Outcomes achieved by Fellows of the Australasian College of Podiatric Surgeons.

A collaborative report.

2011 to 2012

Executive summary:

This report summarises the findings of a 12 month study into the outcomes of foot surgery performed by Fellows of the Australasian College of Podiatric Surgeons in Western Australia. This project utilise for the first time an electronic health records "eHealth" solution to collecting real-time data and storing this information in a secure "virtual" cloud repository for instant access by the researchers. This approach attempts to reduce duplication of activity and address issues of; quality of care, patient safety and cost containment by optimising information management.

Six fellows of Australasian College of Podiatric Surgeons practising in metropolitan Perth, were recruited to participate in this study. One hundred and sixty-two patients treated for orthopaedic, neurological or dermatological diseases of the foot were enrolled in this 12 month study. Approximately 90% of these subjects had private health insurance. 75% of the cohort were female (mean age 52 years) compared with their male counterparts (mean age 41 years). Older subjects tended to have multiple procedures performed. Increased age was clearly related to an increase in comorbidity (P equals 0.026). A total of 267 individual operations were performed on this cohort of patients.

Orthopaedic procedures were the most commonly performed surgery (65%) followed by dermatological surgery (30%) with a smaller proportion having surgery to the nerves of their feet (5%). The vast majority of orthopaedic procedures were for the management of the first metatarsal phalangeal joint pathology (hallux abductor valgus commonly referred to as a "bunion") and lesser digital deformity i.e ("hammer" and "claw toes").

Health status was measured preoperatively and surgical outcomes were measured 1, 3 and between 10 and 12 months post operatively. The Foot Health Status Questionnaire and the World Health Organisation Quality of Life measures were used to calculate the quality and effectiveness of surgery.

Findings suggest podiatric surgeons were able to significantly improve the quality of life of orthopaedic patients one year after surgery by way of reducing patients' level of pain and increasing their physical function. Patients' general perceptions of foot health also improved over this time, indicating a second form of validation of outcome. On closer analysis of the specific orthopaedic procedures performed, adverse quality of life outcomes are identified in an extremely small percentage of subjects (e.g. approximately 1 to 2% of cases). This tends to reflect an extremely high standard of care is being achieved. Moreover footwear fitting and comfort with footwear proved to be an ongoing source of concern for some patients. Generic measures of health status (WHOQOL) did not tend to identify significant changes in health status. This lends further support to the fact region and disease specific measures of health status are more sensitive to identifying changes in health status. Patients undergoing dermatological surgery (e.g. those patients seeking care of acute and chronically ingrown and infected toenails) showed significant improvements across all foot health domains three months after surgery. This indicates excellent, effective and rapid resolution of their foot problems.

Podiatric surgeons reported good experience when using the eHealth platform as a means of data collection and this approach has implications for future research.

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Project Brief

Project Name: Health Related Quality of Life change following podiatric surgery in WA.

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Project description: A prospective study to investigate outcomes of patients who have undergone foot surgery by fellows of the Australasian College of podiatric surgeons (FACPS). Outcomes were assessed using 2 validated health status instruments, which measure global health (World Health Organisation Quality of life WHOQoL-BREF Australian Version (May 2000) and foot health (Foot Health Status Questionnaire). A new eHealth records platform was utilised for data acquisition.

Aim: The aim of this study is to provide evidence of the quality and efficacy of services provided to HBF members who undergo elective foot and ankle surgical procedures conducted by fellows of the ACPS.

Objectives:

1. Measure health related quality of life (HRQoL) of HBF members prior to receiving surgical services by FACPS
2. Measures health related quality of life of HBF members at selected time points after surgical intervention by FACPS .
3. Compare and contrast the outcomes of the various interventions in order to establish the efficacy of those interventions for HBF fund members.
4. Provide the HBF with a report detailing HRQoL changes as well as identifying other additional descriptive data such as predictors of successful and adverse outcomes (demographic, Socioeconomic status, co-morbidity, gender, and age) which inform the HBF of services relevant to foot and ankle surgery .
5. Make recommendations regarding the adoption of an innovative eHealth platform for data collection.

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1. Background:

Internationally there are an increasing number of studies of a prospective nature which are designed to investigate podiatric surgical outcomes. Some of these are of a highly technical nature while others provide evidence of podiatric daycare surgery [1, 2]. The use of clinical audits and carefully controlled (highly specific research projects), as well as “ad hoc” reporting methods used to evaluate surgical outcomes[3, 4]. There is however a growing need for, and movement towards, the use of research methods which accurately measure both objective and subject in dimensions of health. Subjective measures include factors such as health related quality of life. Objective measures include factors such as infection, complication and readmission rates.

One of the challenges service providers face is obtaining this information in a "timely" manner. With rapid advances in information technology, the prospect of using the internet and electronic health record systems provides a new avenue for data collection. Recent trends suggest the Australian Government Department of Health and Ageing is now actively encouraging Australians to personally control their electronic health records.

Figure 1 FACPS at work

2. Australian Government Initiative:

The Australian Government has made several announcements regarding investing almost $467 million over two years to develop the critical national infrastructure for eHealth records as a key element of the national health reform agenda. The purpose of this investment was to give all Australians, from July 2012, the option to sign up for a personally controlled eHealth record. The objective was to enable better access to important health information currently held in dispersed records around the country. It is planned to mean that patients will no longer need to unnecessarily repeat their medical history every time they see a doctor or other health professional. These words are largely drawn from the "Draft Concept of Operations: Relating to the introduction of a personally controlled electronic health record (PCEHR) system" released in April 2011.

Figure 2 Information superhighway

The PCEHR system requirements have stimulated interest in eHealth and its potential benefits across the healthcare industry and helped stimulate the acceptance of secure web based solutions for aggregating healthcare data.

One of the systems we evaluated for the capture and aggregation of our research data was Smart Health. Smart Health is an Australian pioneer of secure cloud-based eHealth solutions. Established in 2000 and has developed market leading products and expertise in eHealth. Its core product is its shared

Electronic Health Record (EHR) which is deployed in public and private healthcare sites in several Australian states. It mainly supports programs for chronic disease and condition management and could very easily be extended to support broader podiatric clinical requirements. The shared EHR is provided as a fully maintained software service, including all maintenance and support. It does not require any local hardware and software infrastructure and typically only minimal local IT support. There are however some issues with the Macintosh platform that relate to the smartcard and PKI usage for access control and security. The smartcards and PKI are issued by Medicare Australia and it is expected that these issues will be resolved in the near term.

The shared EHR capability enabled data to be captured securely regardless of location by our surgeons with authorised users accessing the system using the Medicare Australia smartcard and PKI. All captured data was submitted to the cloud host for aggregation in patient-centric form. Together with Smart Health we designed and implemented new formats for data capture to suit our research requirements. Data was downloadable on demand for reporting.

Smart Health was chosen as our system provider because it was considered as lead technology provider to two of the government's large PCEHR programs and it is now extending its footprint beyond these programs.

3. Instruments for Measuring Outcomes of Foot Surgery

Once the research team had established the appropriate data capture platform the next step became identification of key health outcome indicators. The project team elected to capture health related quality of life performance indicators. These were of two main types. The first of these being generic measures of health related quality of life as captured by the world health organisation's assessment tool[5]. Previous research had been conducted using the Short Form 36 health status measure[6], however this time we elected to use a contrast the measure for the purposes of providing additional construct validity.

Most research has indicated that in order to capture specific changes in health status region or disease specific measures are required. To this end the project team elected to use the widely used and well validated Foot Health Status Questionnaire[7].

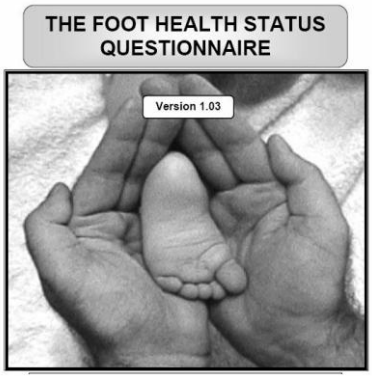


Figure 3 cover of the questionnaire administered

3.1 The Foot Health Status Questionnaire (FHSQ)

Until recently, there had been few valid foot specific quality of life instruments that could be used to assess the outcomes of foot surgery. The Foot Health Status Questionnaire (FHSQ) has been subject to many validity and reliability assessments[8].

3.2 Domains of health status captured:

Essentially, the FHSQ contains four scales that capture aspects of the patient's foot pain, foot function, footwear and general foot health perceptions[9]. The foot pain and function scales concentrate on physical phenomena, whilst the footwear scale assesses practical issues

associated with footwear availability and comfort. The general foot health perception scale deals with the patients' own self-assessment of the state of their feet.

On completion of the questionnaire, respondent's scores are re-coded, then summed and finally transformed to a scale from 0 (indicating poorest foot health) to 100 which indicated the best possible foot health status. Detailed reports of the development, validation and reliability of the Foot Health Status Questionnaire (FHSQ) have been previously published[8].

Basic summary of the foot health status questionnaire scale score interpretation.

Foot health status questionnaire scores	interpretation
75 to 100	Good to excellent health status
50 to 74	Above average health status
25 to 49	Below average health status
0 to 24	Poor health status

The aim of this study was to establish to what extent podiatric surgeons alter the self reported foot health status of patients with common foot diseases. To achieve this, the newly developed Foot Health Status Questionnaire was used.

3.3 The World Health Organization Quality of Life assessment (WHOQOL)

Figure 4 WHOQOL measures disability

The WHO's initiative to develop a quality of life assessment arose for a number of reasons. In recent years there has been a broadening in focus in the measurement of health, beyond traditional health indicators such as mortality and morbidity, to include measures of the impact of disease and impairment on daily activities and behaviour e.g. Sickness Impact Profile[10], perceived health measures e.g. Nottingham Health Profile[11] and disability / functional status measures e.g. the MOS SF-36,[12, 13]. These measures, whilst beginning to provide a measure of the impact of disease, do not assess quality of life per se, which has been aptly described as "the missing measurement in health"[14].

4. Methods:

Six surgeons with Fellowship of the Australasian College of Podiatric Surgeons and based in WA recruited patients from their (five practices) to be subjects in this study. Surgeons were asked to recruit patients who met the selection criteria for elective foot surgery detailed in table 1. For comparative purposes, the type of operations were categorised into three groups based on the type of primary foot problem being treated; orthopaedic, neurological and dermatological conditions.

Table 1 *The selection criteria for the recruitment of subjects into the study of health related outcomes of patients following foot and ankle surgery by FACPS.*

Selection Criteria
1. Must undergo foot and ankle surgery performed by a Fellow of the ACPS between 21st March 2011 and 20th June 2011.
2. Must have a current mail address for contact.
3. Able to provide informed consent to participate in this study.
4. No age limits on participants

Surgeons were asked to administer a baseline questionnaire which contained 39 items, including the four foot health scales (FHSQ) and the WHOQOL scale that investigated four domains: physical function, psychological function, social function, and environmental scales. The questionnaire was administered prior to the patient's foot operations.

Figure 5 smartcard reader

All questionnaires were completed without assistance or advice from the surgeon. Surgeons were instructed to inform subjects to complete the questionnaire "as best they could" if they were unsure of any particular item. Questionnaires were then uploaded onto the Smart Health Online System using a unique ID card.

4.1 Follow-up surveys

Participants were subsequently contacted by mail one, three and ten months post-operatively and, on each occasion, asked to complete the same questionnaire.

4.2 Missing Items

Missing items (question is not answered) were managed by excluding the entire scale for that subject. In addition data was not subsequently analysed due to a lack of a repeated measures capability. This necessitated analysing data at three months for all three groups of conditions and at 10 to 12 months for primarily the orthopaedic group.

4.3 Data Analysis

General Linear Modeling was the main form of analysis used in this study. In essence, a repeated measures multiple analysis of variance (repeated measures ANCOVA) were used. The statistical program SPSS was used for this purpose[15].

4.4 Ethics approval

Full ethics approval was obtained from the Queensland University of Technology ethics committee. Ethical approval was granted and the details are provided below.

Institution:	Queensland University of Technology, School of Clinical Sciences.
Project Title:	Health related quality of life change following podiatric surgery.
Approval Number:	1000001342
Clearance Until:	7/02/2014
Ethics Category:	Human

5. Results:

5.1 Descriptive and demographic data

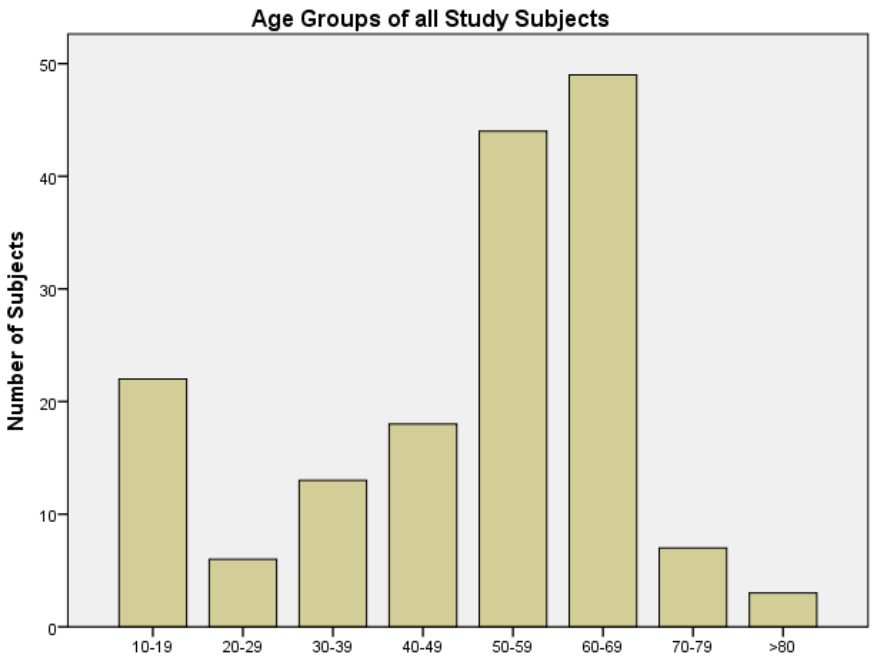
A total of 162 subjects across five practices were approached to participate in the study. The number of subjects recruited from each practice is shown in Table 1. Subject attrition rate was smaller than anticipated. 150 participants (92.6%) completed the pre-operative questionnaire, 146 follow-up at one month (90.1%), 139 at three month follow-up (85.8%) and 82 at ten month follow-up (50.6%). A sample of 162 was sufficient to insure adequate statistical power of 0.8 for the research questions. It should be noted that, in the ten month follow-up, only three out of the five surgery practices had completed and returned the questionnaire for their patients.

