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FREE PAPER ABSTRACTS

Title: The Effect of Rigid Ankle Foot Orthoses on Knee Alignment and Muscle Recruitment during Stance Phase in Early recovery from Stroke

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Due to time and resource constraints, this study was carried out as two studies, however all data was collected simultaneously from the same subjects with all instrumentation in situ for the duration of the studies.

The evidence for the use and effects of Ankle Foot Orthoses (AFOs) in early stroke is lacking. This pilot study considered the effect of rigid AFOs on knee angle, alignment relative to ground reaction force vector (GRFV) and electromyography (emg) activity of vastus medialis and vastus lateralis on a group of nine subjects within thirty two weeks of having a stroke.

Both studies are of A B cross over design with randomisation of intervention. Subjects were within thirty two weeks of suffering a stroke and presented with full knee extension in stance. They were able to walk up to ten metres with the use of walking aids but safety supervision only from the therapist. Details of the subject group will be presented.

Subjects attended the gait laboratory where they walked six metres with and six metres without a rigid AFO, the order of which was randomised. A force plate linked to an ORLAU video vector system was embedded in the walkway, only walks which produced a clean strike of the effected side were recorded for analysis, the results of which were averaged. A single frame was selected for analysis with and without AFO. This was the point immediately after toe off on the unaffected side, the reliability for frame selection was tested. Knee angle was measured from the frame and alignment relative to GRFV was recorded as in front of the knee joint axis or level or behind it. This has relevance to the turning moment induced by GRFV as if passing behind the knee it will induce a hyperextension moment and if passing level or in front of the knee will induce either a flexion or no turning moment.

A statistically significant change in average knee angle of 10.87 degrees into flexion was recorded. A statistically significant change of alignment relative to GRFV was also apparent. These changes are clinically significant as they make sufficient change to subjects that posture and performance may also improve however further work is required to fully qualify and quantify those functional effects.

Title: The Silicone Ankle Foot Orthosis (SAFO), a new generation in Orthotics

Presenter: Matthew Hughes, Orthotist/Prosthetist
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This paper is an introduction to a new and exciting development in the world of Orthotics the Silicone Ankle Foot Orthosis (SAFO). The idea of the paper is to outline the concept of the SAFO including patients treated, indications and a summary of the research carried out to date.

The presentation discusses five Cerebral Palsy patients that have been part of an ongoing case study through Yeovil NHS Trust in the UK over the last 12-18 months, looking at visual clips, clinical outcomes and experiences and patient feedback.

The SAFO is a total contact silicone orthosis incorporating the foot and lower limb, it is reinforced down the anterior aspect of the leg and onto the dorsum of the foot, thus lifting the foot from above, as opposed to pushing from underneath as per traditional rigid AFO's.

Due to the total contact around the foot and ankle it gives support without interfering with normal biomechanics and the proprioceptive feedback is that things feel normal and the patient has control over their foot/feet.

Each SAFO is bespoke to a cast of the individual patients limb. A negative cast is taken ideally with the foot in approximately 0-5 degrees dorsiflexion. The positive mould is then reduced to set measures. Individual specifications are chosen by the orthotist e.g. No of straps, colour & reinforcements. Each SAFO is manufactured entirely from silicone.

Cerebral Palsy Trial 2004-2005

The trial, conducted over 12 months between October 2004 and October 2005, examined the clinical and functional benefits of using the Silicone Ankle Foot Orthosis (SAFO) as an alternative to the more traditionally prescribed rigid Ankle Foot Orthosis in children and young adults aged 7 – 16.

The Senior Paediatric Physiotherapist from Yeovil NHS Trust in the UK selected all patients. The children presented as follows:

- High –Tone Rt Hemiplegic, aged 12.
- Low – Tone Diplegic, aged 12.
- High – Tone Rt Hemiplegic, aged 12.
- Spastic Diplegic, aged 7.
- High – Tone Rt Hemiplegic, aged 16.

All patients attended our Orthotic clinic in Ringwood UK to be assessed and cast/measured for the SAFO's, following this the deliveries and all reviews were also held at the clinic. All the patients chosen had worn a variety of orthotics in the past with mixed results.

The patients were filmed and monitored before and after fitting of their new SAFO's and at 3 monthly intervals over the 12-month trial in order to record the mobility and behaviour change. Video footage of these stages is available. Key measurements and observations for all participants were taken under the following indicators:

- Range of active and passive foot movement.
- Body posture.
- Gait.
- Balance.
- Walking speed and endurance.
- Skin condition.

