



**International Society for Prosthetics and Orthotics
UK National Member Society**

2002 UK Annual Scientific Meeting

Marriott Hotel Liverpool 12-13 October

Free Paper Abstracts

Effects of Wearing Compression Shrinker Socks on Transtibial Residual Limbs

Presenter: *L. A. Burgess*, Superintendent Physiotherapist, Holderness Limb Fitting Centre, Charing Cross Hospital, Fulham Palace Road, London, W6 8RF Tel: 0208 846 1144 E-Mail: lburgess@hhnt.org.uk

Other Authors: *D. Bain, M. Ferguson-Pell*, Centre for Disability Research and Innovation, University College London

Following transtibial amputation it has long been established that reducing residual limb oedema and promoting wound healing are an important part of pre-prosthetic rehabilitation. Oedema reduction is necessary prior to casting for a prosthesis in order to achieve the best possible fit for the primary prosthetic socket. One of the most common methods for oedema reduction is the use of compression shrinker socks. To date there has been no quantitative research undertaken into the effects of wearing a compression shrinker sock on the microcirculation in the skin of the residual limb.

The aim of this study was to try and establish that wearing a compression shrinker on a transtibial residual limb does not impair skin microcirculation, measured in terms of skin blood content and oxygenation. The effect on the circumference of the residual limb was also investigated. Tissue reflectance spectroscopy (TRS) was the method used to measure skin blood content and oxygenation. A spectroscopic probe was developed which has two single 1 mm diameter polymer fibres with rounded ends which allow them to be pushed through the weave of the compression shrinker. Compression shrinker socks made by Juzo were used in this study.

Five sites on the skin surface of the residual limb were selected for the measurements of skin blood content (IHB) and oxygenation (IOX). These included three bony areas and two areas of soft tissue. Initial measurements of skin blood content and oxygenation and residual limb circumference were taken. The compression shrinker was applied and the IHB and IOX measurements were repeated at ten minute intervals for a total of fifty minutes. The compression shrinker was removed and the measurements were repeated including circumference measurements of the residual limb.

Eight subjects who had undergone transtibial amputation surgery were included in the study with a mean age of 67, 6 were male and 2 female. The results were analysed using an excel spreadsheet and paired t-tests. There was no statistically significant difference found between the IHB and IOX measurements before and after application of the shrinker or between the different sites selected i.e. bony or soft tissue. Although there was a very small increase in the percentage reduction in circumference of the residual limb pre and post application of the compression shrinker, this was also not found to be statistically significantly different. The sample size was small and the measurements were taken over a relatively short time period. Therefore there is potential for this study to be expanded. However, compression shrinkers used as in this experiment do not appear to impair skin microcirculation, measured in terms of skin blood content and oxygenation. Effects on IHB and IOX over bony prominences of the residual limb are not significantly different when compared to areas of soft tissue.

Evidence based practice in the use of lumbosacral orthoses in the treatment of low back pain

Presenter: *Laura A Johnson*, Orthotist, Peacock Medical Group, Peacock Medical Group Limited, Benfield Business Park, Benfield Road, Newcastle upon Tyne, NE6 4NQ Tel: 0191 276 9600 Fax: 0191 2769696 Email: peacockgrp@aol.com

Other Authors: *Paul T Charlton*, Senior Orthotist, Peacock Medical Group

Fabric lumbosacral orthoses are often used in the management of low back pain. Although many clinicians recognise their benefits, there is little evidence to support this. Some recent reviews of treatment modalities used for low back pain have not mentioned their use or have gone so far as to suggest they are of little value. There is also no consensus as to when best to wear such orthoses and a small pilot study found that different patients were given inconsistent recommendations about their use.

With these points in mind we have reviewed recent clinical publications and have undertaken a clinical audit of 100 orthopaedic outpatients who were prescribed a lumbosacral orthoses of this kind for the treatment of low back pain at Newcastle General Hospital post two years ago. The patients were contacted and asked to complete a questionnaire asking why the corset had been prescribed, what instructions they had received, when they used the corset, and whether they experienced any difficulties with it. Those who no longer wore the corset were asked why they had given up using it. Patients were also asked if wearing the corset had any effect on their symptoms. These results were then compared and have shown that instructions received about when to wear the corset differed widely. Most patients found benefit in wearing the orthosis. Problems with the corsets included being too hot, uncomfortable and donning the corset. Despite these problems, compliance was good.

A separate study was also undertaken of 50 patients seen by one common consultant at Newcastle General Hospital. This patient group was prescribed a fabric lumbosacral orthosis and placebo over a 3-month period. The patients were contacted when they received the corset and placebo and were then asked to complete a questionnaire 6 weeks later to determine whether the orthosis offers any advantage over the placebo. The results indicated that there is evidence that fabric lumbosacral orthoses are beneficial in the treatment of low back pain. It is believed this study highlights further areas for research, including studies to determine whether fabric lumbosacral orthoses relieve symptoms in clearly defined conditions such as degenerative lumbar spondylosis, so that prescription criteria can be improved.

