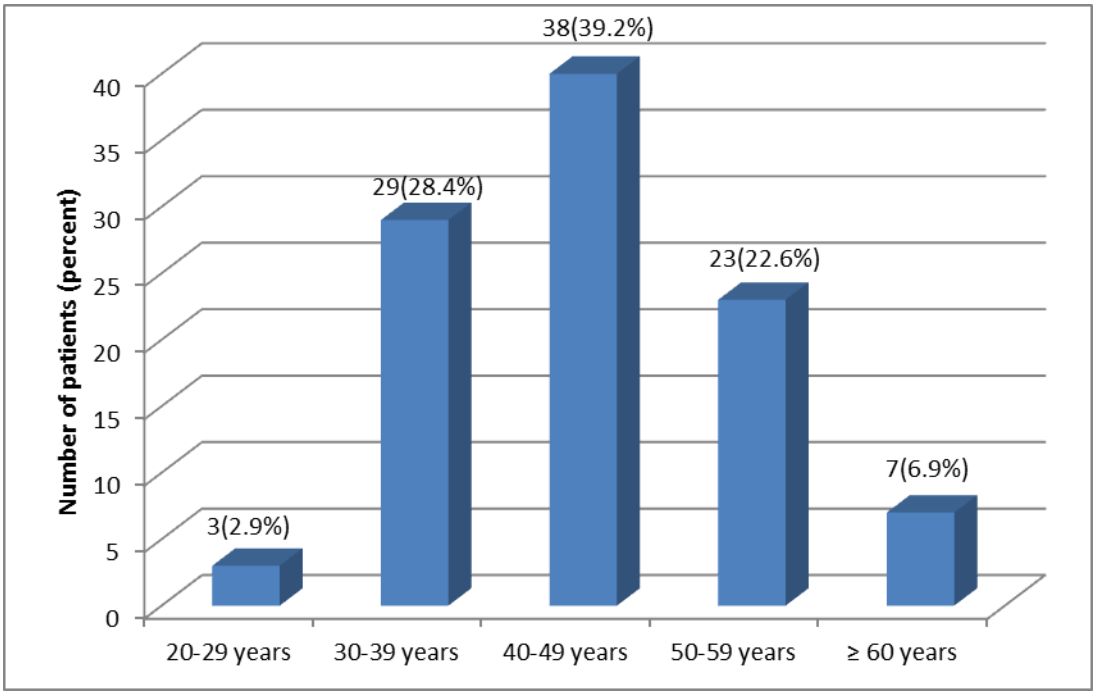

Figure 1: Age distribution of patients presenting at KNH with lumbar radiculopathy or neuropathic heel pain

Patients' sex

Figure 2 shows the sex distribution of the patients presenting with lumbar radiculopathy and heel pain. Most (72%) of the patients were females. There were 29 (28%) males yielding a male-to-female ratio of 1: 2.5.

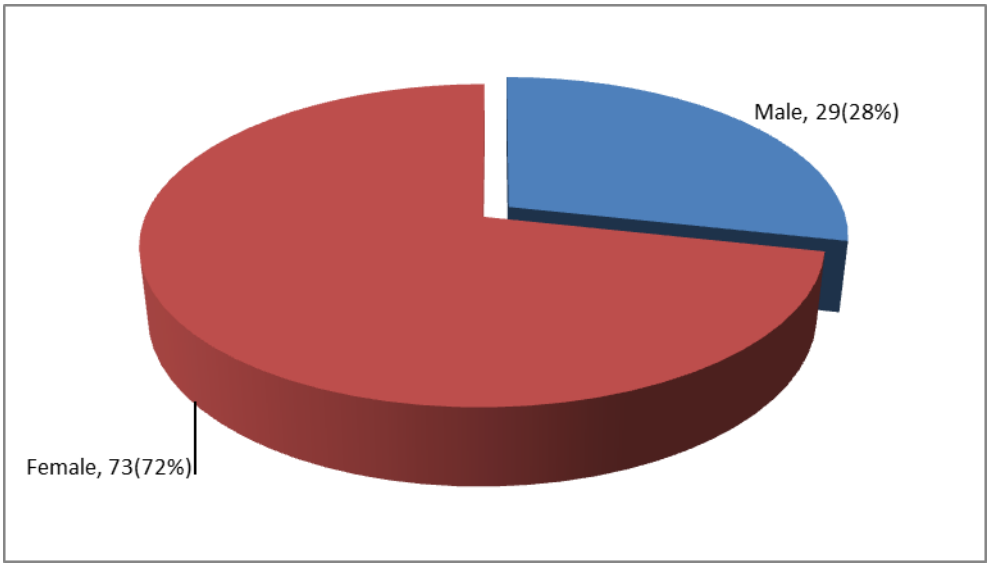

Figure 2: Sex distribution of patients with lumbar radiculopathy or neuropathic heel pain