Table 2 *Descriptive characteristics for Surgery Practice*

Practice		Operative Group			Questionnaires Completed			
	N	Orthopaedic	Dermatological	Neurological	Pre-op	1 mth post	3 mths post	10 mths post
1	59	45	13	1	49	50	48	38
2	52	37	11	4	52	47	42	36
3	26	7	19	0	24	24	24	0
4	15	8	5	2	17	17	17	0
5	8	7	1	0	8	8	8	8
Total	**162**	**104**	**49**	**7**	**150**	**146**	**139**	**82**

The age distribution of the sample is "bi nodal" in distribution with a mean age of 49.5 years. This suggests at least two different sub cohorts, based on age, in the group.

Figure 6 *Depicts age group of the study population*



5.2 Descriptive Characteristics of Sample

Table 3 illustrate the descriptive characteristics of the patients in the study. Female subjects also tended to be older. Orthopaedic, neurological and dermatological system patients were found to differ significantly in their age and as one would expect, level of co-morbidity is strongly associated with age. In addition, patients who had undertook with two procedures and three or more procedures were older compared to those who had one procedure.

Table 3 *Descriptive characteristics of study population.*

	N	Percent %	Mean age (years)	SD	Sig.
Study population	162		49.5	18.2	
Gender					
Females	123	75.9	52.1	16.5	α0.004
Males	39	24.1	41.0	21.0	
Operative group $^{\eta}$					
Orthopaedic	104	65.0	55.3	13.2	χ0.000
Dermatological	49	30.6	36.5	21.7	
Neurological	7	4.4	54.6	10.3	
Number of procedure$^{\eta}$					
One procedure	95	59.4	45.0	20.0	δ0.000
Two procedure	36	22.5	53.8	14.2	
Three and more	29	18.1	59.2	10.7	
Co-morbidity $^{\phi}$					
No illness	50	43.5	49.8	18.1	y0.026
One illness	31	27.0	52.0	15.0	
Two or more	34	13.0	59.2	12.0	
Employment status$^{\psi}$					
Working Full Time	57	39.3			
Studying	22	15.2			
Working Part Time	19	13.1			
Retired	19	13.1			
Not in labour force	17	11.7			
Casual	6	4.1			
Voluntary work	3	2.1			
Unemployed	2	1.4			
Health Insurance					
Health benefit fund	97	59.9			
Medibank Private	25	15.4			
Other	23	14.2			
Not insured	17	10.5			
Education^{z}					
Senior Secondary	51	31.5			
Certificate/ Diploma	29	17.9			
University Degree	26	16.0			
Junior Secondary	20	12.3			
Primary	4	2.5			

α t-test, with equality of variance not assumed
χ one way ANOVA ($F_{2,157}$ = 22.84), post hoc test difference among dermatological group compared to orthopaedic and neurological groups
δ one way ANOVA ($F_{2,157}$ = 8.93), post hoc test difference among patients with one procedure compared to those with two or three and more procedure
y one way ANOVA ($F_{2,112}$ = 3.77), post hoc test difference among patients with two or more condition compare to patient with no condition
η two missing values for operative type
ϕ forty-seven missing values
ψ seventeen missing values
β seven missing data.
Z Thirty-three missing data.

Table 4 *Types of operations being performed (broad definitions)*

	Frequency	Percent	Cumulative Percent
Orthopaedic – Digital Surgery	82	30.7	30.7
Orthopaedic - 1st Ray Surgery	51	19.1	49.8
Dermatological – Ingrown Nail	47	17.6	67.4
Orthopaedic - Metatarsal	29	10.9	78.3
Neurological – Neuroma of the Forefoot	12	4.5	82.8
SoftTissue Lesions – Unspecified	11	4.1	86.9
SoftTissue – Ligment & Tendon Repair	10	3.7	90.6
Orthopaedic Rearfoot - Miscellaneous	9	3.4	94.0
Orthopaedic Midfoot - Miscellaneous	5	1.9	95.9
Other – Not specified	5	1.9	97.8
SoftTissue – Fascia Release/Repair	4	1.5	99.3
Neurological Rearfoot – Entrapment	1	.4	99.6
Dermatological – Verrucae Pedis	1	.4	100.0
Total	**267**	**100.0**	

Table 4 provides a summary of the relevant frequency of a broad classification of surgical procedures undertaken. A total of 267 individual operations were performed. Several of these were in combination for example, orthopaedic digital surgery and first ray surgery often occurred in conjunction (ie hammer toe and bunion surgery combined). This table clearly illustrates that greater than 60% of all surgery was performed on hallux abductor valgus cases. These findings are supported by previous studies[16, 17]

Table 5 *Descriptive characteristics Gender by Operative Group*

		Operative Group			
		Orthopaedic	Dermatological	Neurological	Total
Gender	Male	17	20	1	38
	Female	87	29	6	122
Total		**104**	**49**	**7**	**160**

(Chi-Square Likelihood Ration 10.77 , DF 2, P = 0.005)

Table 5 illustrates the over representation of females in the cohort, however dermatological conditions had reasonably equal representation of male and female subjects.

5.3 Descriptive Characteristics for the scales on FHSQ and WHOQOL

Table 6 *Descriptive characteristics for scales*

	Pre-operation		Post-operation					
			1 month		3 months		10 months	
	M	SD	M	SD	M	SD	M	SD
FHSQ Foot Pain	61.19	25.08	75.88	18.56	80.63	16.52	77.62	22.29
FHSQ Foot Function	65.81	27.14	62.46	28.57	80.99	21.52	84.93	22.09
FHSQ Foot Wear	35.98	27.84	38.79	29.65	44.20	29.97	45.38	31.09
FHSQ General Foot Health	44.07	27.39	61.97	24.99	69.33	22.80	65.44	28.06
WHOQOL Psychological	65.51	13.64	63.32	14.86	68.17	15.88	67.32	15.14
WHOQOL Physical	69.74	13.31	69.68	13.11	71.38	13.78	70.49	13.33
WHOQOL Social	78.09	20.32	77.18	19.32	77.78	18.47	80.41	16.56
WHOQOL Environmental	82.79	12.85	80.58	14.33	84.93	14.36	84.60	11.49

Table six provides raw data for actual scale scores across the four time periods. Of importance to note is the size of the standard deviation of these measures indicating wide variability in the measure.

5.4 Response Rate across the Four Survey Periods

Table 7 illustrates the response rate according to the operative group. Due to the high drop-out rate on the ten months follow up questionnaire, this study has analysed the outcomes of foot health status and quality of life into two stages. Part 1 of the analysis compared those patients who had completed the first three survey periods (85.8%). Part 2 of the analysis compared those patients who had completed all the four survey periods (50.6%). Care must be exercised when interpreting the second analysis due to potential non-response bias.

Table 7 Descriptive characteristics for Operative Group

Operative Group	N	Pre-operation	Questionnaires Completed Post Operation		
			1 month	3 months	10 months
Orthopaedic	104	96	95	93	65
Dermatological	49	45	43	38	14
Neurological	7	7	6	6	3
Total	**160**	**148**	**144**	**137**	**82**

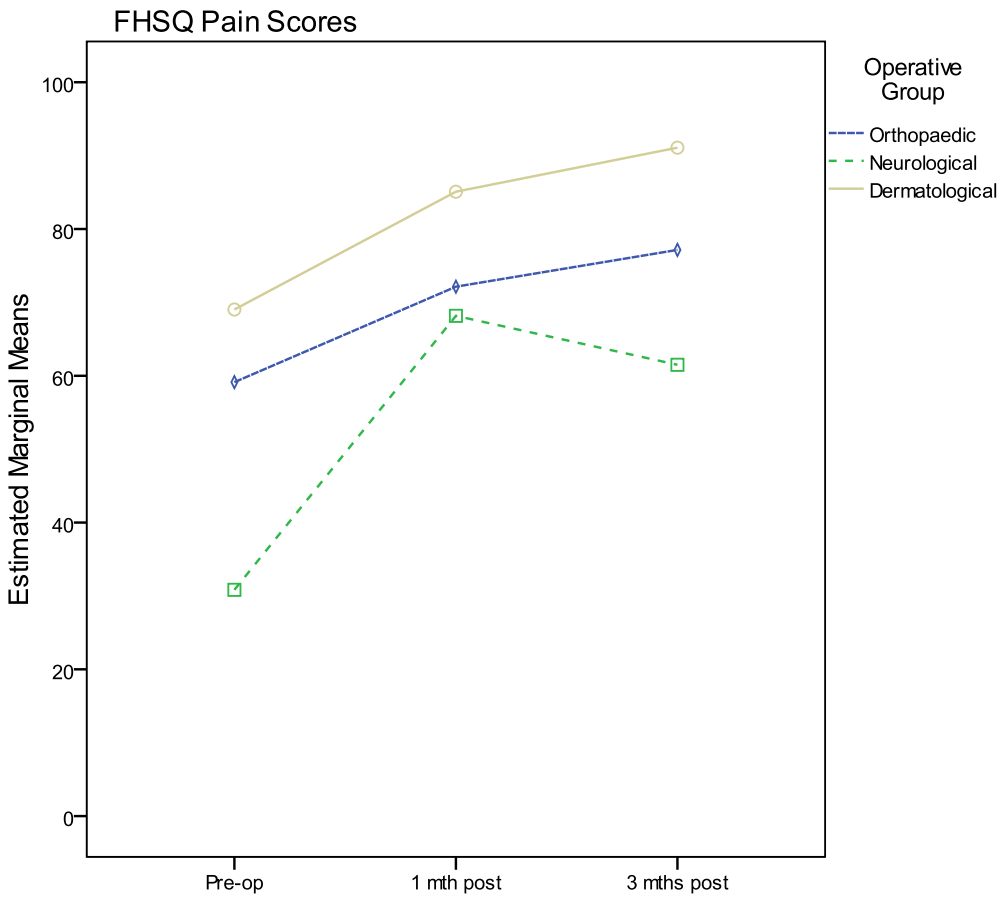
6. Part 1: Health Status 3 Months Post Operative

The reader is reminded that for the interpretation of scale scores, the *lower* scores represent poorer foot health status (for example, scores in the bottom quarter e.g. 0 to 25) whilst *higher* scores represent optimal health status (for example scores in the top quartile e.g. 75 to 100). According to the work by Landorf and Radford, the minimally important clinically significant differences range from changes of 4.0 for foot pain, 7.4 foot function, and 9.24 general foot health. Upward trends over time typically indicate an improvement in foot health status and conversely downward trends indicate reduced health status. This will however be influenced by sample size.

6.1 The Foot Health Status Outcomes

Figure 7 demonstrates both the time trend and between group trends for the "pain scale" in the Foot Health Status Questionnaire. The higher the scale score (closer to 100) the better the health status. Each of the three study groups has a line which connects the scores achieved over the first three survey periods.

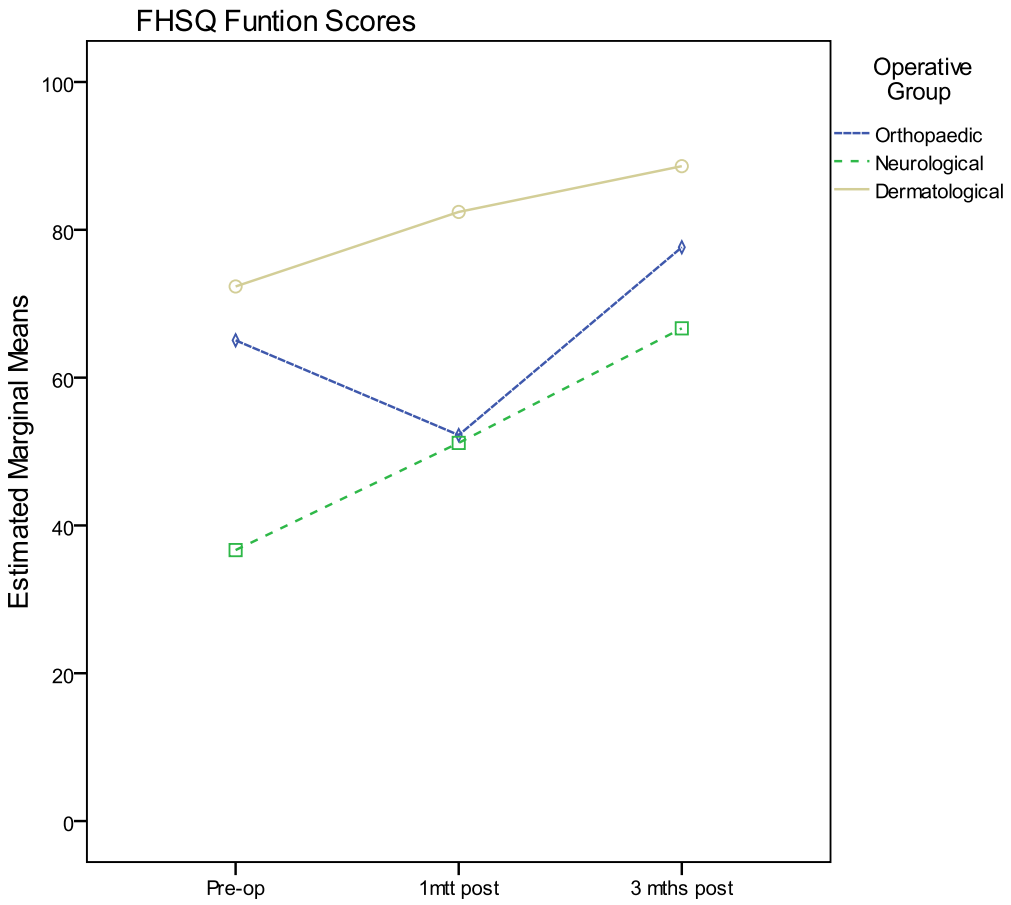
Figure 7 *The FHSQ pain scale scores for each group of patients over the three time periods.*



The analysis of variance on repeated measure for FHSQ pain scale has shown a significant difference across the first three time period, $F(2,122) = 19.48$, $P < 0.001$. A significant between groups difference was identified, $F(2, 123) = 19.5$, $p < 0.001$. Therefore, there is a

significant change in the pain scores over the time for the patients in different operative groups. The result of Post Hoc comparisons indicated significant differences in pain scores between dermatological group and orthopaedic group ($p < 0.001$) and between dermatological group and neurological group ($p<0.05$). No different was found between orthopaedic and neurological group, which had significantly more pain present than the dermatological group. All three operative groups have an improvement in their levels of pain (i.e. pain reduction) during a three month period.