The use of finite element analysis in the design of carbon fibre composite ankle foot orthoses

Presenter: *Stephen Osborne*, Orthotic Development Manager

Other Authors: *A Sharpe* Principal Prosthetist, *M J Jenkins*, *C Spence*, School of Engineering, University of Birmingham, B15 2TT

The design and manufacture of ankle foot orthoses (AFO) has changed significantly since plastic materials were first utilised, and many new designs have evolved. However, the shape of these devices has been to some degree limited by the material properties of the plastic. In recent years devices produced from carbon fibre composite materials have allowed new designs to evolve. Carbon fibre composite materials have many distinct advantages over plastics, structures are lightweight, stiff and strong. The mechanical properties of the structure can also be controlled by utilising an appropriate layup. These 'high performance' materials have the potential to improve the effectiveness of the AFO devices while continuing to be user friendly to the patient.

Laminate materials provide many more design possibilities allowing the Orthotist to control the mechanical performance of the AFO. However this new freedom can only be fully utilised if accurate information is available to allow the clinician to design a device from an evidence base. Previously, new designs of orthoses were in effect tested directly on the patients but this practice is no longer acceptable. To gain an insight into what effect differing laminate structures have on one design, an analysis of the effect of composite layup on mechanical performance (stiffness and strength) was carried out using classical lamination theory. In addition, a finite element analysis was performed on an AFO structure using data generated from the laminate analysis and the areas of stress concentration were found. This provides a basis for the development of a more quantitative link between material choice and patient need.

The use of computer aided design (CAD) and finite element analysis in the design of components is common practice in many industries including prosthetics. They have a number of advantages, which may have an application in orthotic design. Devices can be modelled within the CAD system and tests loads applied in a finite element analysis package. It is also possible to create a cyclic load on the component, which may highlight problems that a static load does not, for example fatigue failure. There are however problems with entering the complex curves that represent an AFO within the CAD environment, and the model can be highly inaccurate.

The tracer cad system was used to digitally capture a three dimensional image of a subject. This was then exported into a CAD program. The generated shape was then rendered and material properties were defined. To understand the likely forces and loading rates that the potential AFO was likely to be subjected to, gait analysis was performed. This information was then added to the finite element analysis package to provide the most realistic modelling of the working parameters expected of the device.

This process should allow construction of orthoses that are designed much more specifically for the patient needs being thinner, lighter and potentially more cosmetic than current devices. Risk management should be more effective and as experience develops new designs of orthoses may evolve.

Auditing the Skills of Graduate Prosthetists and Orthotists

Presenters: *Elaine Figgins & Sandra Sexton*, Senior Lecturers, National Centre for Training and Education in Prosthetics and Orthotics, University of Strathclyde, Curran Building, 131 St James Road, GLASGOW G4 OLS

The primary aim of the study was to find out how graduates of the BSc (Hons) Prosthetics and Orthotics course at the National Centre for Training and Education in Prosthetics and Orthotics perform within the clinical environment.

As limited information was available in the literature about the outcome of education for Prosthetists and Orthotists, a review of the literature in relation to the education of medical students and in relation to graduates in general was undertaken.

An audit tool in the form of a questionnaire was subsequently developed. A prospective audit has now been administered, with the audit measuring the performance of graduates with at least 1 year post graduation. The audit has been conducted for two consecutive years and the opinion of the graduate and their employer was sought via the use of a postal questionnaire.

The questionnaire used a combination of visual analogue scales and open comment to elicit opinion in four sections:

- Section 1 Clinical
- Section 2 Personal and Interpersonal Skills
- Section 3 Knowledge and Understanding
- Section 4 Skills/skills base

Results of the audit to date show interesting trends with both graduates and their employers indicating marked improvements in the perceived clinical performance of the graduate over the year following graduation. Further analysis of results reveal that both graduates and their employers rate all aspects of learning (knowledge and understanding) relatively well, but that certain aspects could be redeveloped.

The presentation will initially focus on the content of the evidence base and the development of the questionnaire. The presenters will then explain the results of the audit (audit returns for the current audit will be available from July 2002 and so results cannot be presented fully in this abstract). The results will be used to monitor graduate competence and inform undergraduate course development within the National Centre in the University of Strathclyde.

References:

1. CRYER P (ed).(1998). Developing postgraduates' key skills. In: Issues in postgraduate supervision, teaching and management. No 3. *The Times Higher Education Supplement*. P 2-4.
2. HARVEY L, MOON S, GEALL V, BOWER R (1997). Graduates' work: Organisational change and students' attributes – *Birmingham: Centre for Research into Quality*.

Assessment of the effectiveness of stock orthoses in assisting neuromuscular gait abnormalities

Presenter: *G Pearce*, Senior Lecturer, School of Applied Sciences, Wolverhampton University, Wolverhampton, West Midlands, UK.

Other Authors: *S E Farmer*, Research Physiotherapist, *J Whittal*, Physiotherapist, *R C M Quinlivan*, Consultant with Special Interest in Neuromuscular Diseases, Robert Jones and Agnes Hunt Orthopaedic and District NHS Trust

Introduction

Individuals with neuromuscular diseases present with gait abnormalities due to muscle weakness. In some neuromuscular diseases e.g. Charcot-Marie Tooth Disease, weakness of dorsiflexors leads to difficulty in swing phase with foot clearance. Clinicians attempt to provide assistance with ankle foot orthoses that assist ankle dorsiflexion. Recent clinical experience has shown that patients appear to benefit from the use of the lygaflex brace. This is an elasticated ankle support with straps which can be applied to limit inversion or eversion and plantarflexion.