There was no statistically significant association between patients' age and sex. The average age of females was 44 years (SD 9.1) compared to an average age of 46.4 years (SD 10.7) among the male patients (difference = 2.4 [95% CI -1.8 to 6.6], p = 0.26).

Occupation

As shown in table 1, the most frequently reported occupation among patients was formal employment, 39 (38.5%). There were 35 (33.9%) self employed or business persons. Housewives or other individual predominantly engaged in household duties comprised 20

% of the participants and 7 (7.7%) of the patients reported that they were involved in farming activities.

Table 1: Occupation of patients with lumbar radiculopathy and plantar heel pain

	Number (n)	Percent
Occupation		
Business/ self employment	35	33.9
Household duties	20	20.0
Farming	8	7.7
Formal employment	39	38.5
Total	102	100

Plantar heel pain and lumbar radiculopathy

Figure 3 shows the percentage distribution of pain symptoms among patients with plantar heel pain and lumbar radiculopathy presenting to KNH. All the patients in the study had plantar heel pain. Plantar heel pain was associated with lumbar radiculopathy in 76.2% of the 102 patients seen at KNH.

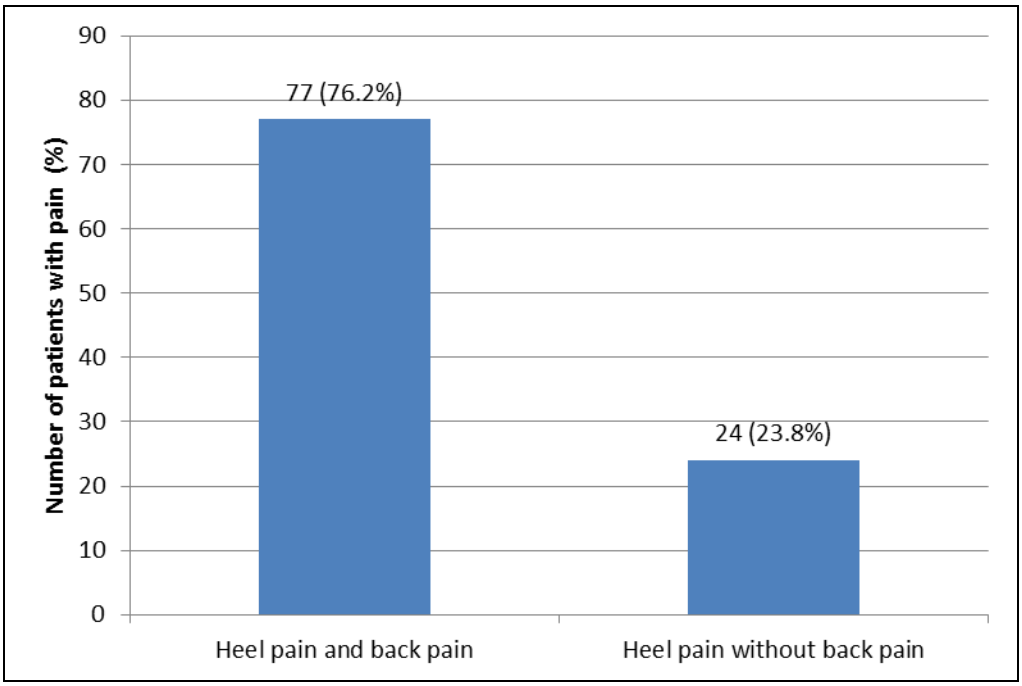

Figure 3: Presentation with back pain in patients with plantar heel pain at KNH

The prevalence of back pain associated with plantar heel pain among male and female patients is shown in Table 2. Back pain was more prevalent among females (80.6%) compared to male (65.5%) patients, Relative risk = 2.2 (95% CI 0.9-1.6) but this association was not statistically significant (p = 0.11).