Figure 8 *The FHSQ function scale scores for each group of patients over the three time periods.*



The FHSQ function scale is designed to evaluate an individual's functional abilities based specifically on the health of their feet. A low FHSQ Function score implies the subject has a foot problem which limits them in a broad range of physical activities such as performing their regular work, walking, and more demanding activities such as climbing stairs.

The graph shows a significant difference over the three time period, $F(2, 122) = 15.3$, $p < 0.001$.

There is also a significant interaction on the time effect and the operative groups, $F(4, 244) = 6.0$, $p < 0.001$), which means that the groups are changing over time but are changing in different ways. For example the orthopaedic group, as one might expect, have deterioration in functional activity one month post operatively. This could be explained by the fact that many of these patients have internal fixation devices, immobilisation white plaster casting, and the need to use post operative air splints and fiberglass or plaster casts.

Significant differences on the physical function scores over time were found across the three operative groups, $F(2, 123) = 11.8$, $p < 0.001$. The follow up analysis revealed significant difference between the dermatological group and orthopedic group ($p <0.05$), and between the dermatological group and neurological group ($p< 0.05$). The dermatological group's other ones least impaired in terms of function. This makes the obvious sense.

Figure 9 *The FHSQ footwear scale scores for each group of patients over the three time periods.*

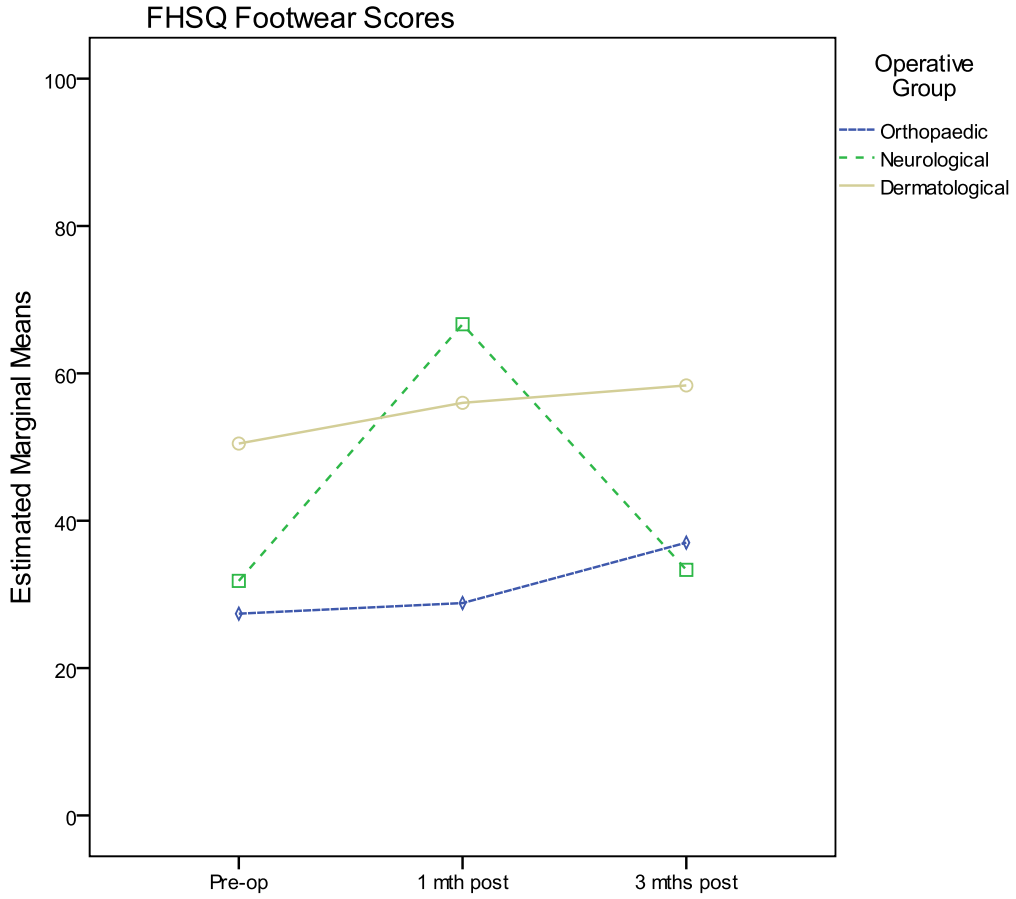


Figure shows a significant difference between groups over time with respect to footwear scores, $F(2, 123)=14.1$, $p<0.001$.

A significant interaction on the time effect and the operative groups was revealed, $F(4, 244) = 4.4$, $P<0.05$.

Significant differences on the footwear scores over time were found across the three operative groups, $F(2, 123) = 14.14$, $p < 0.001$. A follow up analysis revealed that only the orthopedic group and dermatological group to be statistically different from each other in regarding to the footwear scores ($p < 0.001$). In particular, and as one may anticipate, those subjects undergoing orthopaedic surgery still had a significant amount of difficulty with footwear fitting three months post operatively.

Figure 10 *The FHSQ general foot health perception scale scores for each group of patients over the three time periods.*

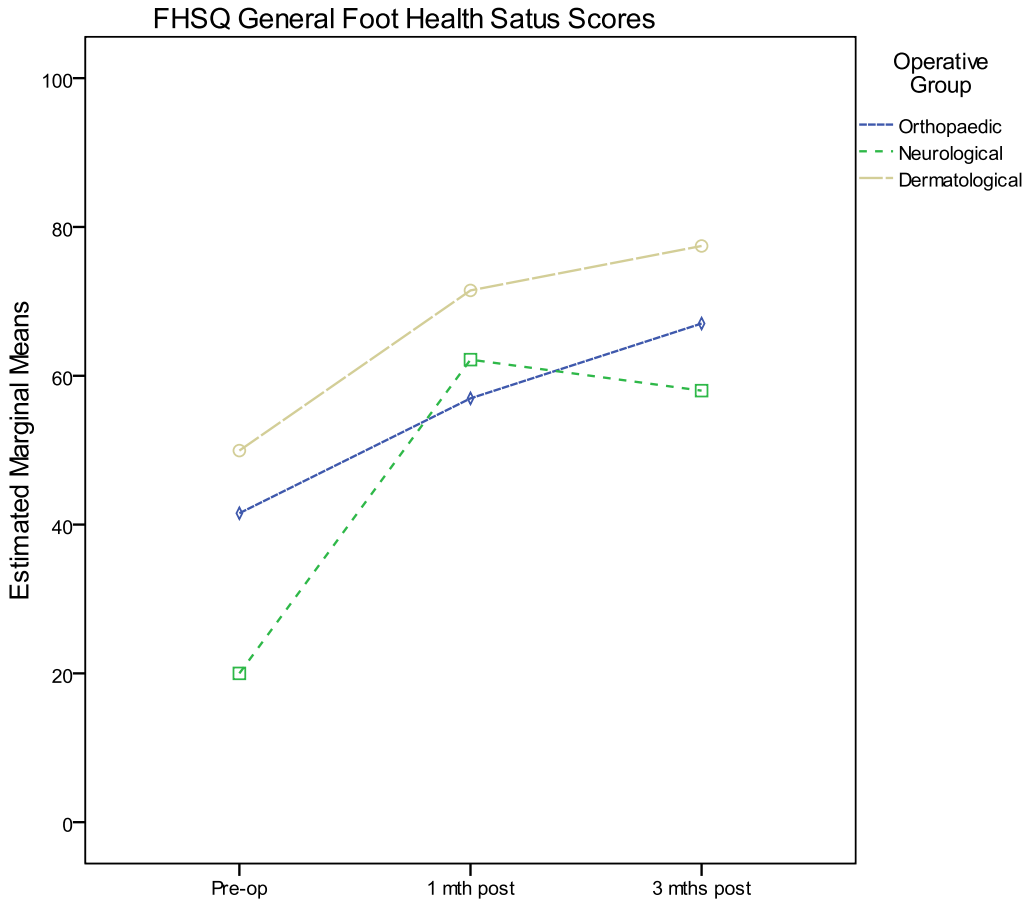


Figure 10 illustrates an overall significant time trend effect, $F(2, 122)=23.0$, $p<0.001$, with patients recording an improved self-perception of their feet over the three time period.

This trend demonstrates a significant differences between the three groups, $F(2, 123) = 5.5$, $p <0.05$. The patients in orthopedic group were significantly different from patients in dermatological group ($p < 0.05$) on their general foot health scores. Once again the time trend illustrates that all groups perceive an improvement in their foot health three months post operatively.

6.2 Individual subjects change in health status over the three month period.

In order to gain a more detailed understanding of individuals changes in health status, individual analysis was undertaken for the three groups of surgical procedures.

Figure 11 *individual subjects change in health status over the three months*.

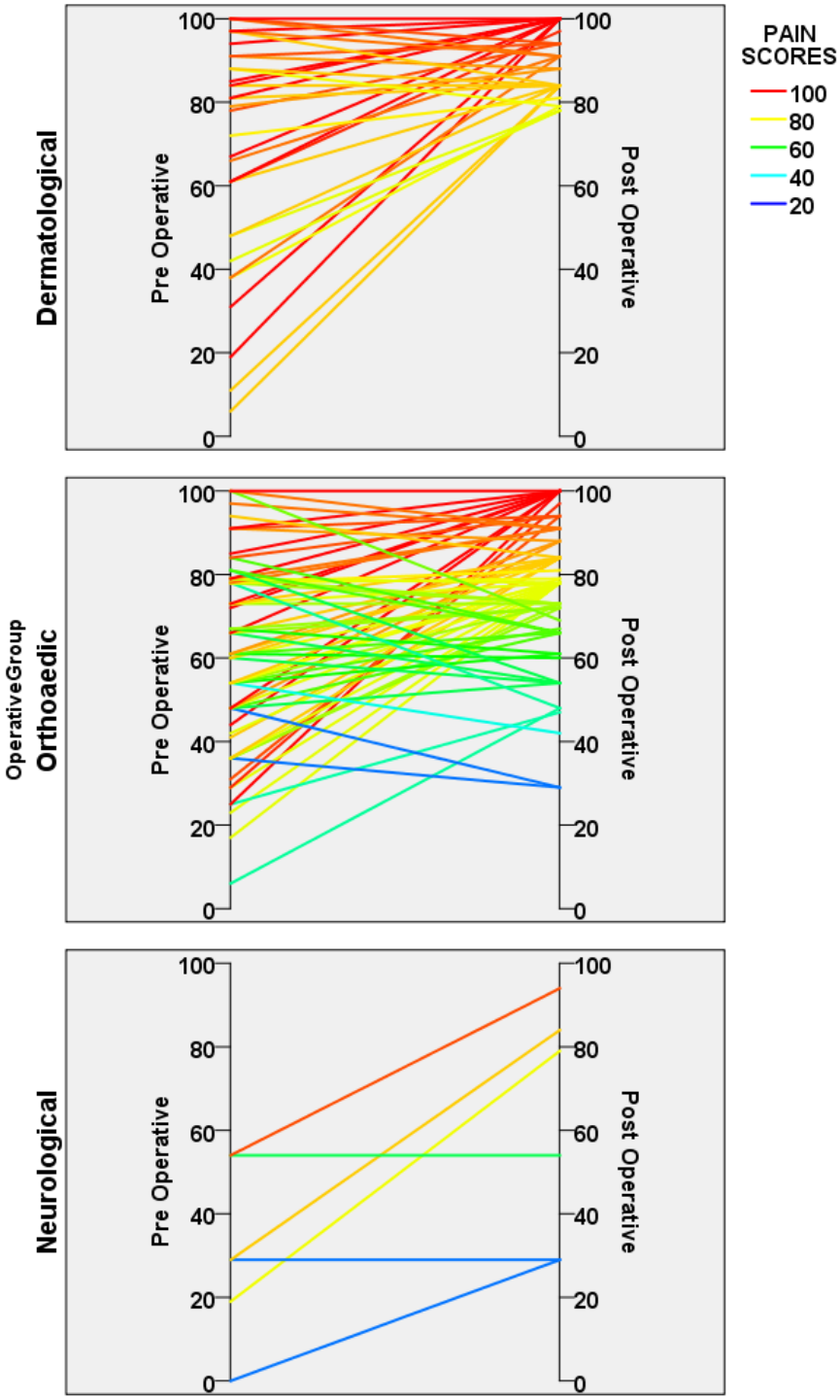


Figure 11 illustrates several important features. Firstly the dermatological group had a uniform and impressive improvement in the levels of foot pain they experience. In other

words, from a variable amount of foot pain (for example extremely low scores) virtually no pain three months post operatively. Subjects demonstrated close to optimal foot health.

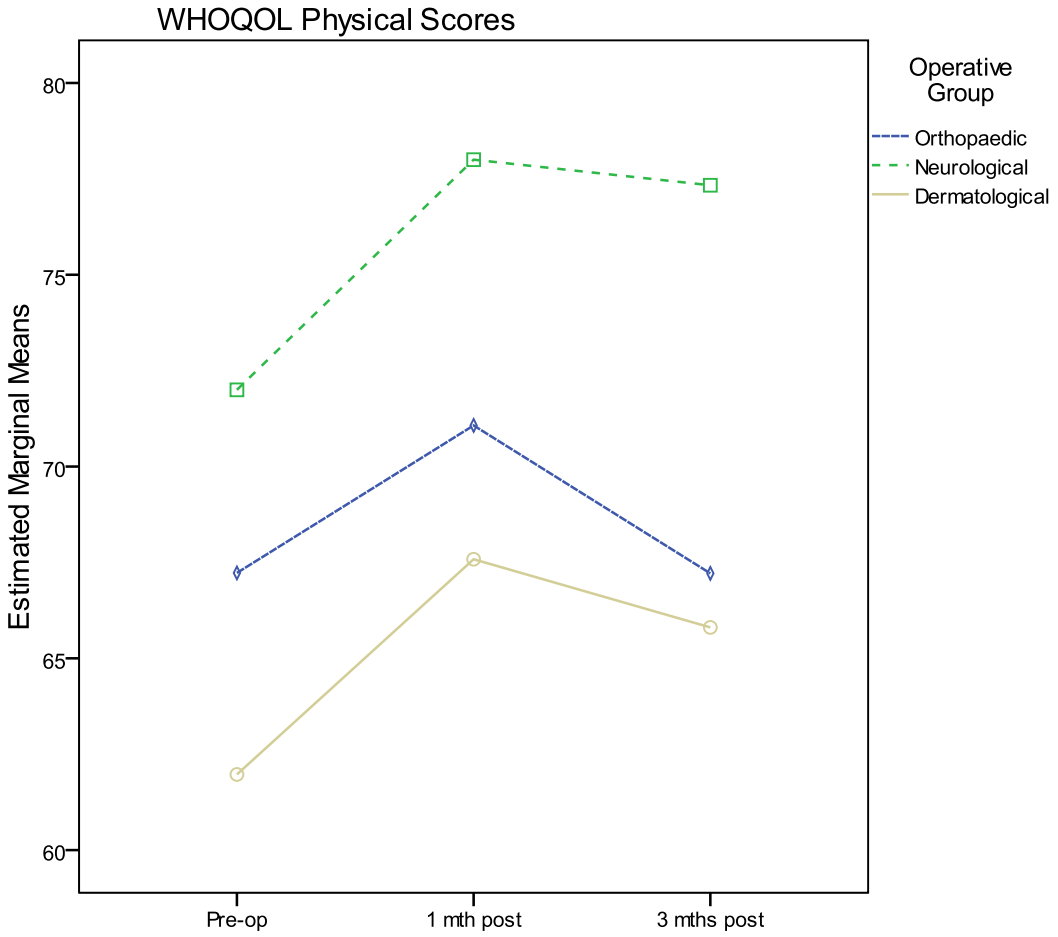
Secondly, the orthopaedic group demonstrated a much greater variability in the pain levels three months post operatively. The reader is reminded scores close to or above 80 represent optimal levels of health status. This variability warranted further analysis and is described later.