Objectives

This preliminary study investigates the differences in walking speed of subjects wearing their own shoes alone, with lygaflex braces and with leafspring orthoses. It seeks user opinion on comfort and stability.

Method

Subjects with a diagnosis of a neuromuscular condition, difficulty in controlling their ankle position during walking and aged over 12 years were asked give informed consent to this study with local research ethics committee approval.

Subjects were timed walking 10 metres, five times with (a) shoes, (b) the Leafspring and (c) The Lygaflex. The order for each of (a) to (c) was randomised, in order to overcome order effect either with fatigue or a practise effect with each subject. Each subject rested for 5 minutes between each set of 5 walks. The time taken to walk 10 metres five times for each device was recorded. All data were collected on one day for each subject. Following the walks, the subjects were asked to complete a questionnaire, concerning the comfort, stability of the orthoses and preference.

Results

The 8 subjects (4 men and 4 women) ages range 14-63 years, included patients with Limb-Girdle muscular Dystrophy, Charcot-Marie-Tooth, Fascio-Scapulo-Humeral Muscular Dystrophy, Myotonic Dystrophy, and Hypo-proteinaemia-betalap.

The mean times for each subject's walk in shoes, lygaflex and leafspring is given in the table below. 4 subjects walked faster in shoes, 3 faster in lygaflex and one achieved the same speed in shoes and lygaflex. 7 subjects walked slowest in the leafspring.

6 subjects found shoes most comfortable and 7 found the leafspring the least comfortable. 7 found the lygaflex the most stable and the leaf spring the least stable. Subjects were divided as to their preference between shoes(3), the lygaflex(4) and leafspring(1). The subject who preferred the leafspring for comfort and stability was the only regular user of a leafspring but walked faster in the lygaflex.

Conclusion

Despite the few subjects, the results do indicate appear to indicate the limited utility of the stock leafspring splint. Users appreciated the stability of the lygaflex; perhaps with the use of a lycra garment this benefit could be more comfortably achieved. The use of orthoses for subjects with neuromuscular disorders warrants further study to optimise walking with comfortable stabilising orthoses.

	Shoes	Lygaflex	Leafspring
Subject1	7.60	7.86	8.17
Subject2	10.99	11.66	12.92
Subject3	10.10	9.30	10.20
Subject4	24.87	17.07	23.34
Subject6	8.89	8.59	9.94
Subject7	9.11	9.76	12.46
Subject8	7.81	8.02	8.58
Subject9	6.85	7.03	8.30

Table: Mean Times for each subject in each condition

A comparison of gait kinetics and kinematics for trans-tibial amputees with two different socket suspension systems.

Presenter: *Ian Harris*, Senior Lecturer, Sheffield Hallam University, Mobility and Specialised Rehabilitation Centre, Sheffield Teaching Hospitals, Northern Campus, Herries Road, Sheffield S5 7AT Phone 0114 256 1571

Other Authors: *Ben Heller*, Clinical Scientist, Sheffield Teaching Hospitals, *Dipak Datta*, Rehabilitation Consultant, Sheffield Teaching Hospitals, *John Howitt*, Prosthetist, Blatchfords Ltd. Sheffield.

Aims and objectives of the study

To establish normal ranges for gait parameters of below-knee amputees. Additionally, to see if two different socket fitting techniques lead to differences in gait parameters.

Methods

Gait analysis was performed using a six camera *Vicon* motion analysis system (Oxford Metrics Ltd, UK) with a Kistler force-plate (Kistler, Switzerland) on 41 adult subjects with unilateral below-knee prostheses. Twenty-seven subjects (mean age 51) used strap-suspended prosthetic legs with a patella-tendon bearing (PTB) socket and fourteen subjects (mean age 51) used silicon sleeve suspension systems with a total-contact socket (Iceross system, Ossur, Iceland).

Each subject was asked to walk at their preferred speed along a walkway in which a force-plate was buried. Strides without a single, complete foot contact over the plate were rejected. Tests were repeated until there was at least one acceptable trial for each foot.

Kinematic and kinetic parameters were calculated for each subject and were re-sampled so that each phase (initial double support, single support, second double support and swing) contained the same number of samples as the ensemble averages for those phases. The re-sampled gait parameters were then used to form a mean and standard deviation for each of 51 points during the gait cycle. Force parameters were normalised to body-weight prior to averaging.

Results

There were no significant differences in any gait parameters between the different socket designs so results for both socket types were combined. Average speed was 1.05 m/s. Peak ground reaction force was higher for the non-prosthetic leg (1.16 x bodyweight c.f. 1.03 x BW, significance < 0.1%). Stance-phase knee-flexion was higher for the non-prosthetic limb (18 degrees c.f. 10 degrees, significance < 0.1%). Swing phase knee flexion was similar for both limbs (61 degrees). Maximum extending moments generated by the knee during stance were less for the prosthetic limb (0.30mm x BW c.f. 0.75mm x BW, significance < 0.1%). The duration of the mid-stance extending moment generated at the hip on the prosthetic sides was increased for both socket types, and more power was generated at the hip during these periods for the prosthetic sides compared to the non-prosthetic sides (1.2 mW x BW c.f. 0.88 mW x BW, sig < 5%).