(All of which will be discussed in more detail during the presentation)

Each of the 5 patients taking part in the trial showed significant improvements against each indicator. Children were able to go up and down stairs and take part in sports and play activities in a way that had not been possible with any previous treatment.

Importantly, compliance was 100%, with each child happily wearing the SAFOs daily in school/college.

At the initial assessment for all of these patients there were question marks raised by many as to the appropriateness of the SAFO as a treatment plan, however the patient and parent testimonials in conjunction with the observed differences from a clinical perspective using video data and clinical tests has served to show that the SAFO does indeed have a place in the treatment of patients suffering from differing forms of Cerebral Palsy.

This is undoubtedly a small group of children and further research needs to be done to quantify the observed improvements during this 12-month period nonetheless a new era in dynamic orthotic splinting is upon us. Minimum orthotic input, to allow maximum functional output.

Title: **The effect of shoe sole thickness on lower limb muscle activity**

Presenter: D Wallace, Medical Student, University of Dundee, Mr

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Introduction: The purpose of this study was to quantify the effect of shoe sole thickness and style on lower limb muscle activity as a follow on to the work by Kerr (2005) which showed that footwear was an independent risk factor for ankle injury. Electromyography (EMG) recording of peroneus longus muscle activity following sudden controlled forced inversion of the foot was collected from 34 healthy participants (24 men and 10 women, mean age 26.8, SD=7.7, UK shoe sizes 4 to 11).

Methods: Five shoe conditions were tested: (a) standardised test shoe with parallel heel; (b) the standard shoe with a 2.5 cm shoe sole adaptation; (c) the standard shoe with a 5 cm shoe sole adaptation; (d) a flared heel training shoe; and, (e) a high-top army boot.

Barefoot conditions were also tested. The study was a matched design with the same subjects acting as their own controls, carried out as a crossover study. A two-footplate computer controlled tilting platform was used to force sudden inversion the participants' left and right feet through a series of randomised movements up to 20°. Repeated measures ANOVA was conducted to analyse in-subject differences.

Results: The results of this study confirmed that footwear negatively influences the requirements of lower limb muscle activity by increasing the muscle force necessary to overcome the moment of inversion. Analysis of the EMG data of the peroneus longus muscle showed that the response time of the muscle is not altered when wearing shoes compared to barefoot, or when shoes of varying thicknesses and styles are worn. However, there was a significant increase in muscle contraction in response to inversion when wearing shoes with thicker midsoles adaptations of 2.5 cm and 5 cm respectively.

Conclusions: An increased muscular response indicates a greater effort required to stabilise the foot-ankle complex. This places the foot at more risk of injury. The findings of this study suggest that no additional protection is offered by heel flare or high-top footwear. Shoes with thinner soles are preferable to minimise the effects on lower limb muscle activity and to reduce the risk of lateral ligament injuries. Further research is currently ongoing to determine the effects in diabetic subjects whom were shown to suffer from muscle dysfunction by Abboud et al. (2000).

References:

“Shoes Influence Lower Limb Muscle Activity and May Predispose the Wearer to Lateral Ankle Ligament Injury”. Presented at the International Society of Prosthetists & Orthotists, 4th - 5th November 2005, Swindon, England, UK. R Kerr, G P Arnold, T S Drew, L Cochrane, R J Abboud

“Lower Limb Muscle Dysfunction May Contribute to Foot Ulceration in Diabetic Patients”. *Clinical Biomechanics* (2000), **15**(1), 37-45. R J Abboud, D I Rowley, R W Newton

Title: Do running shoes go the distance?

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Introduction: Running shoe manufacturers suggest that you should change a pair of running shoes every 300 miles. This study aimed to investigate whether the cushioning capabilities of more expensive running shoes are more durable than cheaper alternatives and do running shoes provide enough protection from impact force after 300 miles of wear.

Methods: Three pairs of neutral UK size 10 running shoes from three different manufacturers were purchased at three different price ranges; low (£40-45); medium (£60-65) and; high (£70-75). The right shoe of each pair was tested in a universal testing machine that simulated 300 miles of wear. The left shoe was not tested. After testing, plantar pressure was recorded in both shoes from 12 subjects (mean age 26.3, SD=10.2) using the Pedar[®] in-shoe pressure measurement system, over approximately 15 footfalls.

Results: Midsole stiffness increased with wear. Mean peak pressure was relatively lower in most of the tested shoes. No significant difference in mean peak pressure was observed after 300 miles with respect to brand and cost. In the majority of shoes tested, mean instant of peak pressure occurred significantly earlier in medium and high cost shoes than low cost shoes.