Finally, there were only six subjects in the neurological (neuroma) group. The small sample size makes for difficult analysis. Notwithstanding this point no subjects were identified as being worse off after the surgical procedure in the short to medium term..

6.3 Generic Quality of Life Outcomes

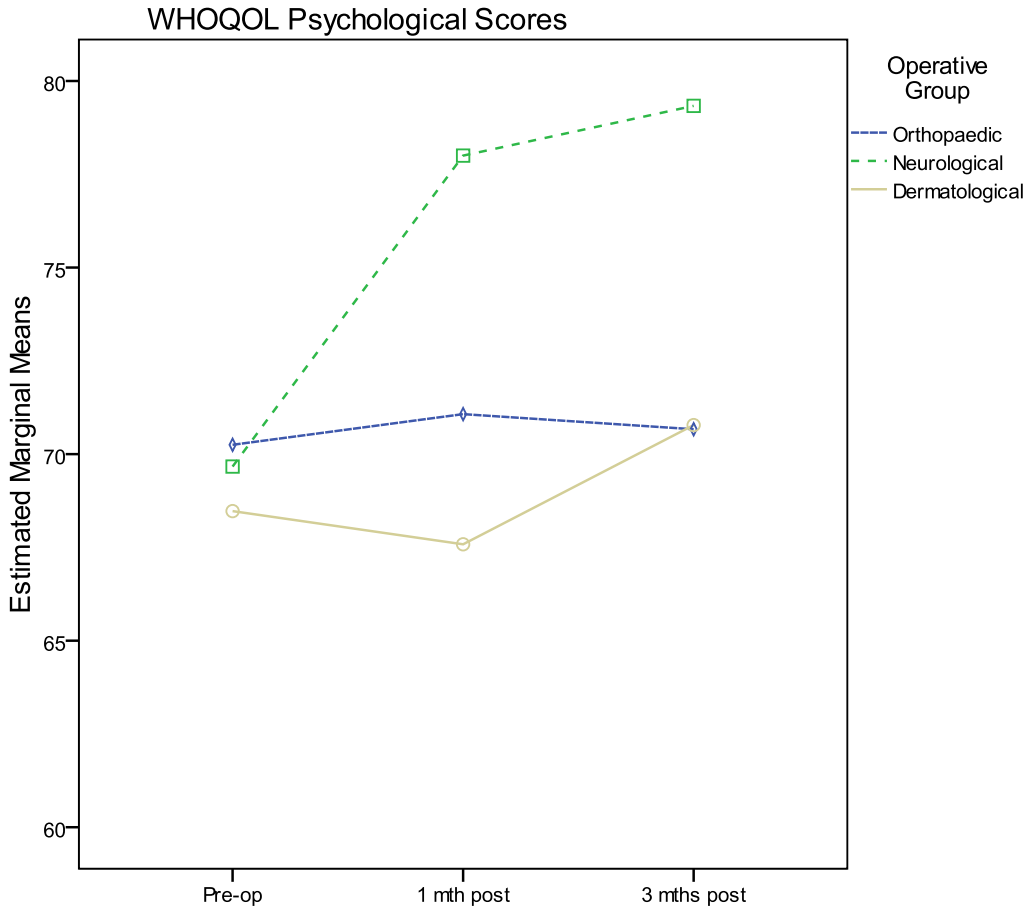
Figures 12 illustrates both the time trend and between group trends for the four domains in the WHOQOL scale over the first three survey periods. Again, the higher the scale score (closer to 100) the better the health status.

Figure 12 *The WHOQOL physical scores for each group of patients over the three time periods.*



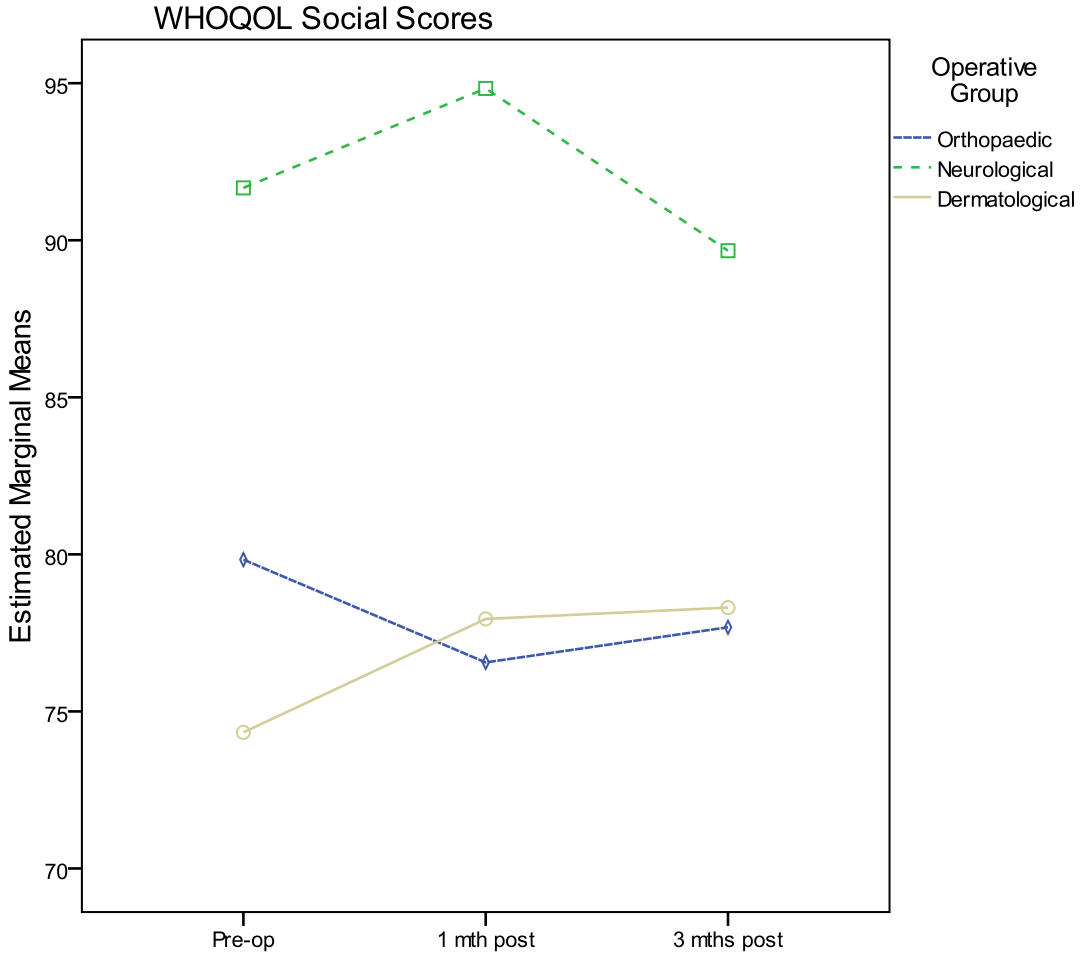
The within subject test indicate that there is a significant time effect, in other words, the groups do change marginally in physical activity levels and scores over time, $F(2, 122) = 3.9$, $p < 0.05$. Effectively physical activity increased but then plateau. However, between groups test indicates that the operative groups did not significantly differ from each other over the time tread, $F (2, 123) = 2.8$, $p < 0.66$.

Figure 13 *The WHOQOL psychological scores for each group of patients over the three time periods.*



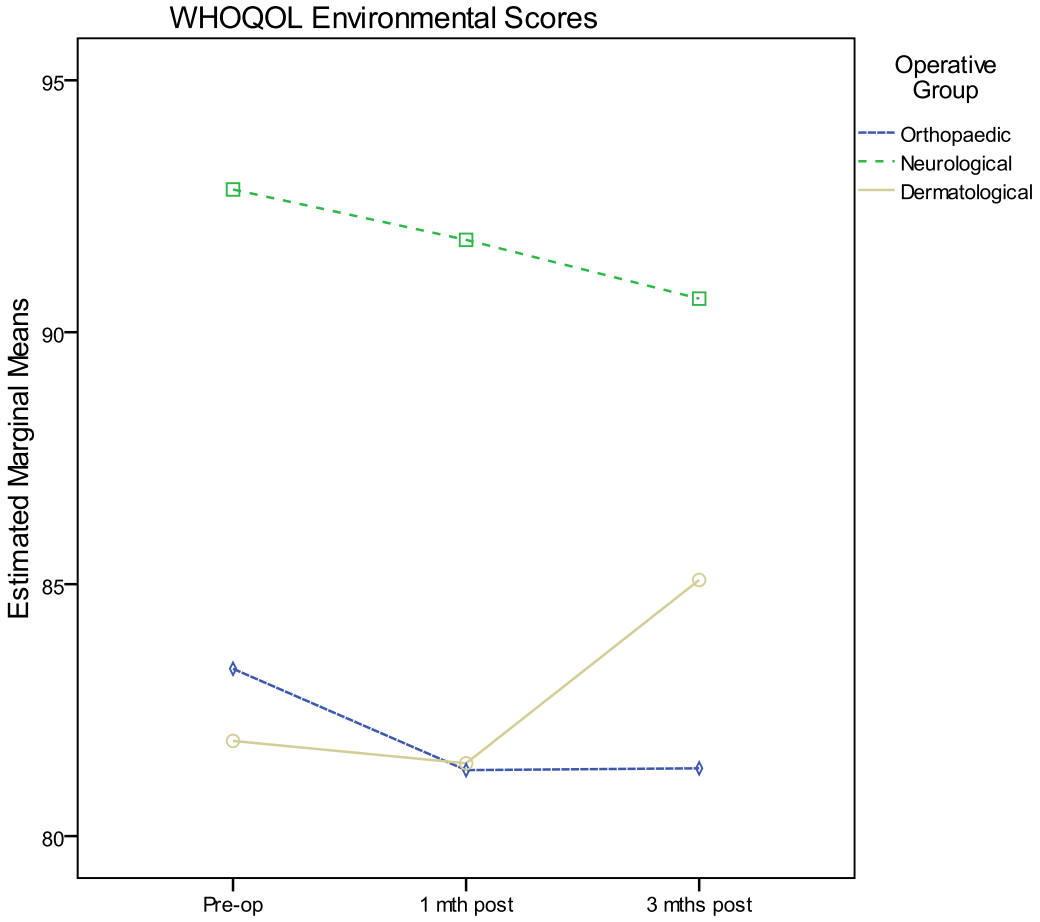
There were no significant time trend effect over three time period, F (2, 122 =2.8), p=0.06, and no statistically significant differences between operative groups over time, F (2, 123) =1.06, p=0.35) was observed on WHOQOL psychological scores

Figure 13 *The WHOQOL social scores for each group of patients over the three time periods.*



There were no significant time trend effect over three time period, F (2, 122) =0.2, p=0.80; and no differences between the three operative groups were found over the time period, F (2, 123) =2.33, p=0.10) on the WHOQOL social scores

Figure 14 *The WHOQOL environmental scores for each group of patients over the three time periods.*



There were no significant time trend effect over three time period, F (2, 122) =0.3, p=0.74; and no differences between operative groups over time, F (2, 123) =2.09, p=0.13) was observed on WHOQOL environmental scale

7. Part 2: Health Status 10 to 12 Months Post Operative

Long-term analysis was affected by the fact "dermatological" subjects, e.g. those patients treated for chronic or acute ingrown toenails, tended not to respond in this study at the 10 to 12 month time period. This would be largely as a result of the fact their foot problems would have been resolved by three months, hence no need or interest in being followed up by the surgeons beyond that timeframe. Of more interest is a detailed assessment of orthopaedic outcomes, which essentially do need to be followed up over the 12 month time frame. These can be regarded as the "long-term" outcomes after healing has occurred.

7.1 The Foot Health Status Outcomes

Figure 15 illustrates both the time trend and between group trends for the four Foot Health Status Questionnaire scales over the four survey periods. The higher the scale score (closer to 100) the better the health status. Note most neurological subjects lost follow-up.