Conclusions

No significant differences in gait parameters were found between the Iceross and PTB socket types. The increased ground-reaction forces transmitted through the non-prosthetic side and the increased hip extending moment on the prosthetic side may be potential causes for concern.

The implications for gait of changing from a PTB to an IceX socket for trans-tibial amputees.

Presenter: *Dipak Datta*, Rehabilitation Consultant, Mobility and Specialised Rehabilitation Centre, Sheffield Teaching Hospitals, Northern Campus, Herries Road, Sheffield S5 7AT Phone 0114 256 1571

Other Authors: *Ben Heller*, Clinical Scientist, Sheffield Teaching Hospitals, *Ian Harris*, Senior Lecturer, Sheffield Hallam University, *John Howitt*, Prosthetist, Blatchfords Ltd. Sheffield.

Aims and objectives of the study

The socket is the crucial part of a prosthesis. The ICEX (Ossur, Iceland) and the Icelandic Direct Casting system allow the socket to be manufactured directly onto the stump. It has been reported to provide the advantages of a total surface bearing design such as improved comfort due to better pressure distribution whilst being easier to fit and to manufacture. However, the ICEX system component costs are considerably more than patellar tendon bearing prostheses (PTB).

Although studies have reported high levels of satisfaction with the ICEX socket in terms of comfort and security (Kahle 1999), there has been no formal assessment of the impact on gait. In light of the suggested benefits and the possible cost implications, a randomised controlled trial was undertaken to compare gait performance when changing from a conventional PTB socket to the ICEX.

Methods

Thirty trans-tibial amputees with an existing PTB socket requiring a replacement prosthesis consented to be involved in the study. They were randomised into an experimental group who were fitted with the ICEX socket and a control group receiving a PTB socket.

Prior to the fitting of the new socket gait analysis was performed using a *Vicon* 370 3-dimensional gait analysis system (Oxford Metrics Ltd, UK) and kinetic data was obtained from a force plate (Kistler, Switzerland). The gait analysis was repeated at 6 weeks after the fitting of the new socket. Temporal, spatial, and force symmetry parameters were determined to provide an overview of gait quality.

A total of 21 subjects (11 experimental and 10 control) completed the trial. There were no statistically significant differences between the two groups for age (mean 54.6 years), height (1.74 m), weight (83.2 kg) and time since amputation (10.3 years).

Results

Increase in parameter mean PTB-ICEX mean PTB-PTB significance (%) speed (m/s) 0.0290-0.04556-7 stride length (m) 0.0040-0.03526-3 cadence (steps/s) 2.5451-3.0040-5 temporal asymmetry 0.034-1.89718-3 spatial asymmetry 0.020-0.0249-9 force asymmetry 3.818-11.60056-9 non-pros knee moment (Nm) -0.056-0.18038-9 pros knee moment (Nm) 0.047-0.09410-5 pros stance knee flexion (degree) 2.6821-4.4342-7 pros swing flexion (degree) 2.7242-9.3196-1

There were no significant differences in any of the parameters

Conclusions

The study demonstrates no differences in the change in gait parameters between the PTB socket and the ICEX socket, which, in view of the cost implications would advise caution in the routine prescription of the ICEX compared to a PTB. However, it is important to realise that these findings relate to the group as a whole. The decision as to which type of socket to prescribe is a multifactorial one based on the individual characteristics of the amputee.

Reference

KAHLE JT (1999). Conventional and hydrostatic transtibial interface comparison. *J Pros. Orth.* 11(4),85-91.

The time and costs of fitting an IceX socket compared to a PTB socket.

Presenter: *John Howitt*, Prosthetist, Blatchfords Ltd. Sheffield, Mobility and Specialised Rehabilitation Centre, Sheffield Teaching Hospitals, Northern Campus, Herries Road, Sheffield S5 7AT Phone 0114 256 1571

Other Authors: *Ben Heller*, Clinical Scientist, Sheffield Teaching Hospitals, *Ian Harris*, Senior Lecturer, Sheffield Hallam University, *Dipak Datta*, Rehabilitation Consultant, Sheffield Teaching Hospitals, *Rose Martin*, Prosthetist, Blatchfords Ltd. Sheffield.

Aims and objectives of the study

The Ossur ICEX socket system is widely used for trans-tibial amputees and some of the claimed benefits have been reported upon. However the time and cost implications of supplying an ICEX compared with traditional socket systems needs further investigation. This study will help prescribers to make a more informed choice with respect to the financial and time implications of two different socket systems.

Methods

Twenty trans-tibial patients wearing patella tendon bearing (PTB) sockets on Endolite system were selected at random through our normal prosthetic clinics. Of these patients; eight received new PTB sockets with the same or similar prescription, twelve changed from their PTB socket to the ICE X system.