Conclusions: Decreasing mean peak pressure with increasing midsole stiffness may be accounted for by a change in foot and leg kinematics. A cheap running shoe is as good (if not better) than a more expensive running shoe. No brand of shoe provided superior durability of cushioning.

Title: **Amputee self alignment using a patient adjustable heel device**

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Aims and Objectives

Both clinicians and amputees have long requested an ability to be able to make quick and convenient adjustments to heel height alignment to accommodate different shoes without resorting to a second prosthesis. Adjustment to make standing more comfortable and repositioning the foot for sitting cross legged are further advantages brought by an ability to re align the prosthetic foot. As shown by biomechanical study (Pinzur et al. 1995) minor differences in alignment can have a significant impact on the gait patterns produced and thus the quality of life of an amputee. Until recently having an adjustable heel height capability at the prosthetic foot either dictated foot selection or inconveniently required removal of the shoe and hand tools to make adjustments. A simple patient adjustable heel (PAH) device has been developed which enables alignment adjustment without doffing and donning shoes and allows amputees to keep using their preferred foot. Over 20 amputees participated in trials of these devices expressing a life transformative impact on many aspects of daily life. This paper discusses the impact on quality of life and the biomechanical and practical issues raised by facilitating amputee self-alignment.

Methodology

While the impact of the PAH device was conceived to address practical needs rather than biomechanical needs quantitative evaluation of function is largely drawn from amputee feedback. Extensive clinical trials were carried out where the performance and impact of the PAH on the users life were evaluated mainly by questionnaire and interviews. Selected patients were allowed to align their prosthesis and using gait analysis it was possible to quantify the biomechanical impact of the different alignment.

Summary and conclusions

So far the trial results indicate that users find making the PAH adjustments simple, quick and easy to learn. The results also show that users can satisfactorily self align their own prosthesis to achieve comfortable gait. Several amputees expressed a major impact in their life style when during the middle of night they need to put their leg on for using the bathroom. Based on the overwhelmingly positive feedback it is clear that the PAH is transforming the lives of the amputees who have tested the device. The direction and further development of these types of devices are now clearly defined and aimed towards further life enhancement transformations.

References:

Pinzur MS et al. 1995. The Effect of Prosthetic Alignment on Relative Limb Loading in Persons with Trans-tibial Amputation: A Preliminary Report. Journal of Rehabilitation Research and development, 32:373-378

Title: A Pilot Study into the use of the Long Term Activity Monitor

Presenter : John Ross BSc (Hons), SRPros/Orth

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It is difficult to quantify how much amputees use their prosthesis. Even simple things such as the extent the limb is worn or how many steps were taken outside the clinic are normally beyond our knowledge. The need for outcome measures and clinical evidence practice are planned to be introduced as part of changes to contract currencies as we look for viable groups of outcome parameters to meet the changing needs of our service purchasers.

Initially, activity monitors were developed around collecting as much data as possible over a short period. Operating time was limited to a few days. The Long Term Activity Monitor (LAM), was developed in collaboration between Chas A. Blatchford & Sons Ltd and PAL Technologies, a spin off from the University of Strathclyde. This simple device was designed to allow a clinician to monitor use of the prostheses over a 12 month period. In conjunction with the validated prosthetic evaluation questionnaire, a simple protocol proved to provide a more complete picture of the amputee's mobility and measure of success of rehabilitation.

LAM records the number of steps taken each day and then totals them each week with dates. The device is designed to fit inside the pylon (and hence won't be visible) of most prosthetic systems coming with adaptors to allow it to fit inside 30,34 and 35mm pylons tubes. The device has a further advantage of being lightweight and inexpensive. The record below illustrates step count for a 4 week period of a 70 year old Transtibial amputee who had the resultant amputation due to Peripheral Vascular Disease.