Table 2: Prevalence of back pain associated with plantar heel pain in male and female patients at KNH

	Low back pain			
	Yes	No	RR (95% CI)	P value
Male	19 (65.5%)	10 (34.5%)	1.0	0.11
Female	58 (80.6%)	14 (19.4%)	1.2 (0.9-1.6)	
Total	77 (76.2%)	24 (23.8%)		

The occurrence of back pain in patients with plantar heel pain was not explained by the occupation (Table 3). Findings of the chi-square test showed that there was no statistically significant association between patient reported occupation and the diagnosis of back pain associated with plantar heel radiculopathy ($p = 0.28$). As shown in table 3 below the prevalence of back pain was high across all the four occupation groups and ranged from 63.6% among business or self-employed persons to 82.3% among patients who reported that they were formally employed. The risk of low back pain in patients involved in household duties was comparable to that of business or self-employed persons (Relative risk 1.0, 95% CI 0.6-1.7). Similarly, the risk in other occupations namely farming (1.3, 95% CI 0.7-2.2) and formal employment (1.3, 95% CI 0.9-1.8) did not differ from the risk of low back pain in business/ self-employed persons.

Table 3: Prevalence of back pain associated with plantar heel pain according to occupation of patients at KNH

	Low back pain			
	Yes	No	RR (95% CI)	P value
Business/ self employment	14 (63.6%)	8 (36.4%)	1.0	0.28
Household duties	8 (66.7%)	4 (33.3%)	1.0(0.6-1.7)	
Farming	4 (80%)	1 (20%)	1.3(0.7-2.2)	
Formal employment	51 (82.3%)	11 (17.7%)	1.3(0.9-1.8)	
Total	77 (76.2%)	24 (23.8%)		

The average age of patients presenting with radiculopathy associated with plantar heel pain was 44.6 years (SD = 9.5) compared to an average age of 45 years (SD = 10.4) for patients with plantar heel pain without lumbar radiculopathy (t-test t= -0.18; p value = 0.86). As shown by the findings of the t-test and the distribution of back pain across different age group (Table 4), age did not influence presentation with lumbar radiculopathy in patient with plantar heel pain. At least 57% of patients in all age groups had lumbar radiculopathy associated with plantar heel pain (Table 4). The prevalence was highest in the age groups 40-49 years (79.5%) and 50-59 years (82.6%) but these differences were not significant.

Table 4: Prevalence of back pain associated with plantar heel pale in different patient age groups at KNH

	Low back pain	
	Yes	No
20-29 years	2 (66.7%)	1 (33.3%)
30-39 years	21 (72.4%)	8 (27.6%)
40-49 years	31 (79.5%)	8 (20.5%)
50-59 years	19 (82.6%)	4 (17.4%)
60-69 years	4 (57.1)	3 (42.9)
Total	77 (76.2%)	24 (23.8%)

Characteristics of plantar heel pain

Most (92.3%) patients reported that plantar heel pain was associated with weight bearing. A total of 17 (16.9%) had radiating heel pain. The duration of plantar heel pain ranged from 1 month to 5 years with an average duration of 1year (SD = 0.9). Table 5 shows that 44 (43.3%) patients reported that they had experienced plantar heel pains for durations less than 12 months and 41 (40%) had experienced the pain for between 12 and 23 months.

Table 5: Characteristics and duration of plantar heel pain

	Number (n)	Percent
Heel pain	102	100
Weight bearing (n = 102)		
Yes	94	92.3
No	8	7.2
Radiating heel pain (n = 102)		
Yes	17	16.9
No	85	83.1
Duration of pain (months)		
< 12 months	44	43.3
12 -23 months	41	40.0
24-35 months	10	10.0
36 months and above	7	6.7

Characteristics of low back pain

Table 6 shows that lumbar radiculopathy was reported in 77 (62.5%) patients in the study. Half of the patients with back pain reported radiating back pain and 34.5% had numbness. 14 (18.8%) patients reported tingling sensation associated with back pain.