Both groups were allocated to one of two prosthetists trained in the use of the Icelandic Direct Casting system. The prosthetists timed:

- The taking of the PTB cast, setting up, and rectification of the cast.
- Preparation and casting the patient for ICEX.
- Technician's manufacturing time for the PTB and assembly/preparation of the ICE X.
- The walking / fitting trial completed by the prosthetist.

Frequency of visits for both systems post delivery for any adjustments/repairs over a three month period were also recorded. Labour and transport costs were not calculated in this paper, as these costs vary amongst different regional centres.

Results

The components for the ICE X are considerably more expensive (£744) compared to the PTB (£188). Times for casting, assembly, and fitting the ICE X (75 minutes prosthetist time, 25 minutes technician time) are less than for producing the PTB (105 minutes prosthetist time, 180 minutes technician time). Visits to the centre for post delivery adjustments/repairs showed no difference between the two systems.

Conclusions

The study indicates that the overall cost for supplying the ICEX system is considerably higher than the standard PTB system, even when the reduced time input is factored in.

Clinical use of silicone as a socket material for Through Hip and Hemipelvectomy patients.

Presenter: *S K Taylor*, State Registered Prosthetist, MBAPO, MISPO, RSLSteeper Ltd., Nottingham Mobility Centre, City Hospital, Hucknall Road, Nottingham, NG5 1PJ Tel 0115 960 6048 Fax: 0115 985 6539

Silicone is now widely used as a socket material in the UK for both transtibial and transfemoral patients. This has not been the case for through hip and hemipelvectomy patients, where leather has been the preferred socket material in England and flexible acrylic laminate in Scotland. We have several patients at Nottingham Mobility Centre who have not been totally happy with either of these options. Our consultant mentioned that she had seen silicone used as a socket material in Canada and suggested that this could be used as an alternative. This prompted the research of silicone as an alternative socket material.

Firstly a computer readout of all through hip and hemipelvectomy patients receiving a new socket for a modular prosthesis within the RSLSteeper organisation in the last twelve months was produced. This was done to identify what was currently being prescribed throughout the country for these levels of amputation. Secondly the Internet and prosthetic papers were researched. Thirdly several Canadian centres were contacted for information on silicone sockets. Once we had got a suitable silicone material and an idea of manufacturing technique, a few patients were approached and asked if they would like to participate in a trial. These were all volunteers who then signed an appropriate consent form, having the option to withdraw at any time without giving a reason.

It was found that 76 new sockets were made over the period Sept.2000 to Sept.2001 (twelve months) throughout the RSLSteeper organisation. They were made of the following materials.

Flexible Acrylic Laminate = 31

Leather = 30

Flexible Thermoplastic = 7

Silicone = 2 (Nottingham Mobility Centre)

½ Laminate Socket = 1

UNKNOWN = 5

It was noticed that there was a wide variation between different RSLSteeper branches as to which socket material was used with a slight preference for Flexible Acrylic Laminate in Scotland and a preference for Leather in England. RSLSteeper has no branches in Wales or Ireland.

It was found that these 76 patients were on the following modular limb prescriptions.

Otto Bock = 42

Quantum = 29

Endolite = 5

It was noted that Otto Bock components were used exclusively for the thirteen patients prescribed with new sockets in Scotland. In England the components varied considerably from branch to branch.

Research of the Internet produced three relevant Web sites and research of various medical libraries produced twelve relevant prosthetic papers.

Three Canadian prosthetic centres were contacted with various degrees of success. The Bloorview Macmillan Centre being particularly helpful provided a full manufacturing procedure for silicone sockets.

Up to now six silicone sockets have been produced at Nottingham Mobility Centre with one patient requesting a duplicate socket. All of the patient's are still wearing their silicone sockets the longest being nine months, with so far very good results. We have improved and modified the socket manufacture technique considerably as we have gone along. We now feel that our technique is as good or better than that used by the Bloorview Macmillan Centre. We have over the last few months proceeded with gaining ethical approval to run a more extensive trial with questionnaires and possible gait analysis.

Can existing clinical balance tools measure postural control post amputation?

Presenter: Mrs Anne Cowley, Senior Physiotherapist, Nottingham City Hospital Mobility Centre, Hucknall Rd, Nottingham NG5 1PJ Tel: 0115 9691169 ext 47535 Fax: 0115 9628052 Email: acowley@ncht.trent.nhs.uk

Other Authors: Dr Kate Kerr, Senior Lecturer, Division of Physio. Edu. Nottingham University, Dr Alan Sunderland, Reader, Dept of Psychology, Nottingham University

Background

Postural control declines with advancing age with 1/3rd of 65 year old community dwellers experiencing one or more falls in any one year. This rises to 50% of 80 year olds and injurious falls are a major cause of death in this population.

Most lower limb amputees are aged over 65 years old, present with a pathology of diabetes or peripheral vascular disease and fail to regain their prior mobility.

Amputees have a higher risk of falling than comparable non-amputees (Kulharni et al 1996) due to advanced age, pathology and physical loss of a limb. No research had been published on clinical measurements of postural control post amputation and few laboratory studies were identified. This project was the first to examine whether clinical balance tools used with other populations could be used with lower limb amputees in order to identify high risk individuals who would benefit from targeted balance interventions.