Data file: C:\Documents and Settings\andrew reece\My Documents\activity monitoring\LAM\LAM 40444 25 Apr 05
Results file:

LAM serial number: LAM 40444
Start Time: 11:35 AM 25-Apr-05
Stop Time: 09:54 AM 26-May-05
Elapsed Time: 30 day(s) 22 h 19 m

Total number of steps: 180598

Day count: 32
Average steps per day: 5644

Week	steps
17	35290
18	39674
19	43218
20	43304
21	19112

Starting	Week num	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Total for w
25-Apr-05	17	3562	5686	7074	7066	5158	2138	4606	35290
#####	18	4940	4418	4216	5852	8986	5886	5376	39674
#####	19	4868	5796	6728	6970	7792	4668	6396	43218
#####	20	5896	6008	7724	6592	7662	6174	3248	43304
#####	21	4772	5226	7592	1522	0	0	0	19112

Data file: C:\Documents and Settings\andrew reece\My Documents\activity monitoring\LAM\LAM 40444 25 Apr 05
Results file: C:\Documents and Settings\andrew reece\My Documents\activity monitoring\LAM\LAM 40444 25 Apr

PAL: Physical Activity Logging. © PAL Technologies Ltd 2005

The presentation will detail outcome of this pilot study, provide some examples of the patients who have consented to help with the initial data collection and will conclude with limitation of the device and protocol. Clinical assessment of success of care provided by the profession and future requirement may justify such form of interventions, and a simple device like this with consideration could give a simple and cost effective solution to this need.

Title: Are energy storing and releasing mechanisms of current dynamic elastic response prosthetic feet effective? – A pilot study

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The aim of this preliminary investigation is to establish whether or not the energy storing and releasing mechanisms of current dynamic elastic response (DER) prosthetic feet are effective. The objective is to compare the kinetics and kinematics of a standard DER prosthetic foot with those of a rigid prosthetic foot.

Energy storage and return within the heel and keel of a standard DER prosthetic foot is aimed at assisting upward and forward propulsion. Although the action of

both the heel and keel are important, the research community puts greater emphasis on energy storage and return during late stance, which is why the current investigation will focus purely on changes in the dorsiflexion angle triggered by compliance of the keel.

Following an increase in ground reaction forces (GRFs), and hence in the dorsiflexion angle during mid-to-late stance, the stored energy is released during late stance due to a decrease in GRFs, and hence in the dorsiflexion angle. However, DER prosthetic feet can be considered to counteract, and thus reduce, upward and forward propulsion generated by other lower limb structures, as their energy is not directly transmitted onto the ground, but partly absorbed by prosthetic foot compliance.

To establish the effectiveness of current DER prosthetic feet, two identical DER prosthetic feet (Vari-Flex, Össur) were tested under two conditions: “mobile” with full dorsiflexion capabilities, and “rigid” without dorsiflexion capabilities. Following ethical approval, tests were conducted in a gait laboratory with a thirty-one-year-old male trans-tibial amputee volunteer. Kinetic and kinematic data were collected using two force-plates (Kistler) and an eight-camera motion capture system (Qualisys) to determine the vertical and fore-aft GRFs, as well as sagittal plane dorsiflexion angles, respectively. After the volunteer had time getting accustomed to both test-feet, they were each tested 100-times during level, straight walking at a self-selected, comfortable speed.

Compared to the rigid foot, the magnitude of peak vertical GRFs was only minimally greater for the mobile foot, which indicates that very little of its energy storing capabilities contributed to upward propulsion. In turn, compared to vertical GRFs, the difference in the magnitude of peak fore-aft GRFs between the two test-feet was greater, which indicates that more of the mobile foot’s energy storing capabilities contributed to upward propulsion than to forward propulsion. This can be confirmed using the kinematic data. Compared to the peak in dorsiflexion angles, the peak in vertical GRFs occurred earlier and the peak in fore-aft GRFs later. Therefore, as dorsiflexion angles continued to increase after the vertical GRFs were already decreasing, the subsequent release of energy due to the decrease in dorsiflexion angles is therefore unlikely to have influenced the vertical GRFs. However, this is different for the fore-aft GRFs, as these still further increased following the peak in dorsiflexion angles.

Conclusively, taking into consideration that vertical GRFs are greater in magnitude than fore-aft GRFs, the fact that there was very little difference in the magnitude of vertical GRFs between the mobile and rigid foot makes the mobile foot’s energy storing capabilities appear rather ineffective.

Title: **The provision of evidence on which to base prosthetic prescription.**

Presenters: Carl Elliott MBAPO, Clinical Prosthetist and member of the Clinical Socialists Group of RSL Steeper.
Timothy Verrall MBAPO, Clinical Prosthetist, member of the Clinical Socialists Group and Head of the Best Practice Group of RSL Steeper.

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Introduction

RSLSTEEPER, aware of the requirement to provide an evidence base to support the clinical decisions of their prosthetists and the clinical prescription and application of the products they supply, have set up the Best Practice and Clinical Specialists Groups.

Aims.