Table 6: Characteristics of lumbar radiculopathy in patients with plantar heel pain

	Number (n)	Per cent
Back pain	77	62.5
Radiating back pain (n = 77)		
Yes	38	50.0
No	39	50.0
Back numbness (n = 77)		
Yes	27	35.5
No	50	64.5
Tingling back (n = 77)		
Yes	14	18.8
No	63	81.2

The reported duration of back pain ranged from 6 months to 30 years with an average duration of 4.4 years (SD 5.9). Figure 4 presents the distribution of the duration of lumbar radiculopathy. Twenty-nine (38.2%) patients reported durations of between 2 and 4 years while 32.4% of patients with this complain reported durations of less than 2 years.

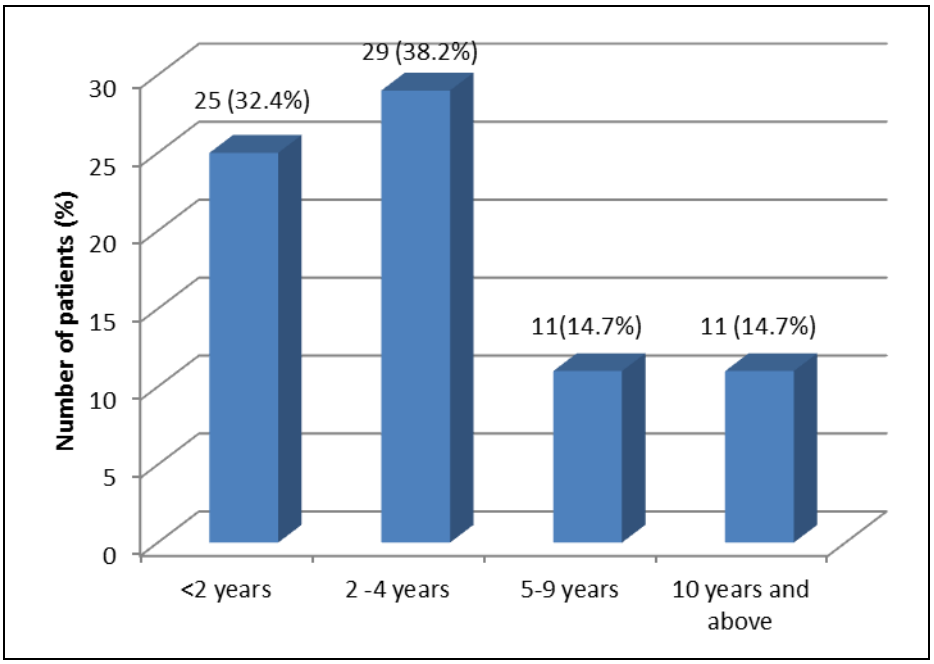

Figure 4: Reported duration of lower back pain in patients with plantar heel pain

Association between plantar heel pain and lumbar radiculopathy

Table 7 compares characteristics of patients with lumbar radiculopathy and plantar pain to those of patients with plantar pain but no lumbar radiculopathy. Most (72 out of 93) patients who reported heel pain associated with weight bearing also had lumbar radiculopathy. Similarly, lumbar radiculopathy occurred in 15 out of the 17 patients with radiating heel pain. Duration of heel pain did not appear to influence lumbar

radiculopathy because most patients in the different durations of illness had back pain (table 7).

Table 7: Comparison of patients with and without lumbar radiculopathy

	Low back pain	
	Yes	No
Weight bearing (n = 102)		
Yes	72	21
No	5	3
Radiating heel pain (n = 102)		
Yes	15	2
No	62	23
Duration of pain (months)		
< 12 months	32	12
12 -23 months	30	11
24-35 months	9	1
36 months and above	6	1

Prior treatment and imaging

Table 8 shows that majority of patients seen in the study reported that while most patients had undergone prior imaging procedures to investigate causes of either plantar heel pain or lumbar radiculopathy fewer patients had been treated previously for the conditions. A total of 47 (46.1%) patients reported that they had previously been treated for low back or plantar heel pain and 61 (59.8%) had undergone diagnostic imaging investigations.

Table 8: Previous reported management and imaging of lower back and plantar heel pain

	Number (n)	Percent
Prior treatment		
Yes	47	46.1
No	55	53.9
Prior imaging		
Yes	61	59.8
No	41	40.2

Pain assessment (Visual analogue scale)

A visual analogue scale ranging from 0 (no pain) to 10 (severe pain) was used to assess the severity of pain reported by patients with plantar heel pain and lumbar radiculopathy. The findings of these assessments are shown in figure 5.