Aims and objectives

The aims of this study were to determine if clinical balance tools could measure postural control post amputation and to target balance interventions appropriately to reduce falls in this 'at risk' group. Objectives were to determine whether the Timed Up & go (TUG) and Functional reach (FR), were sensitive to change over time and reliable when used with amputees.

The study examined sensitivity and reliability of these tools when used with amputees

Method

The study design was repeated measures.

A convenience sample of 16 recent transtibial patients were measured twice on the selected tools (TUG, FR). Subjects were tested on the day of delivery of the prosthesis and again on discharge from rehabilitation, (approximately 4-8 weeks later). Use of walking aids and falls or 'near misses' were also recorded.

Results

The TUG showed change over time with all subjects' performance improving and this corresponded with a reduction in the use of walking aids. FR did not appear sensitive to change. Nearly all patients studied did experience at least one fall during the study time.

Conclusions

TUG is a simple performance test, which includes 'transfers' and a complete turn, both are occasions when falls commonly occur. TUG appears sensitive and reliable when used with transtibial amputees. It appears to be a promising tool to use in busy clinics. Further research is ongoing to determine appropriate balance interventions and more studies are required in this area.

Reference:

KULHARNI J, TOOLE C, HIRONS R, WRIGHT S, MORRIS J. (1996) Falls in patients with lower limb amputation: prevalence and contributing factors, *Physiotherapy* **82** 2 130-156

This study has been supported by the NHS Executive (Trent region) and BACPAR.

The Manufacture of Prosthetic Sockets Using 3D Printing Technology

Presenter: N Herbert, RDM Centre, University of Strathclyde, Glasgow, G4 0LS Tel 0141 548 3486 Fax 0141 548 3309

Other Authors: D Simpson, W Spence, Ion, University of Strathclyde

The most critical component of a prosthetic limb is the socket - the interface between the patient and the prosthesis. Each socket is a tailor-made device, designed to fit the unique geometry of the patient's residual limb. The socket must be carefully designed so that the patient is supported correctly and so that pressure is not exerted on sensitive tissues. It is the socket that determines the comfort and performance of the prosthesis and ultimately whether or not the device will be accepted and worn regularly.

Traditionally the design and manufacture of a prosthetic socket has been a manual process and this remains the dominant technique used by the National Health Service in the UK. This process relies on the use of plaster of Paris casts to capture the shape of the patient's residual limb and then moulds and artisan fabrication techniques to manufacture the socket. This process has several disadvantages. The plaster casts and moulds are destroyed during the process and so there is no permanent record of the patient's limb geometry. If subsequent sockets are required the entire process must be repeated from the beginning. The process is labour-intensive and can be messy.

Advances in computer-aided design and manufacture (CAD/CAM) technologies have helped to overcome some of the shortcomings of the traditional process. However, despite these advances the final manufacture of the prosthetic socket is still performed manually in the traditional manner.

In an attempt to address the problems associated with both traditional and CAD/CAM methods, several groups have investigated the use of Rapid Prototyping (RP) technologies for the manufacture of prosthetic sockets. RP is a relatively new class of manufacturing technologies which create physical models directly from 3D computer data. Using RP it is possible to create parts of almost limitless complexity both quickly and economically.

Previous research into RP has focused on expensive, high-end technologies such as Selective Laser Sintering, Fused Deposition Modelling and Stereolithography. Although it has been shown that such technologies are able to produce comfortable and functional sockets, the high-costs and facilities needed for such systems mean that it is unlikely that they will become viable alternatives to existing techniques.

The authors have investigated the use of a cheaper, low-end RP technology known as 3D Printing for the manufacture of prosthetic sockets. Models produced using 3D Printing are typically used only for visualisation purposes where mechanical properties are not important. However, our research has demonstrated that 3D Printer models may be infiltrated with polymers and reinforced to increase their strength and create functional components.

Comfortable prosthetic sockets have been manufactured and used in preliminary trials with patients.

Predictors of prosthetic fitting, use and recovery following lower limb amputation: illness related cognitions, attitudes towards prosthetic use, psychological distress and functional limitations.

Presenter: *B Callaghan*, Research Fellow, National Centre for Training and Education in Prosthetics and Orthotics, University of Strathclyde, Curran Building, 131 St. James' Road, Glasgow, G4 0LS Tel: 0141-548-3116 Fax: 0141-552-1283
Other Authors: *E Condie*, Senior Lecturer, SPARG Chairman, NCTEPO, University of Strathclyde *M Johnston*, Professor of Psychology, School of Psychology, University of St Andrews

Introduction

Approximately 700 primary lower limb amputations are performed each year in Scotland, with 50% of these patients being prescribed a prosthesis. No evidence-based criteria are employed to inform the prescription process. Amputee rehabilitation is focussed on improving function (mobility, independence) but not psychological distress (anxiety and depression).

Results from pilot studies

Callaghan *et al.* (2001a) indicates that 40% of transtibial amputees do not use, or only occasionally use their prosthesis. The reasons for this non-use are unclear. Callaghan *et al.* (2001b) found that quality of life correlates stronger with mental health ($r = 0.56$) than physical health ($r = 0.12$) in transfemoral amputees. Amputees also self reported that they feel psychological outcomes are influenced by their amputation but not addressed by healthcare services. Psychological variables have been shown to predict rehabilitation and health outcomes in other physical conditions.