The work of the BPG is geared towards the production of a Prescription Guideline Manual to help prosthetists decide the socket type, casting method and appropriate generic componentry for their patients, by defining what is currently believed to be “best practice”.

The CSG aims to provide a file of Clinical Evaluation Summaries for products supplied by the company. These will attempt to define the most appropriate clinical application, based on evaluations carried out by the group, the manufacturer’s evidence and any other available published evidence.

The prosthetist, having decided on what is “best practice” for the particular patient, can then decide whether any of these are the “best product” for them, with the assurance that there is some evidence to support the decisions they have made.

Method.

An article in a rehabilitation journal, having taken a critical look at over 300 published articles on prosthetic componentary, which provided almost no conclusive or usable evidence, concluded –

“Therefore, with regard to prosthetic guideline development, we must still largely rely on clinical consensus among experts.

The integration of knowledge from research with the expert opinion of clinical professionals and the opinions and wishes of consumers can form a solid base for a procedure on guideline development for prosthetic prescription.”

Both groups seek to provide evidence based on a consensus of professional opinion, backed by whatever research is available.

The BPG draw their consensus opinion from all the company’s prosthetists and also search for articles and research that support the guidelines.

The CSG start by applying the product to the most appropriate patients, as defined by the manufacturer’s guidelines. The opinion of the prosthetists and patients involved, regarding the effectiveness of the product, is collected by means of questionnaires and collated onto a summary sheet. Any supporting research and published articles are also referred to.

Results.

The original BPG have achieved the production of a Prescription Guidelines Manual, which is in the process of being appraised by a new BPG, aimed at refining, improving and correcting it. Whilst it is not yet complete, it is a significant start to the process of collecting the evidence required.

After only a year, the work of the CSG has become clearly defined and a Clinical Evaluations folder issued, limited as yet, but already proving to be a useful tool for prosthetists and rehabilitation consultants alike.

Conclusions.

Whilst neither group would deny the need for research which provides usable and conclusive evidence, the lack of such evidence and the effort required to provide it, makes the work they have carried out already, a significant contribution to the process.

The need to constantly review the evidence, to audit and update it, is obviously essential. Both groups are committed to this process, aiming to constantly improve the quality of the evidence produced and the presentation of it.

TITLE: **The use of fMRI to investigate the role of mental imagery in the relief of phantom limb pain**

Presenter: K.M.Maclver*, Research Fellow.

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Phantom limb pain (PLP) is linked to loss of sensory input from the missing limb, which has been shown to cause reorganisation of somatotopic maps in motor and sensory cortex. We hypothesised that regular imagined movement of the phantom limb would reduce phantom limb pain (PLP) and that this reduction would be associated with a reduction in cortical reorganisation.

Aims: 1) To evaluate the analgesic effect of meditation and mental imagery practice in patients with phantom limb pain. 2) To investigate the relationship between reduction in pain scores after the intervention and changes in cortical activation, using fMRI.

Methods: 13 recruits with unilateral upper limb and PLP of at least one year's duration were taught imagined movement and sensation in the phantom in 6 x 1 hour weekly training sessions. This included daily home practice using a CD. They also underwent functional Magnetic Resonance Imaging (fMRI) at baseline and follow up, to investigate the incidence and extent of cortical reorganisation in motor cortex (M1), somatosensory cortex (S1) and supplementary motor area (SMA).

Clinical instruments: Phantom limb pain questionnaire. Vividness of Imagery scale. Numerical rating scale (NRS) to measure average, worst and least pain over past week at baseline and follow up. Pain diaries to measure average daily background and exacerbations of pain during the intervention.

fMRI: Recruits underwent whole brain Echo Planar scans on a Siemens Trio 3T scanner during the following tasks:

should possess if their role as an artificial replacement is to be improved.

In the anatomic lower limb, the functional capabilities of different muscles involved in controlling the foot depend on the integrated roles of muscle contractile components and tendons. Tendons reduce active muscular work by passively storing and releasing some of the energy required for gait. During early stance phase, some of the tendons that control the anatomic foot stretch and thereby store elastic strain energy. Later, during late stance phase, these tendons recoil and thereby release the stored energy.

DER prosthetic feet attempt to replicate this mechanism of storing and releasing energy. However, compared to the anatomic foot, hysteresis is, in even the most energy efficient DER prosthetic feet, relatively substantial. This therefore indicates that DER prosthetic feet cannot fully compensate for the passive energy storing mechanisms in the anatomic limb and foot. Also, the energy released by DER prosthetic feet must not only be of sufficient magnitude, it also needs to be released at the appropriate point in time during the gait cycle.