Figure 15 *The FHSQ pain scale scores for each group of patients over the four time periods.*

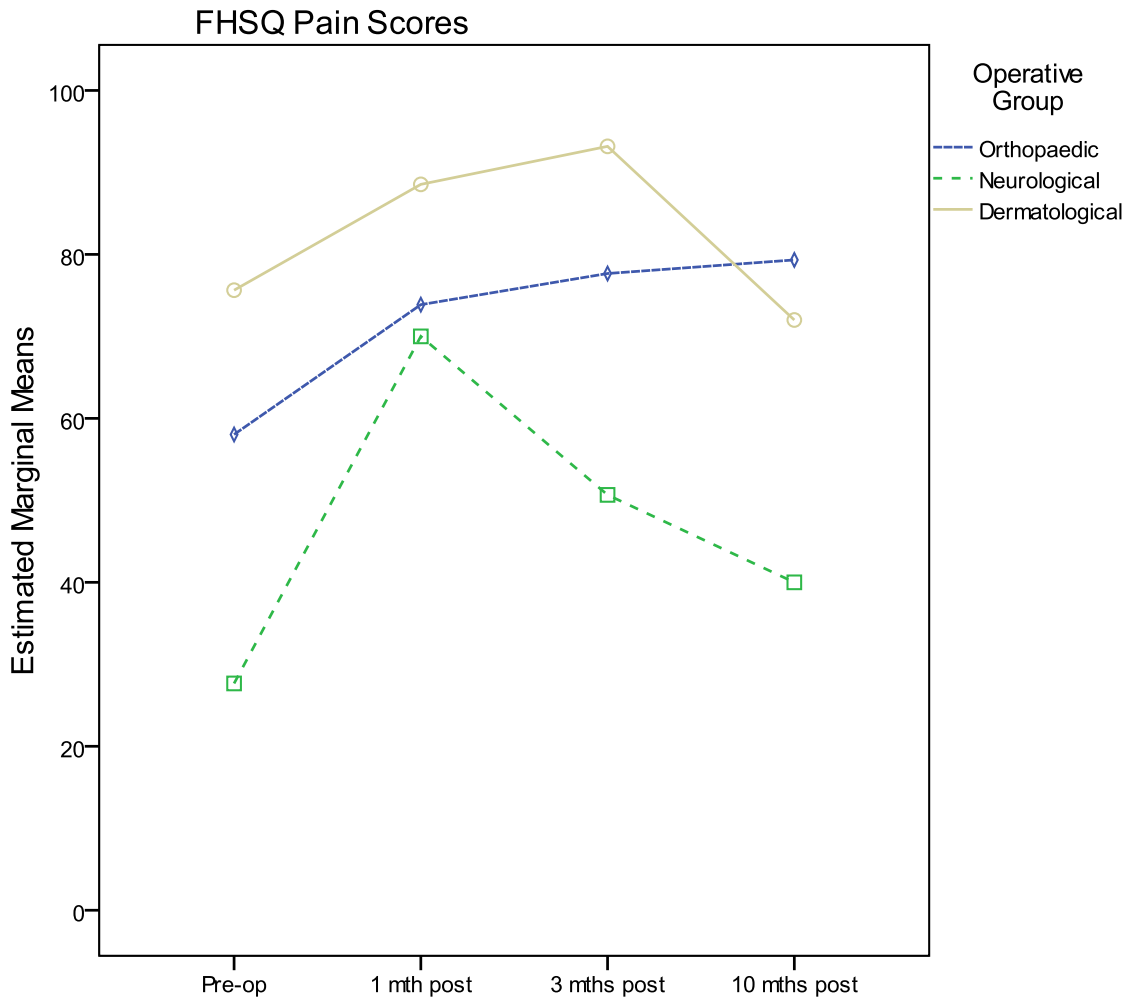


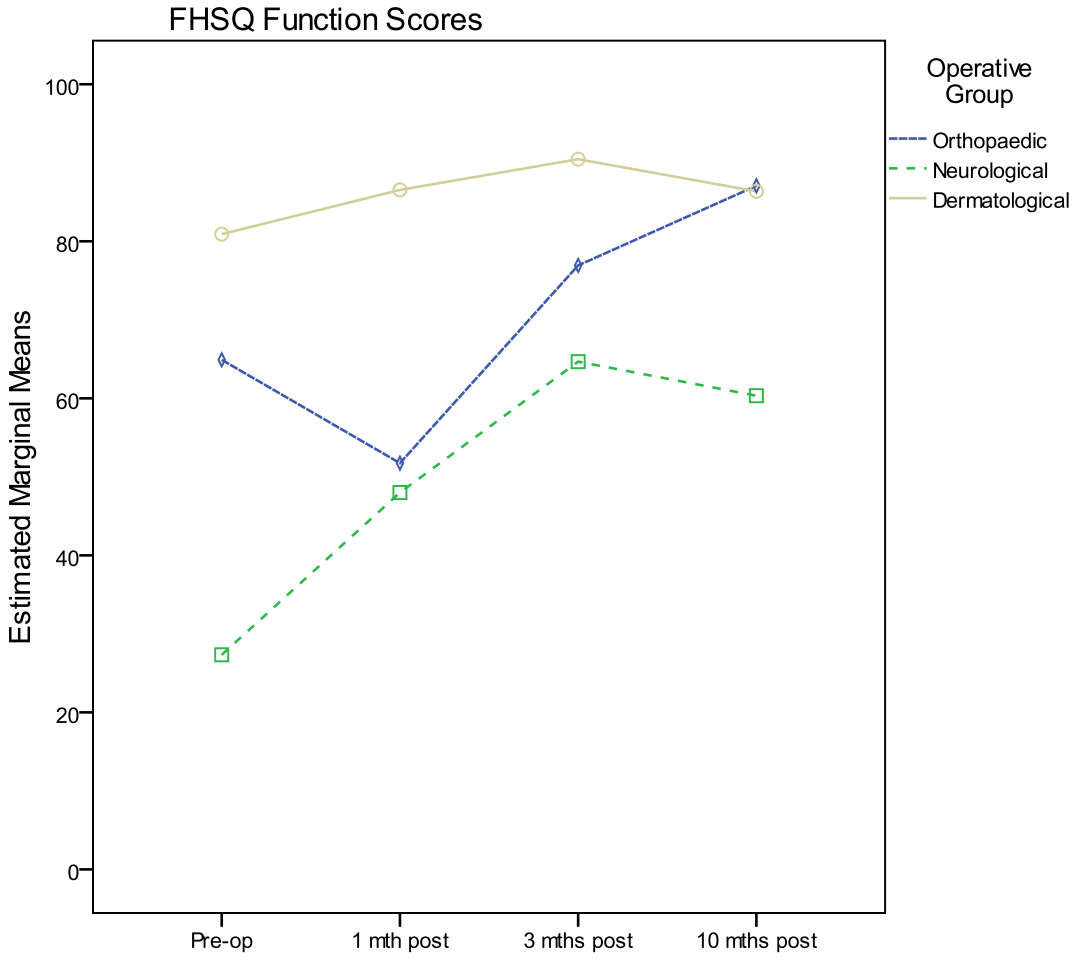
Figure shows a significant difference between groups over time with respect on the FHQS pain scores, $F(3, 64)=7.26$, $p<0.001$.

A significant interaction on the time effect and the operative groups was revealed, $F(6, 128) = 6.0$, $P < 0.05$, which means that the groups are changing over time but are changing in different ways.

This would most likely be explained by the fact that only a small number of neurological patients were followed up at 12 months. This may represent a selection bias, and perhaps only those patients who returned for follow-up may have had ongoing issues? Both the orthopaedic and dermatological group appeared to be close to normal in terms of pain level reduction by 12 months.

This kind of observation made it apparent a case-by-case analysis would need to be undertaken, particularly the orthopaedic patients.

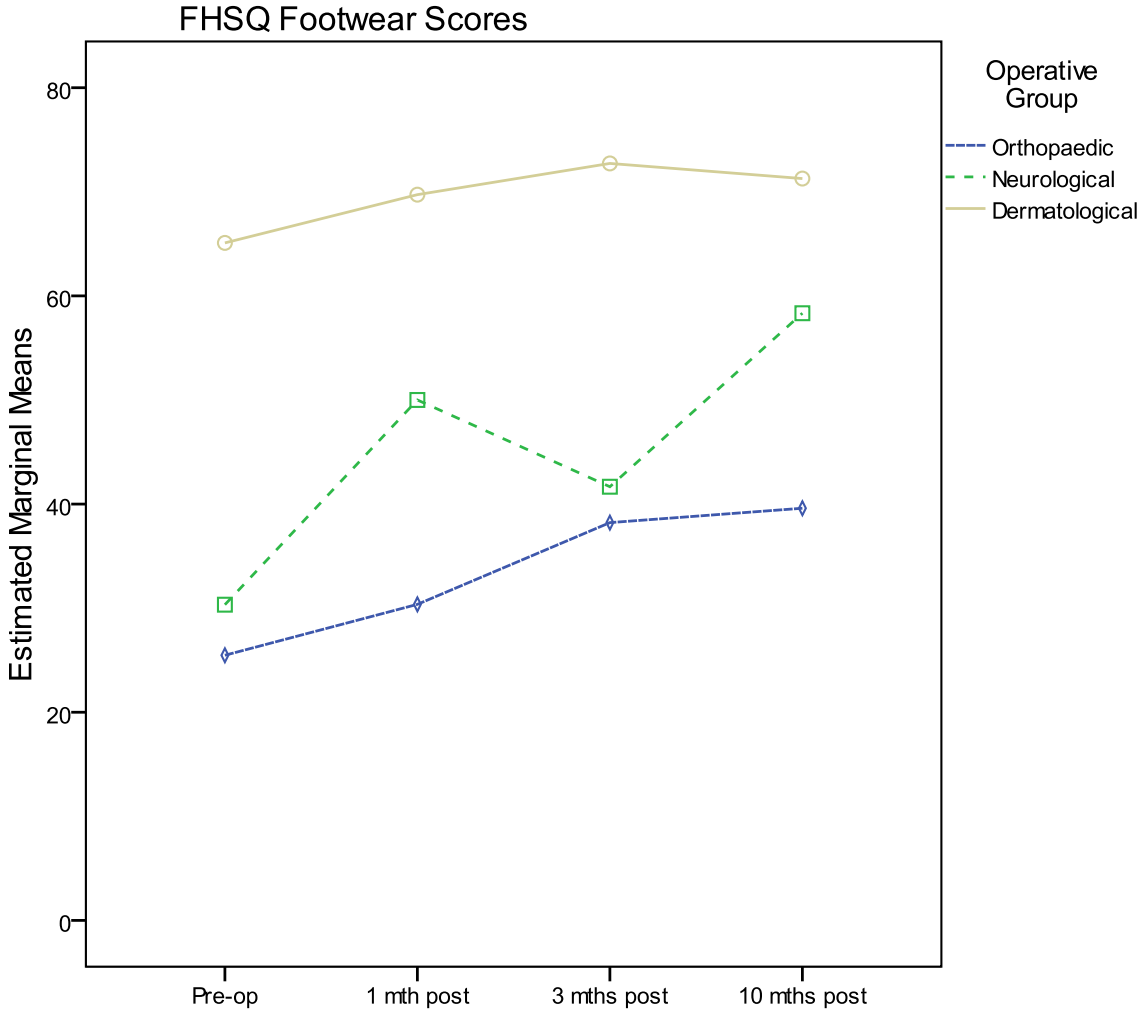
Figure 16 *The FHSQ function scale scores for each group of patients over the four time periods.*



There were significant difference over time with respect to foot function scores, $F(3, 64)=6.75$, $p<0.05$. A significant interaction on the time effect and the operative groups was revealed, $F(6, 128) = 2.84$, $P <0.05$.

In effect the observation noted at the three month analysis indicated those subjects undergoing orthopaedic procedures tend to have a greater degree of physical impairment at one month post operatively this however normalises by 10 to 12 months post operative in other words further improvements in physical activity were identified in the long-term follow-up of orthopaedic patients.

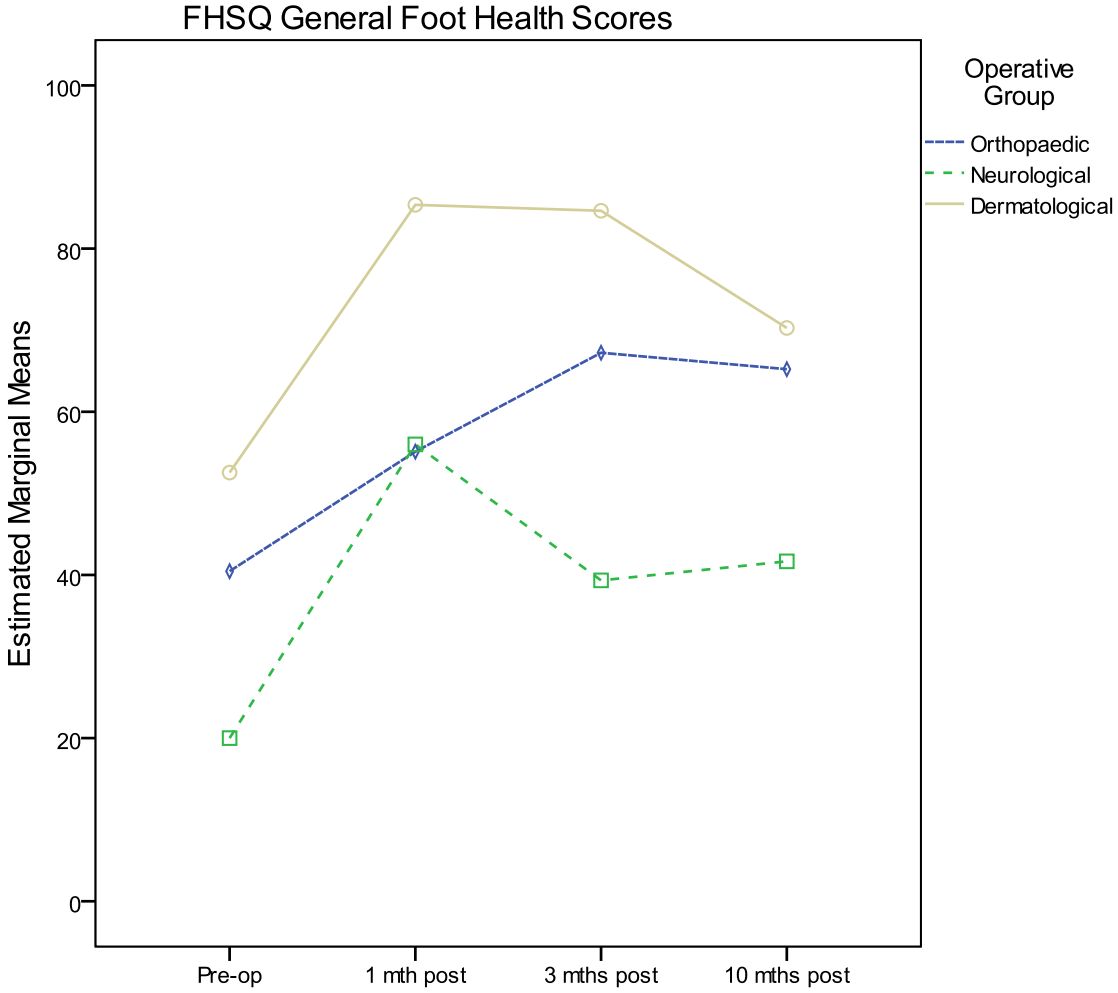
Figure 17 *The FHSQ footwear scale scores for each group of patients over the four time periods.*



There was not a significant time effect, F (3, 64) = 2.12, p = 0.11, in other words, the groups do not change in the foot wear scores over time. The young active people had no difficulty with footwear before or after the dermatological (ingrown toenail) surgical procedure

The between groups test indicates that there was significant difference between the three operative groups over the time, F(2, 66) = 14.24, p < 0.001. Orthopaedic patients tend to struggle with footwear both before and after the operation was performed. This trend was noted in the long-term.The follow up analysis revealed that orthopaedic group to be significantly differ from dermatological group, consequently in the graph we see that the lines for the orthopaedic and dermatological groups are rather far apart.