The mean (± SD) VAS scores were 4.6 (± 1.8) for back pain and 5.1 (± 1.8) for heel pain. No significant differences were found in the assessment of pain severity between the groups with lower back pain and heel pain.

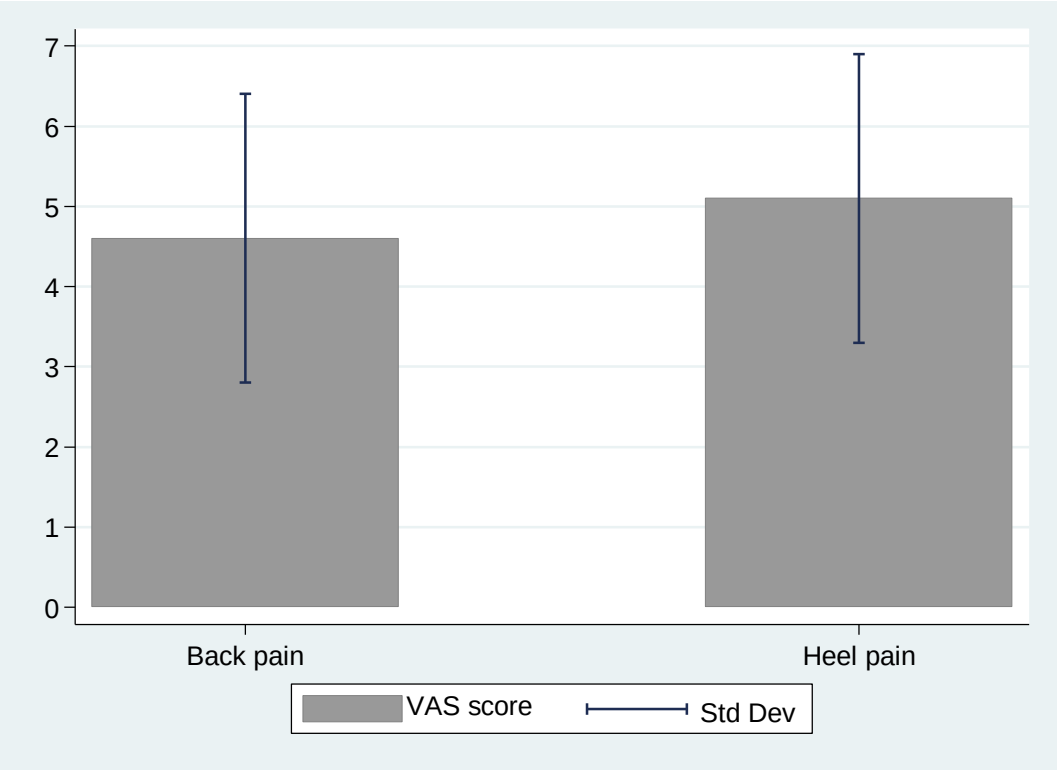

Figure 5: Visual analogue scale assessment of heel pain and lumbar radiculopathy

Discussion

In this cross-sectional study of patients with heel pain in KNH, the mean age was 44.7 years with the most frequent age group 40-49 years. Majority of the patients were female with a male to female ratio of 1:2.5. In regards to occupation, most patients (38.5%) were in formal employment.

Back pain was more prevalent among females (80.6%) compared to males (65.5%). This association was however not statistically significant. Back pain in heel pain was not explained by occupation and prevalence was high in all occupation groups.

Age did not influence presentation with lumbar radiculopathy in patients with plantar heel pain. At least 57% of patients in all age groups had associated radiculopathy with highest prevalence in age groups 40-49 years and 50-59 years. These were however not statistically significant.

Most patients had heel pain associated with weight bearing. In the study however, the point of maximal tenderness was not localized. 16.9% of the patients had radiating heel pain. Patients with current back pain had local tenderness either at the unilateral intercristal line or at the dimple of venus.

Tenderness at these sites corresponds to the MRI findings in the 37 patients who had prior MRI imaging.

37 patients (36.3%) had MRI of the lumbosacral spine. The disc lesions were present at $L_{4/5}$, $L_{5/S1}$ or $L_{4/5}/S_1$. In these patients, there was either a disc bulge or frank prolapse on the same side as the painful heel.