For instance, in the anatomic foot, the plantarflexors are eccentrically contracting during early-to-mid stance phase to resist forward rotation of the tibia [1]. In turn, following compression of the heel in DER prosthetic feet during early stance phase, decompression of the heel during early-to-mid stance phase releases the stored energy, thereby assisting forward rotation of the tibia, rather than resisting it like the plantarflexors do. The energy stored by the heel is therefore not transferred anteriorly to the keel of DER prosthetic feet, and thus not used for forward propulsion, but simply dissipated [2]. Also, some of the energy stored by the keel itself is believed to cause an undesirable whip at push-off. It therefore appears as if the timing of energy release from both the heel and keel of DER prosthetic feet needs to be improved in order to achieve a more energy efficient amputee gait.

In conclusion, there are obvious differences in the functional capabilities between the anatomic foot and DER prosthetic feet. However, in contrast to prosthetic feet without energy storing capabilities, DER prosthetic feet appear to make amputee gait, to at least a certain extent, more energy efficient. This may indicate that the concept of energy storage and release in the various components of DER prosthetic feet is appropriate for amputee gait, but the mechanisms of energy transfer involved in this still seem to be in need of yet further refinements.

References

1. Hunt AE, Smith RM, Torode M. Extrinsic muscle activity, foot motion and ankle joint moments during the stance phase of walking. *Foot Ankle Int* 2001;22(1):31-41.
2. Hafner BJ, Sanders JE, Czerniecki JM, Ferguson J. Transtibial energy-storage-and-return prosthetic devices: a review of energy concepts and a proposed nomenclature. *J Rehabil Res Dev* 2002;39(1):1-11.

Title: **Smart verses manual limb programming – a qualitative study**
Presenter: **Andy Sykes, Electronic Design Engineer, Chas. A. Blatchford & Sons**

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Aims and Objectives

“Plug and play” is now the core design philosophy for the next generation of advanced knee controls with ease of programming being a prime consideration during prescription. The Smart IP swing phase control device was designed to meet this requirement whilst maintaining the known energy efficiency benefits of its predecessor, the IP Plus¹.

This study assesses the qualitative feedback from both amputees and practitioners that participated in the Smart IP trial to determine and qualify the benefits of automatic over manual programming in practice.

Methodology

A total of 15 amputees were fitted with Smart IP modules across 6 limb fitting centres. Out of these 13 had an IP Plus as their current prescription. This allowed a direct comparison to be made between the Smart IP and IP Plus programming procedures and adequacy of settings achieved.

Qualitative data was collected using questionnaires compiled for the amputees and clinicians, completed by each during fitting and at one and three month review intervals.

The questionnaires sought graded responses (1 highest, 7 lowest) from clinicians to questions on programming, user instructions and performance. Amputees were asked to compare the Smart IP response at slow, fast and variable walking speeds to that of their current prescription. A score of 4 indicated no difference, 1 indicating significantly better and 7 significantly worse.

In addition to graded responses comments were also sought on programming, performance and fine tuning outside of the clinical environment.

Summary of Results

The average rating given by clinicians for ease of programming and time to achieve an appropriate set up were 1.4 and 2.0 respectively.

The amputees gave average performance ratings of 2.5, 2.6 and 2.6 when comparing the slow, fast and variable walking speed responses on the Smart IP to the IP Plus, where any rating below 4.0 indicates a preference towards the Smart IP.

Clinician and amputee comments on performance included:

“settings more accurately reflect their ‘real’ gait speeds”

“feels lighter after properly programmed”

“walking seems smoother”

“the more I fine tuned it the better it performed... a smooth walk”

Conclusions

Feedback from Smart IP trials have shown that the original design objectives of making limb programming much quicker and simpler have been successfully achieved.

The ratings given by clinicians for programming have shown they believe limb programming is much quicker and simpler when compared to the IP Plus, not unexpected as the Smart IP had been specifically designed to meet these objectives. However the Smart IP versus IP Plus performance ratings attributed by amputees were expected to average at 4, from the assumption the Smart IP would produce a program exceeding that achieved by an inexperienced clinician programming an IP Plus whilst falling short of the program achieved by a clinician with significant IP Plus programming experience. The results show the ratings far exceeded this expectation as do the comments on performance.

This has prompted future quantitative study of smart versus manual programming that will attempt to provide a biomechanical explanation for the positive qualitative assessments made.

Reference:

1. Buckley et al. (1997)