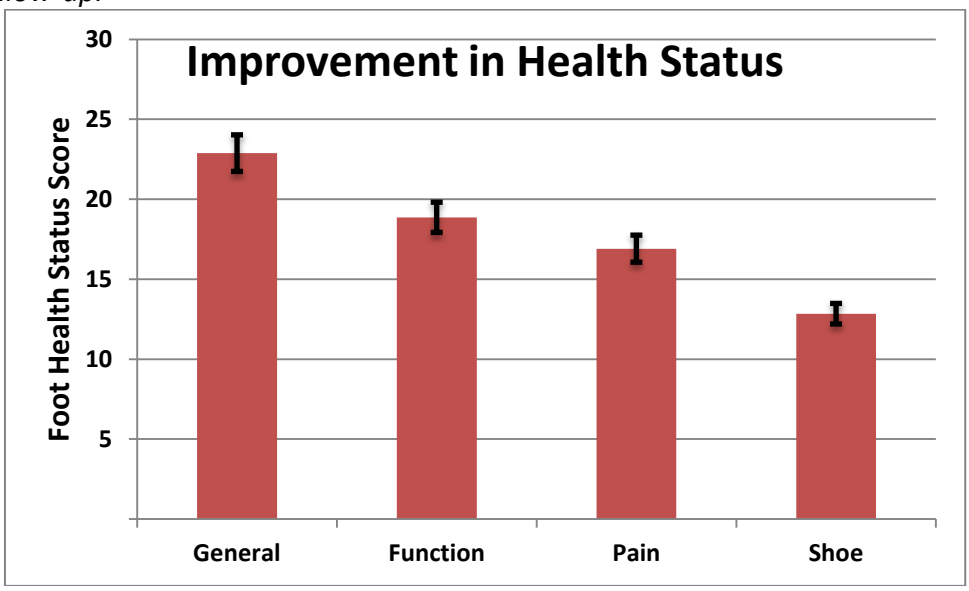
Figure 18 *The FHSQ general foot health perception scale scores for each group of patients over the four time periods.*



Significant difference were found over the four time periods with respect to patients general foot health scores, $F(3, 64)=5.12$, $p<0.05$. A significant interaction on the time effect and the type operative groups was also revealed, $F(6, 128) = 2.45$, $P<0.05$. In general the largest cohort of patients being orthopaedic, indicated they perceive an overall improvement in their foot health status in the long-term. This reflects a positive trend in service provision.

7.2 Improvement in health status

Figure 19 *demonstrates the overall net change in scale scores between baseline and 12 month follow-up.*



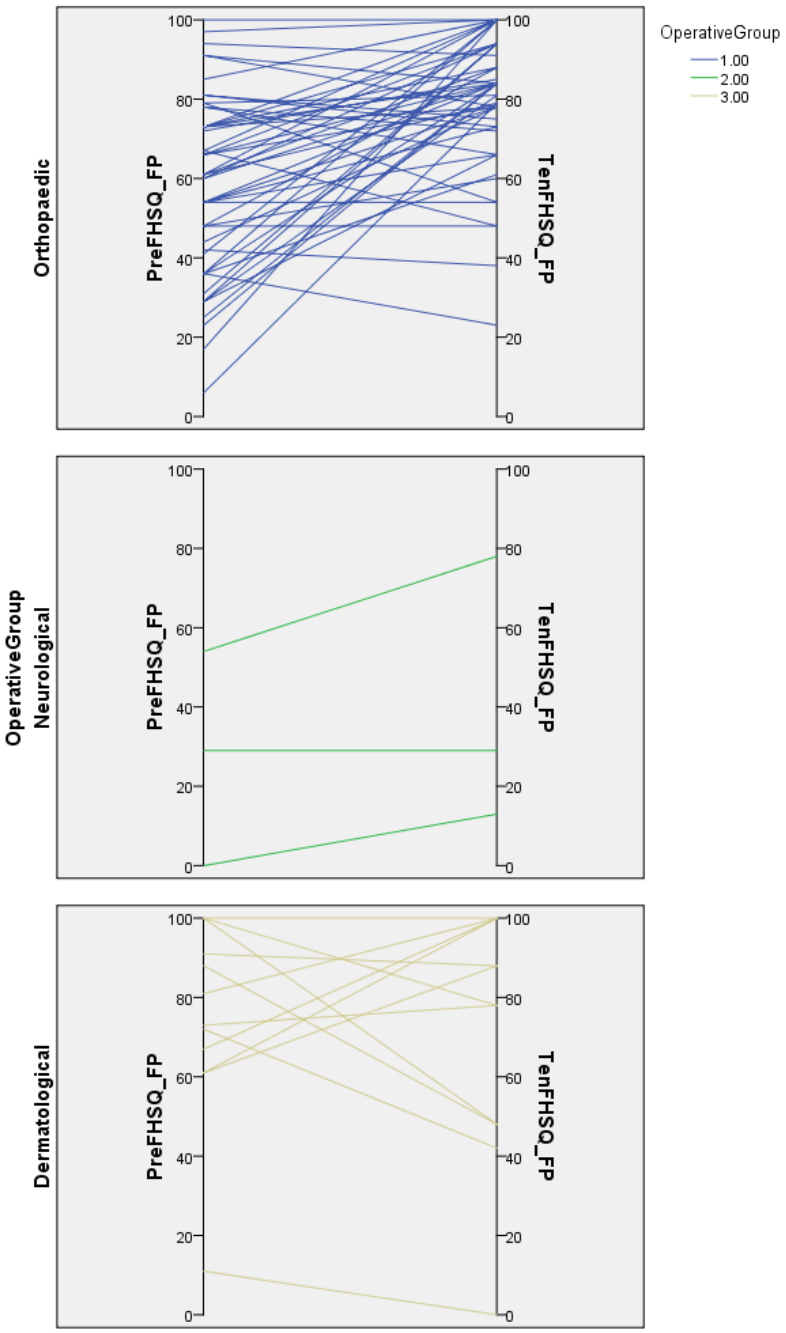
As previously indicated, changes in scale score between five and 10 points indicates a clinically important improvement[18]. As can be seen here, health status was improved for all for health domains over the 12 month period. These findings are consistent with previously reported research[19].

While significant clinically important improvements occurred across all for health domains, it is known that not all patients necessarily improve as one would expect. The purpose of the following analysis was to look at **"individual"** response at the 12 month time point.

7.3 Individual changes in health status 10 to 12 months postoperatively.

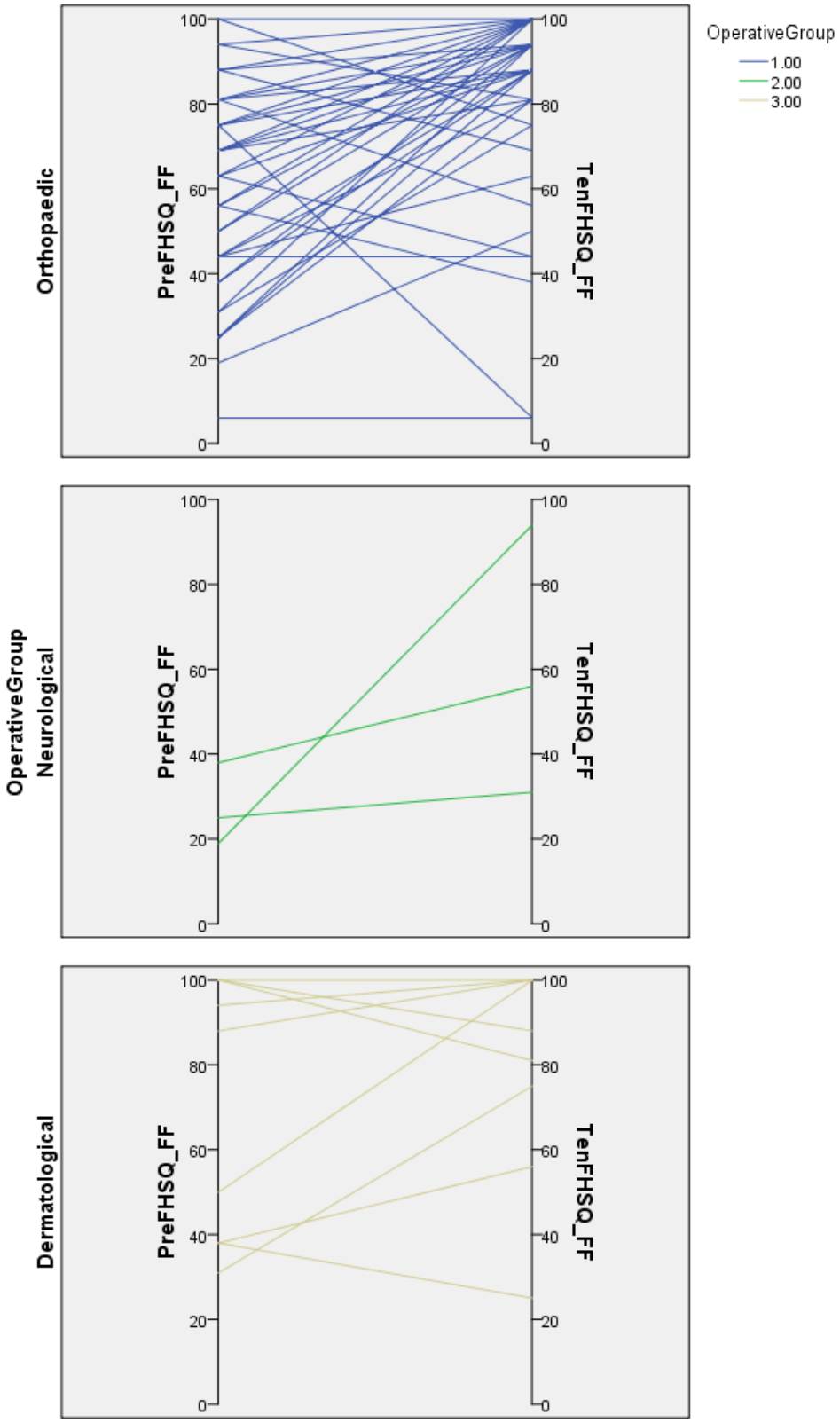
Individual subject analysis was undertaken. The way to interpret these graphs is that an "upward" slope from left to right indicates an improvement in health status score. A line that is basically parallel to the horizontal axis indicates "no major change" in health status. This should not be interpreted necessarily as a poor outcome, as health status is a relative measure of importance to the individual. A significant downward slope from left to right on patient's health status may tend indicate a worse off state. The small number of neurological cases makes interpretation of this group difficult.

Figure 20 *demonstrates "individual" subjects changes in pain health status 10 to 12 months after procedure.*



While the overwhelming trend in foot pain is for an improvement, a sum cohort of the group appeared to be stable rather than "improve" or "worsen" regarding their foot pain. This phenomenon was more markedly demonstrated in the orthopaedic group.

Figure 21 *demonstrates "individual" changes in physical function health status 10 to 12 months after procedure.*



This figure represents level of physical function experienced by individuals. Once again it highlights more noticeably that a very small subset of the cohort felt they had deterioration in their physical activity levels. This observation warranted further analysis.

7.4 Changes in hallux valgus and digital deformity at 10 to 12 months.

Figure 22 individual "pain outcomes" *for the most prevalent foot condition treated, that being for first metatarsal phalangeal joint problems and Digital problems of an orthopaedic nature.*

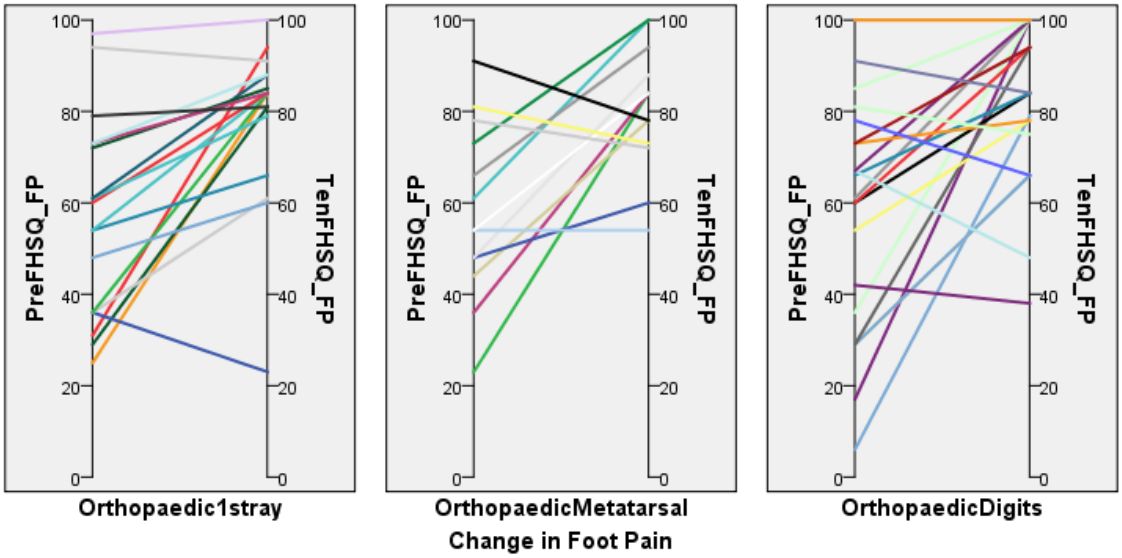
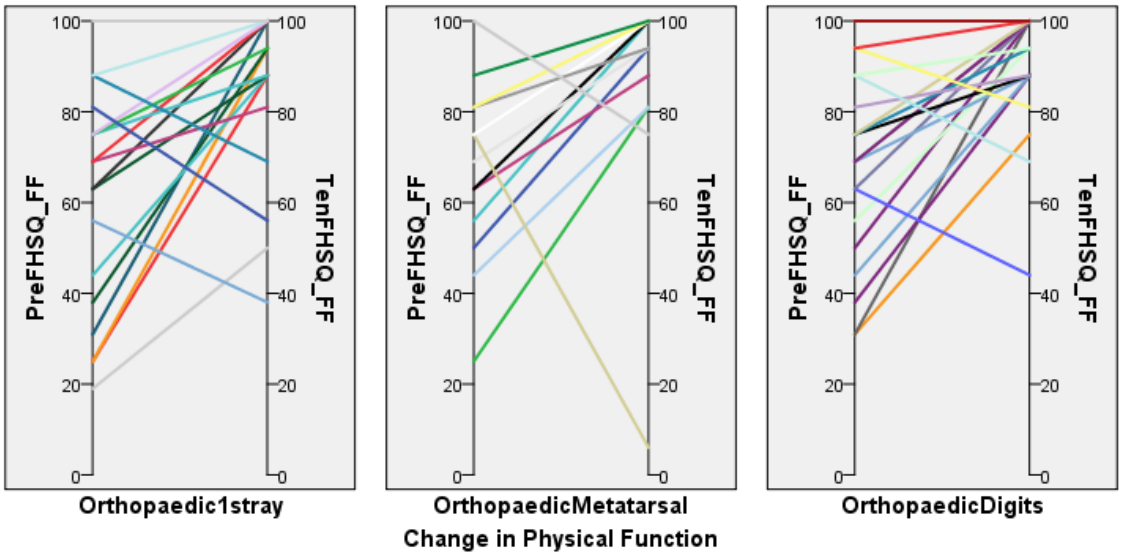