Aims and objectives of current study

Our longitudinal predictive investigation seeks to test the role of illness related cognitions (patients' beliefs about their condition), attitudes towards prosthetic use, psychological distress and functional limitations in predicting a) being prescribed a prosthesis b) subsequent prosthetic use and c) recovery following lower limb amputation.

Methods

The study sample comprises a 12-month cohort of lower limb amputees undergoing post-operative rehabilitation therapy at six Scottish Centres. Patients must be fifty years of age or over, fluent in English and pass a screening test for cognitive and communication problems. The primary aetiology of amputation must be peripheral vascular disease. The Research Fellow and Senior Physiotherapist on site will share responsibility for data collection of the predictor variables at between 3-4 weeks post-operatively. At 1 and 6-months post-discharge from rehabilitation a member of The Murray Foundation, who is also an amputee, will conduct follow-up assessments.

NHS Implications

It may be possible to introduce psychological assessment measures to assist with informing the prosthetic prescription process. Some amputees are submitted to an arduous rehabilitation program with a prosthesis who may be better served by rehabilitation aimed at increasing adaptive coping skills without a prosthesis.

Knowledge of the predictive relationships between psychological variables and outcomes will have the potential to impact on service delivery by informing the development of new ways of treating patients with the aim of increasing the numbers of those patients a) making effective use of their prosthesis and b) achieving successful rehabilitation and health outcomes.

Methods of treating patients, in individual or group settings, could range from pre-operative written communications to hospital or home-based exercise programs to nurse led counselling programs, all aimed at influencing psychological predictor variables to maximise rehabilitation and health outcomes.

We have the ideal vehicle with which to implement positive change in a systematic and coordinated fashion and make routine follow-up assessments through the well established SPARG (Scottish Physiotherapy Amputee Research Group) and ReTIS (Rehabilitation Technology Information Service) networks and by means of the postgraduate courses for relevant healthcare professionals run by the NCTEPO. We also intend to organise local workshops for physiotherapists and healthcare professionals involved in amputee rehabilitation at regional centres.

What Influences Prosthetists Transfemoral Socket Fitting Practice?

Presenter: *Richard R Hirons*, Prosthetist, Össur Europe, PO Box 120, NL – 5690 AC Son & Breugel, The Netherlands
Other Authors: *Richard Nieveen, Ian Massey*

The Audit Commission Report 'Fully Equipped' (2000) suggested there was still a level of user dissatisfaction in the prosthetic service, similar to that recorded by McColl (1986). In a healthcare environment where clinical practice should be evidence based, this study identifies one area of prosthetic practice where user dissatisfaction is thought to be high – transfemoral socket fitting. There are many recognised prosthetic issues that can affect user outcome. Additionally there are previously un-researched areas including professional and political issues that may also affect user outcome.

This study investigates potential factors that influence a prosthetists choice of casting method and socket design for transfemoral prostheses. The total population of 253 practising prosthetists were surveyed by questionnaire, generating 211 valid returns. Ten follow-up telephone interviews were conducted to assist with questionnaire validation and analysis.

The results suggest that 'hand cast' generated 'ischial bearing' sockets are the prosthetists preferred choice, despite subjective evidence that suggests 'ischial containment' sockets offer users greater socket comfort and prosthesis control. Of the influencing factors investigated, only 'employer' and 'time since qualification' showed any difference in trend from the total sample population. One employers prosthetists illustrated a preference for 'brim casting' methods, while another showed an equal preference for 'CAD' and 'hand casting' methods. Recently qualified and long term qualified prosthetists stated a preference for 'brim casting' methods, while 'hand casting' appeared to become less popular with an increase in time since qualification. Interview data revealed influence related themes affecting decision making such as 'equipment availability', 'routine', 'time saving' and 'contractual issues'.

The study identifies statistically significant variance in practice. With reference to a prosthetists employer, it is unclear whether the employer influences practice, or whether it is 'association' with an employer that either provides opportunities or barriers to practicing certain data capture/casting methods and socket design. Regarding time since qualification, it's possible to speculate why brim casting appears more popular with recent and long-term graduates, but ultimately calls for further investigation into this whole area. It is questioned whether any of these influencing factors could be related to user satisfaction issues. Additionally, the role of the professional body is challenged in light of Government initiatives requiring that such practice be evidence-based and in accordance with clinical guidelines that indicate best practice.

Water Activity Limbs

Presenter: *Dr R S Hanspal*, FRCP FRCS, Consultant in Rehabilitation Medicine, Stanmore Disablement Services Centre, RNOH Trust, Brockley Hill, Stanmore, Middlesex HA7 4LB

Other Authors: *Mr R Nieveen*, SRPros, MBAPO

The Government White Paper stresses that clinical practice should be evidence based. With advances in technology, there is increasing availability of Water Activity Limbs (WALs) and subsequently a greater number of requests for their provision. However, there are no agreed criteria or indications for their prescription. The study aims to establish a national consensus for indications and recommend procedures for prescription of WALs.