The relationship between radiculopathy and plantar heel pain is recognized in L_5-S_1 radiculopathy. Heel pain may also be due to neuropathy or referred pain. Some of our patients had involvement of L_4/L_5. Field overlap in nociceptive pain or referred pain makes this possible. The possibility of double crush syndrome with root pathology predisposing to heel pain has however not been explored. Among the patients in this study, an association has been shown. Moreover, the root lesion was not restricted to the L_5/S_1 nerve root, both clinically and for the patients who had MRI imaging. An electro diagnostic study may further clarify the possibility of a double crush syndrome.

This study did not look at the effects of treatment of radiculopathy on the heel pain. Much as the findings point to possible double crush syndrome, a randomized controlled trial would better establish the effect of this treatment on the heel pain.

The study had a number of limitations. Back pain was established by taking history from the patients. Most imaging was plain radiographs with only 36.2% of patients having MRI. MRI imaging would have demonstrated root pathology better. This was however not feasible due to the high costs involved. Moreover, since this was a referral hospital based study, it cannot be generalized to the entire population.

Conclusions

A high prevalence of radiculopathy was found in patients with heel pain. Though MRI imaging was not possible in most patients, the nerve root lesions were between $L_{4/5}$ and L_5/S_1 roots in those who had this done. The clinical findings of tenderness at the dimple of venus or at the level of the intercristal line also points to disc pathology at these levels. This study points to a causal association between lumbar radiculopathy and plantar heel pain. Though plantar fasciitis is the most common cause of heel pain, the study shows there may be a predisposition to heel pain by previous or current radiculopathy. Electro diagnostic confirmation would strengthen the evidence of double crush syndrome.

Recommendations

1. Patients with heel pain need to be evaluated by an orthopaedic surgeon to determine if the pain is arising from the medial calcaneal tubercle or elsewhere around the heel and if there is associated radiculopathy.

2. A larger prospective study needs to be conducted to confirm the presence of a double crush syndrome as this would require a paradigm shift in management of heel pain.

3. A randomized controlled trial would help determine if control of radiculopathy mitigates the symptoms of heel pain.

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Appendix 1

CONSENT BY THE PARTICIPATING PATIENT

Serial No……….. **Hospital No…**……

Purpose of the study

This study aims to determine if there is an association between the existence of low back pain and plantar heel pain. The findings will help create a better understanding of plantar heel pain and guide the treatment of the same.

Risks and benefits

There are no risks foreseen since the study will only look at the clinical features of the illness and treatment will mainly be symptomatic. There will be no additional costs incurred when participating in the study.

Voluntary participation

Participation in the study is out of your free will. Medical care will not be denied for declining to participate. You may choose to withdraw from the study at any time with no consequences whatsoever.

Confidentiality

All information will be treated with confidentiality. Your identity will not be published whatsoever.

I the undersigned have been explained to and understand the above and voluntarily accept to participate in the study.

Signature / Thumb print (Patient/Next of kin):

ID / PASSPORT NUMBER:

Tel 1 (patient)… Tel 2 (Next of Kin)…

DR OYOO OLONDE WERE– TEL 0721365521

Appendix 2

KIBALI CHA RUHUSA

Nambari ya utafiti:…… Nambari ya Hospitali:……..

Sababu ya utafiti

Sababu ya utafiti huu ni kuthibitisha kukiwa uhusiano kati ya uchungu wa mgongo na uchungu kwenye kiwiti cha mguu. Matokeo yatasaidia madaktari kuelewa chanzo cha maumivu kwa kiwiti cha mguu na kusaidia kupanga matibabu.

Hatari na manufaa

Utafiti huu utasaidia madaktari kuelewa kukiwa na uhusianokati ya uchungu mgongoni na kwenye kiwiti cha mguu. Baadaye, maarifa huu utasaidia madaktari kukinga na kutibu shida la uchungu kwenye kiwiti cha mguu. Hatutarajii hatari zozote kwako unaposhiriki kwenye utafiti huu. Utafiti huu hautakugharimu fedha zaidi.

Uhusika Kwa hiari

Kuhusika kwa utafiti huu ni kwa hiari yako mwenyewe na hauwezi kushurutishwa. Utahudumiwa ata kama ukikataa kuhusika kwa huu utafiti. Una uhuru kutamatisha kuhusika wakati wowote bila madhara yoyote ile.