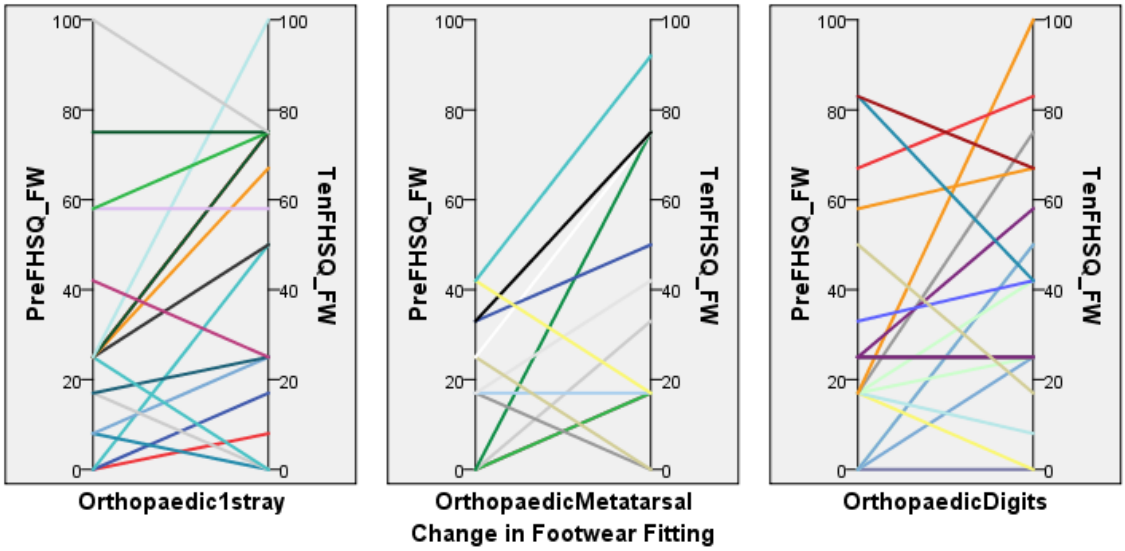
Figure 22 analysis on first metatarsal phalangeal joint problems and digital problems of an orthopaedic nature. In general with respect to foot pain these groups improved well, or at worst did not deteriorate in their level of foot pain. It is important to remember that these quality of life measures have a subjective dimension and hence can be a relative measure.

Figure 22 *first metatarsal phalangeal joint and Digital surgery "functional" outcomes*.



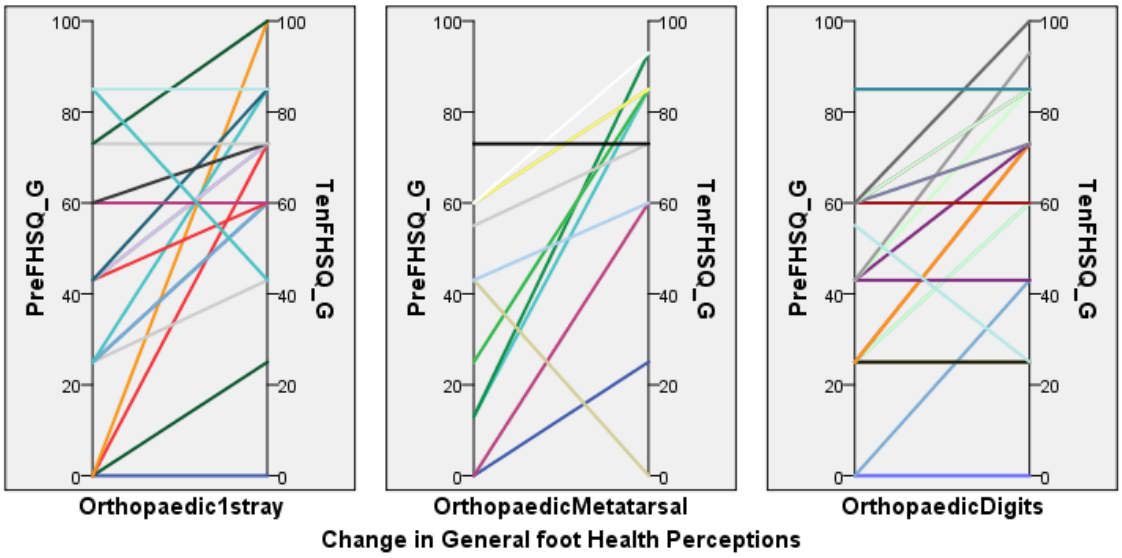
This figure identifies that a very small proportion of subjects (as represented by the downward sloping lines of greater than 10 points) possibly had a deteriorated health status one-year post operatively. As a proportion of the total cohort this property represents no more than 1to 2%. It is also important to bear in mind that this group also had multiple surgeries (ie some subjects were in all three groups).

Figure 23 *demonstrates the 10 to 12 month change in "footwear" related quality of life for the orthopaedic first metatarsal phalangeal joint surgery and digital surgery group.*



This cohort of subjects were shown to have a highly variable outcome with regard to their ability to obtain satisfactory footwear post operatively.

Figure 24 *demonstrates the 10 to 12 month change in general foot health perception related quality of life for the orthopaedic first metatarsal phalangeal joint surgery and digital surgery group.*

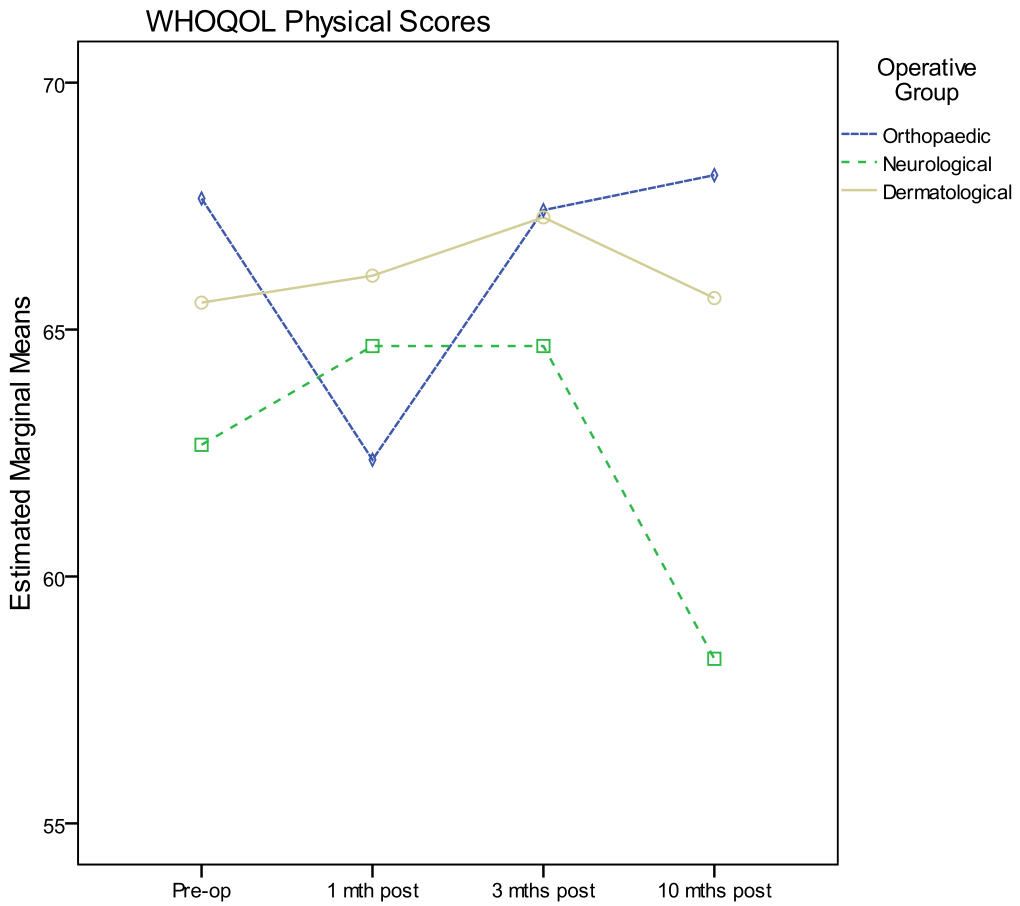


Only one patient who underwent first metatarsal phalangeal joint surgery for hallux abductor valgus and Digital surgery appears to have actually perceiving they were worse off after surgery. This tends to suggest the surgery overall is extremely successful by most standards.

7.5 Quality of Life Outcomes 10 to 12 months post operative

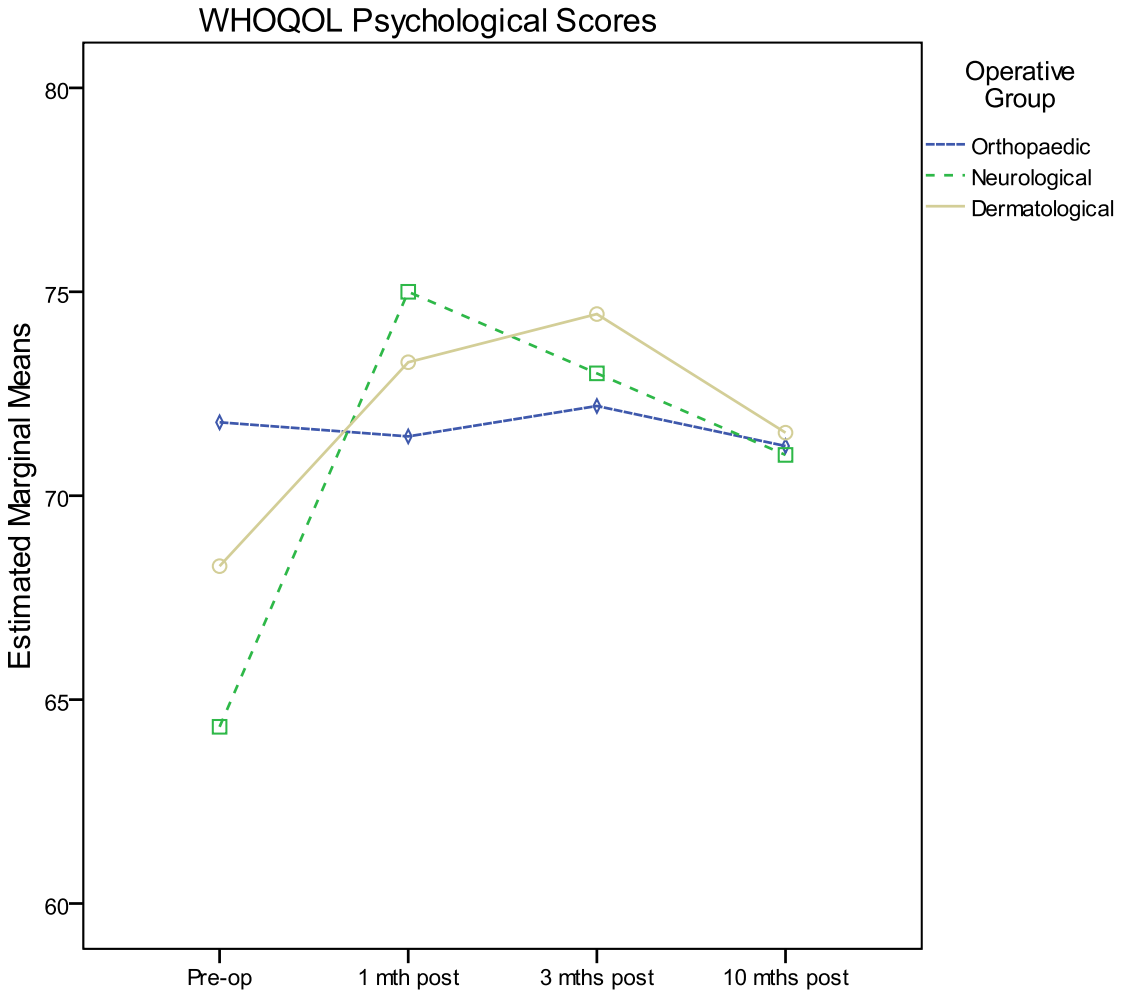
Figures 25 illustrates both the time trend and between group trends for the four domains in the WHOQOL scale over the four survey periods. Again, the higher the scale score (closer to 100) the better the health status.