Method

The study, conducted in three parts, consisted of the retrospective study of the records of all known patients at Stanmore Disablement Services Centre who had been prescribed a WAL, followed by two questionnaires sent to 40 doctors, senior prosthetists and therapists each. The first questionnaire was a list of tasks or activities for the respondents to record their personal rating for prescription of each of the indications. Following analysis of the responses, a list of clinical indications as guidelines and procedures was sent to the same 120 professionals, enquiring whether they agreed or disagreed to each recommendation. The results were analysed to prepare a guideline of clinical indications and recommended procedures for prescription of WALs.

Results

The result of the retrospective study showed that most of the WALs were prescribed for non-specific reasons as a showering or swimming prosthesis. Two thirds of the prosthesis were never seen in the rehabilitation centre after delivery, either for repairs or adjustments. Most of the others notified abandoning its use. Only one patient had a refit.

The task oriented questionnaire (91/120 responses) showed that more than 50% of respondents considered occupation where the feet were either fully or partially/temporarily wet and windsurfing as absolute indications. Other activities where the 'mode' was an absolute indication but in less than 50% were swimming once or more than once a week, all other water sports, beach activity more than 12 weeks per year, associated disability which made simple water activity or leisure a risk hazard without a WAL. Occasional swimming and beach activity were only considered as possible indications. Showering was not considered an indication.

The results of the first questionnaire also showed a significant variation in the opinions of different professional disciplines with the physiotherapists and prosthetists most likely to prescribe WALs. Occupational therapists and doctors appeared to be more discerning in their prescription.

The second questionnaire (83/120 responses) showed an overwhelming agreement to most of the clinical indications recommended except social reasons for leisure, even if there is a health and safety risk.

Similarly there was an overwhelming agreement to the procedures recommended. The only concern was about the feasibility of demonstrating an appropriate prosthesis at the consultation. Only three respondents did not agree that all centres should have a written policy relating to WALs.

Conclusion

The authors present recommendations for prescription of WALs as guidelines and procedures based on the above national consensus amongst peers. They also recommend a process of establishing evidence in a speciality where there is very little written evidence to recommend clinical practice.

Regional Clinical Specialist, Physiotherapy, Amputees: Is there a role?

Presenter: *M J Cole*, Physiotherapist, Physiotherapy Department, King's College Hospital (Dulwich), East Dulwich Grove, Dulwich, London, SE22 8PT Tel: 0207 346 6207

Other authors: *J Anderson*, Physiotherapy Manager, King's College Hospital, *M Boase*, Therapy Services Manager, King's College Hospital NHS Trust, *J Brown*, Therapy Services Manager, St George's Hospital NHS Trust, *C P Bithell*, Head, Physiotherapy School, St George's Hospital Medical School and Kingston University's Faculty of Health and Social Care Sciences

Overview: This paper describes an innovative project that aims to develop, evaluate and ultimately establish a new model of providing physiotherapy expertise within the field of amputee rehabilitation.

Background: Clinical Specialist physiotherapists (CS) are in post supporting medium to large sized teams in many hospital Trusts across the country. The CSs have a key role in introducing evidence based practice, analysing training needs, providing on the job training, and developing clinical standards. However there are many physiotherapists who do not have access to a relevant specialist because either the team is small, the clinical caseload is small or because of funding issues. To address this the post of Regional Clinical Specialist (RCS), Amputees, has been developed by London physiotherapy managers and funded by the South East London Workforce Confederation.

Aims: The principal aim of a peripatetic CS for amputees is to improve the quality of care to this speciality through clinical support and education. The purpose of the project is to develop models of support enabling optimal service provision that might be taken forward to other regions, and that could be used to inform provision for other professionals.

Method: The process has involved regular visits to each participating London Trust, supporting and working alongside 'isolated' physiotherapists. Following needs analysis of each physiotherapist and amputee service, various tools have been developed to facilitate and structure continued support. The RCS role within each Trust has evolved and become established, with support extending to other members of the Multi Disciplinary Team.

Assessing effectiveness: The project has been evaluated in collaboration with the School of Physiotherapy at St George's Hospital Medical School and Kingston University's Faculty of Health and Social Care Sciences. Evaluation has occurred throughout the project by the RCS, developing the role in relation to changing needs, and more formally, via satisfaction surveys and semi-structured interviews for clinicians, therapy managers and patients.

Findings : Preliminary findings indicate that the role of the RCS is effective and makes a real difference to the quality of care for the amputees within the participating hospitals. The physiotherapists state that they are less 'isolated', their knowledge base has increased, and their competency to practice has improved. Managers appreciate that their amputee physiotherapists receive peer support, and value the contribution that the RCS makes in relation to Continual Professional Development and towards government driven policies. Patients appreciate the presence of an 'expert' taking interest in their care and are reassured that best practice is being provided.

Implications: Project findings will be communicated to managers in the London region via a conference, and a full report will be documented at the end of the project in September '02. The proposed models of input will be presented in terms of their applicability to different service settings so that managers may select the most appropriate model. This information can be used as a basis for Trust collaboration in the recruitment of RCS physiotherapists or even Regional Consultant physiotherapists.