Usiri

Habari zozote utakazotoa zitawekwa kwa siri na jina lako halitachapishwa popote.

Ninathibitisha yakuwa nimefahamu yale nimeelezwa na mtafiti na nimekubali kwa hiari yangu mwenyewe kuhusika katika utafiti huu.

Sahihi/Kidole cha Gumba :

(Mhusika/next of kin) Simu 1 (Mhusika) :……. Simu 2 (next of kin):…….

DR OYOO OLONDE WERE– TEL 0721365521

Appendix 3

DATA COLLECTION SHEET

Study no:

Date Age

Sex: Male Female

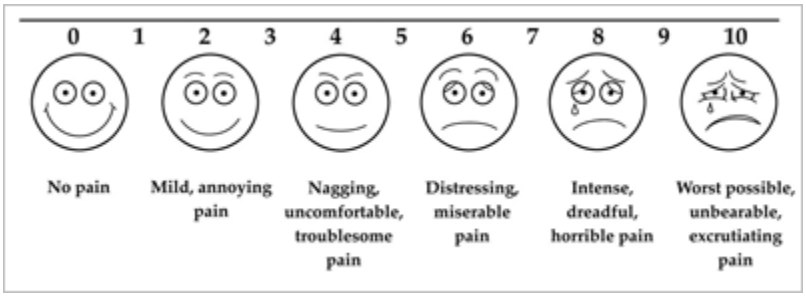
Physical address

Occupation

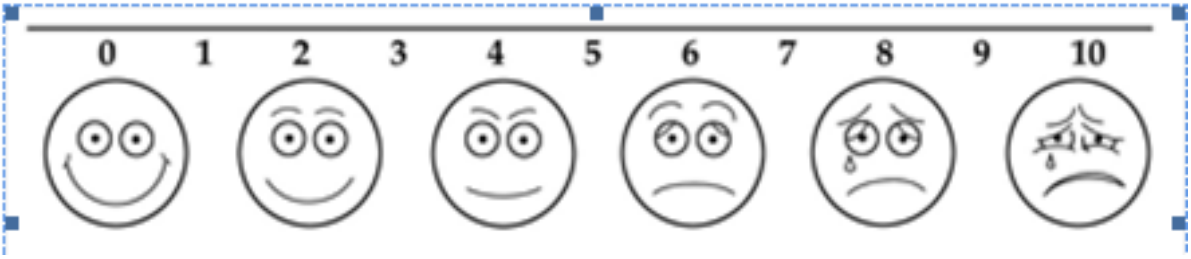
Low back	Pain(within last 3 years)	Yes		No	
	Duration				
	Radiating	Yes		No	
	Numbness	Yes		No	
	Tingling	Yes		No	
Heel	Pain	Yes		No	
	Duration				
	Weight bearing	Yes		No	
	Radiating	Yes		No	
Prior treatment for back pain		Yes		No	
Prior imaging for back pain		Yes		No	
Findings on imaging					

Appendix 4

Visual analog scale



Kiwango cha maumivu



Hakuna **Kiasi** **Yanaudhi/ Yanasumbua** **Yanasononesha** **Makali** **Yasiyovumilika/ Makali zaidi**

Appendix 5

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Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/313

14th November 2012

Dr. Oyoo Olonde Were
Dept.of Orthopaedic Surgery
School of Medicine
University of Nairobi

Dear Dr. Were

RESEARCH PROPOSAL: "THE RELATIONSHIP BETWEEN LMBAR RADICULOPATHY AND NEUROPATHIC HEEL PAIN" (P418/07/2012)

This is to inform you that the KNH/UoN-Ethics & Research Committee (KNH/UoN-ERC) has reviewed and **approved** your above revised proposal. The approval periods are 14th November 2012 to 13th November 2013.

This approval is subject to compliance with the following requirements:

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH/UoN ERC before implementation.
c) Death and life threatening problems and severe adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH/UoN ERC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH/UoN ERC within 72 hours.
e) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
f) Clearance for export of biological specimens must be obtained from KNH/UoN-Ethics & Research Committee for each batch of shipment.
g) Submission of an *executive summary* report within 90 days upon completion of the study
This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/or plagiarism.

For more details consult the KNH/UoN ERC website **www.uonbi.ac.ke/activities/KNHUoN**

Yours sincerely

"Protect to discover"