Figure 25 *The WHOQOL physical scores for each group of patients over the four time periods.*



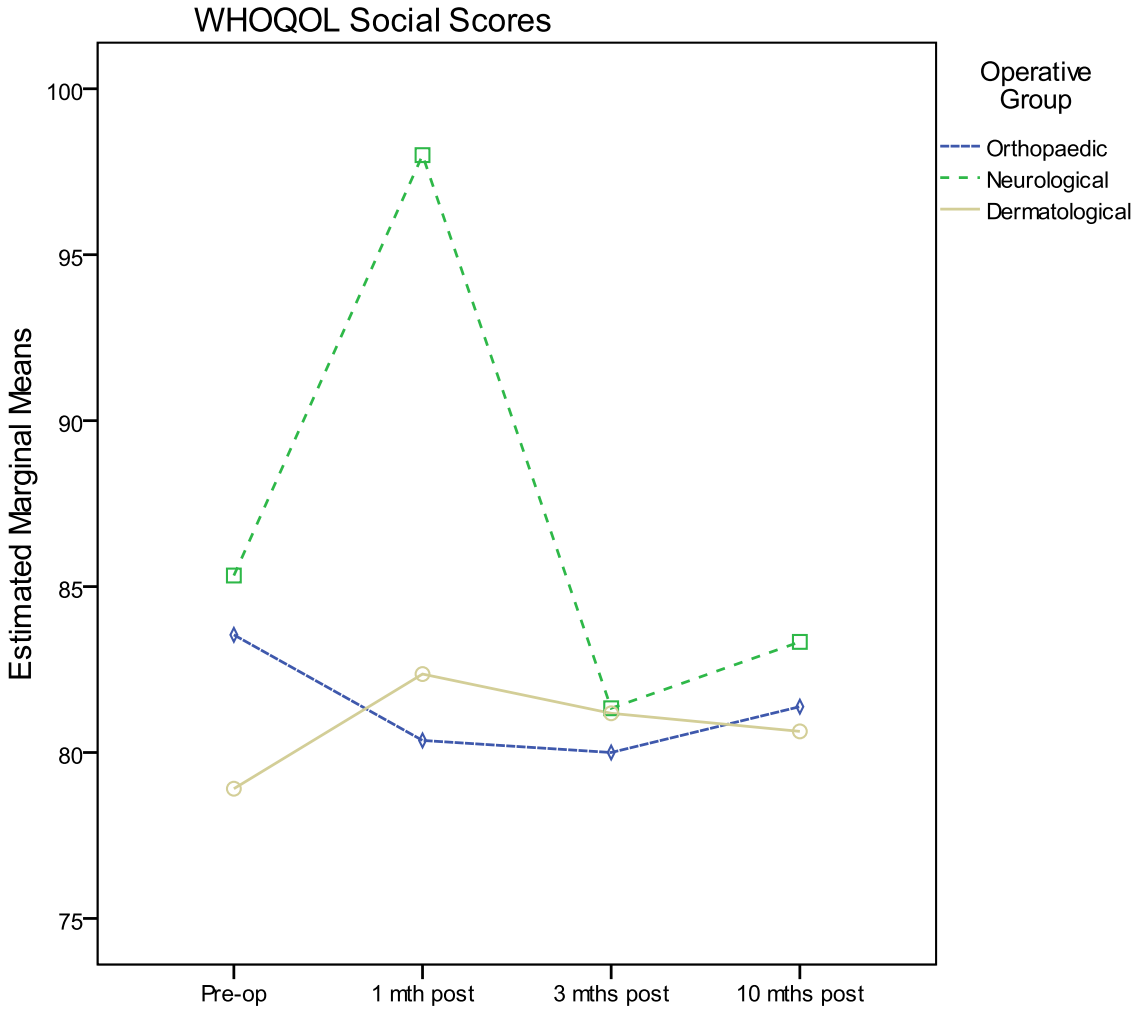
There were no significant time trend effect found over the four time period, F (3, 64) =0.58, p=0.32, and no differences between the type of operative groups on their physical scores over the four time periods were found, F (2, 66) =0.19, p=0.83,

Figure 26 *The WHOQOL psychological scores for each group of patients over the four time periods.*



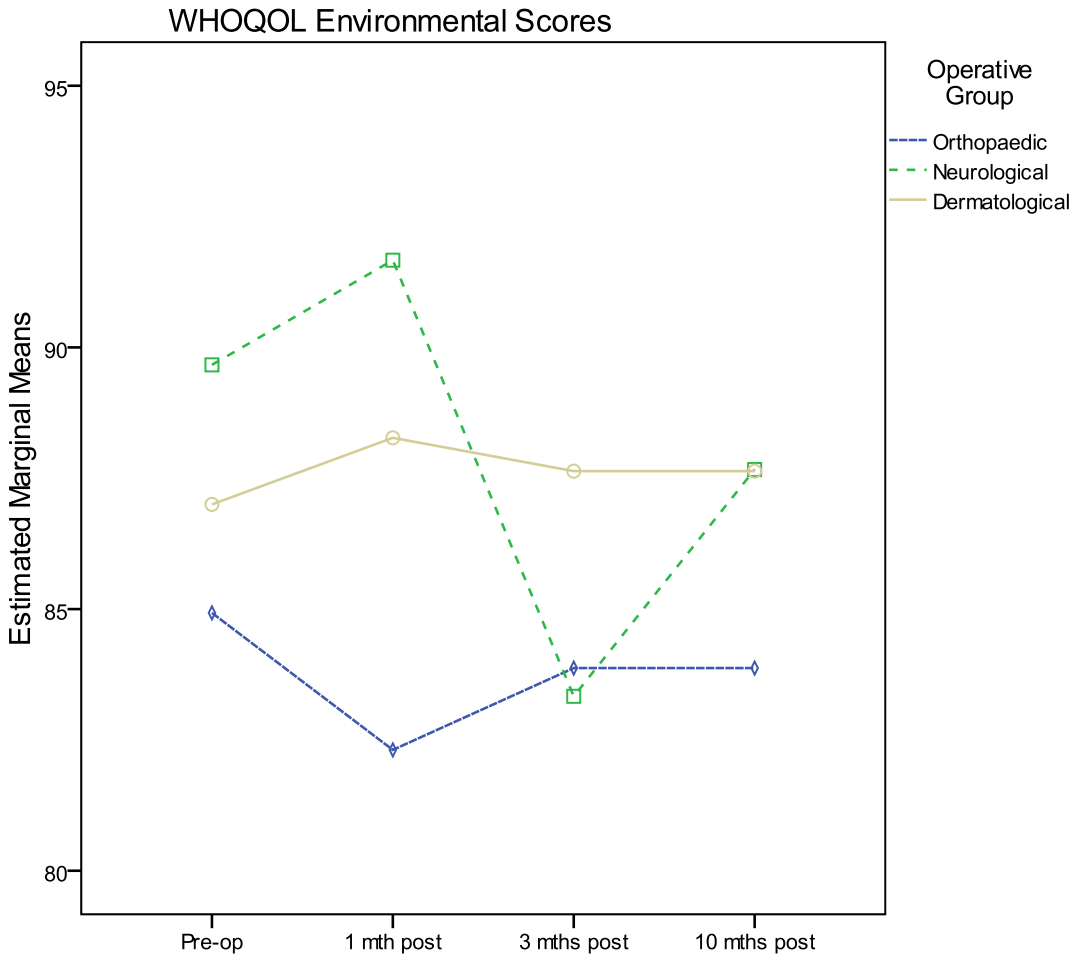
There were significant differences on the psychological scores over time, $F(3, 64) = 3.25$, $p < 0.05$. However, no significant differences were found across the three operative groups over the time period, $F(2, 66) = 0.02$, $p = 0.99$.

Figure 27 *The WHOQOL social scores for each group of patients over the four time periods.*



There were no significant time trend effect found on WHOQOL social scale, F (3, 64) =1.59, p=0.20, and no differences were observed between the three operative groups over the time, F (2, 66) =0.22, p=0.80.

Figure 28 *The WHOQOL environmental scores for each group of patients over the four time periods.*



There were no significant time trend effect found on WHOQOL environmental scale, F (3, 64) =0.8, p=0.5, and no differences were observed between the three operative groups over time, F (2, 66) =0.86, p=0.43.

8. Part 3: Qualitative feedback from podiatric surgeons

A qualitative feedback survey of the research experience and the use of an eHealth platform was undertaken. In essence the researchers were attempting to explore two main issues:

1. Identification of benefits of using an eHealth system.
2. General feedback of the experience including difficulties and problems experienced.

8.1 Identified Benefits of an eHealth approach to capturing patient outcomes:

A number of very clear themes emerged as benefits were identified from this novel approach to obtaining patient related health outcome data. These advantages included:

- The software program itself was identified as being very easy to use. Data entry was considered quite simple and electronic format saved time. There was also an element of versatility regarding the software i.e. individualscould complete in their own time. The software was easy to log onto and use.

- One of the strongest themes to emerge was the fact that good technical support was provided by both smart health and the University research team. Both sources of support were identified as being very helpful. The “on call” assistance was particularly identified as being beneficial. An example of the ease of interaction with service provider included the following comment;
    - "my practice manager was able to correspond and deal with matters pertaining to data collection and input with out having my involvement" and
    - "regular relevant communication on when to enter data".
    - "Good on call assistance".
    - "Support if we needed it".
    - "the communication with QUT was great".
    - "very helpful".

- The systematic data-processing and live data capture which obviates the need for duplication/doubling up on process was identified. This probably has implications for future research needs to be considered further by the team.

8.2 Difficulties and problems experienced:

Three important themes emerged regarding the difficulties and limitations of this project.

Firstly there were some minor, but persistent, issues of a technical nature regarding the smart health in platform. The most significant of these related to the ongoing up dates of the software which appear to occur on a monthly basis. Some conflicts between the computer cache and software updates occur. Examples of the comments included "updates that became available we had to chase up people for them. We were not pre-warned that the updates would have" and "we had some initial setup problems". Depending on the practice location (i.e. self employed private practice setting) or university-based setting, administrator privileges and some I T knowledge became an important factor in resolving these issues. These issues have been raised with the technological personnel of Smart Health.

The second area of concern related to methodological issues. These included factors such as:

- Patients not completing all the questions resulting in software algorithms for the foot health status questionnaire and WHOQoL measure not being able to calculate health status scores.

- Some patients not returning their surveys on time therefore invalidating data.

- Some initial issues regarding data entry procedures prove to be a little challenging.

- It was considered onerous to post hard copies of the questionnaire out to patients and then get them back. Some patients did not return their surveys on time. Patient compliance is known concern for these kinds of studies.

The third area related to some minor issue with consistency of descriptors for the classification of both the pathology and the surgical intervention. It was identified that there are different conventions for recording treatment. The two most prevalent are SNOWMED and the International classification of the disease (ICD 10) coding nomenclature. As part of this research it was necessary to attempt to gain consensus from the participating surgeons regarding the classification procedure and then work within the confines of the SNOWMED nomenclature used by the smart health system.

9. Summary and conclusion

Presented here is a proof of concept which demonstrates a new and innovative method for collecting real-time health related quality of life data. This is the first time a study of this nature has occurred with regard to measuring health outcomes associated with fellows of the Australasian College of podiatric surgeons using this method.

It would appear podiatric surgeons who practice in Western Australia achieve a high level of patient outcomes across a range of health domains. Achieving a reduction in foot pain, increasing patient's level of physical mobility, and improving their perceptions of overall foot health were achieved. This study revealed footwear related improvements in quality of life were more difficult to achieve. This provides the future direction for ongoing research. An extremely small proportion (approximately 1 to 2%) of subjects who underwent orthopaedic foot procedures in this study may have experienced lower levels of health outcomes as a consequence of surgery. It is unknown whether this would have been the likely outcome irrespective of the surgery, for example the natural history of the foot problems experienced.

The extensive nature of the surgery performed indicates a high level of skill would be required to meet these outcomes. Fellows appear to be able to deliver this care.

As the Australian population continues to age, an increase in foot related problems is likely to occur. Podiatric surgeons in Western Australia are well positioned to assist the health workforce meet this growing need in a safe and effective way.

10. Recommendations

- Attention to be drawn to assessing long term neurological outcomes in more detail.
- Potentially look for ways to improve the footwear related outcomes associated with orthopaedic surgery.
- Consideration be given by the Australasian College of podiatric surgeon to adopting an eHealth platform for the purposes of monitoring health outcomes at a national level.
- Expansion of the dataset to include variables other than health related quality of life such as: types of convocation is experienced, return to theatre, infection rates, complication rates, deep-vein thrombosis episodes and so forth.
- More generally, the podiatry profession could consider adopting similar techniques as outlined in this project for the use of assessing outcomes associated with other interventions. These could include foot orthotic interventions.

11. References

1. Hood IS, Kilmartin TE, D.R T: **The effect of podiatric day care surgery on the need for National health services chiropody treatment.** *The Foot* 1994, **4:**155-158.
2. Zammit GV, Menz HB, Munteanu SE, Landorf KB, Gilheany MF: **Interventions for treating osteoarthritis of the big toe joint.** *Cochrane Database of Systematic Reviews* 2010**:**7809-7809.
3. Farndon L, Barnes A, Littlewood K, Harle J, Beecroft C, Burnside J, Wheeler T, Morris S, Walters SJ: **Clinical audit of core podiatry treatment in the NHS.** *Journal of Foot and Ankle Research* 2009, **2**.
4. Osborne A, Glass L: **Personal Experiences of NHS QIS Online Audit for Podiatry.** *Scottish Medical Journal* 2010, **55:**44-44.
5. Orley J: **The WHOQOL: An International Development.** In *Managing and Measuring Health Outcomes; From Policy to Practice*; *1998; Canberra*. Edited by Sansoni J, Tilley L. Australian Health Outcomes Collaboration;1998
6. Garratt AM, Ruta DA, Abdalla MI, Buckingham JK: **The SF 36 health survey questionnaire: an outcome measure suitable for routine use within the NHS?** *British Medical Journal* 1993, **306:**1440-1444.
7. Bennett P, Patterson C, Wearing S, Baglioni T: **Development and validation of a questionnaire designed to measure foot-health status.** *J Am Podiatr Med Assoc* 1998, **88:**419 - 428.
8. Bennett PJ, Patterson C, Wearing SC, Baglioni T: **Development and Validation of a Questionnaire Designed to Measure Foot Health Status.** *Journal of the American Podiatric Medical Association* 1998, **88:**419-428.
9. Bennett PJ, Patterson C: **Psychometric Validation of the Foot Health Status Questionnaire: A New Quality of Life Measure.** In *18th Australian Podiatry Conference: Coming of Age*; *1998; Adelaide*. Edited by Council AP. Australian Podiatry Council; 1998
10. Bergner M: *DEVELOPMENT, TESTING, AND USE OF THE SICKNESS IMPACT PROFILE.* 1993.
11. Hunt SM, McKenna SP, McEwen J, Williams J, Papp E: **THE NOTTINGHAM HEALTH PROFILE - SUBJECTIVE HEALTH-STATUS AND MEDICAL CONSULTATIONS.** *Social Science & Medicine Part a-Medical Sociology* 1981, **15:**221-229.
12. Ware J, Snow K, Kosinski M, Gandek B: **SF-36 Health Survey Manual and Interpretation Guide.** 1993.
13. Ware JE, Snow KK, Kosinski M, Gandek B: *SF-36 Health Survey, Manual and Interpretation Guide.* Boston, Massachusetts: The Health Institute, New England Medical Center; 1993.
14. da Rocha NS, Power MJ, Bushnell DM, Fleck MP: **The EUROHIS-QOL 8-Item Index: Comparative Psychometric Properties to Its Parent WHOQOL-BREF.** *Value in Health* 2012, **15:**449-457.
15. **SPSS.** In *Book SPSS* (Editor ed.^eds.), 6.1 edition. City: SPSS Corporation; 1994.
16. Bennett PJ: **Prevalence and type of foot surgery performed in Australia: A clinical review.** *Foot* 2007, **17:**197-204.
17. Bennett PJ: **Types of foot problems seen by Australian podiatrists.** *The Foot* 2012, **22:**40-45.

18. Landorf KBRJ: **Minimal important difference: values for the foot health status questionnaire, foot function index and visual analogue scale.** *The foot* 2007, **18:**15 – 19.
19. Bennett PJ, Patterson C, Dunne MP: **Health-related quality of life following podiatric surgery.** *Journal Of The American Podiatric Medical Association* 2001, **91:**164-173.