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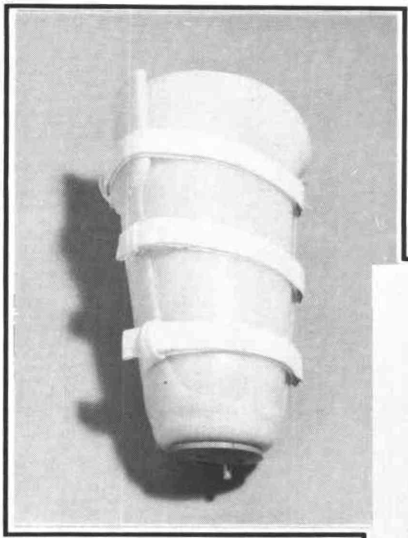

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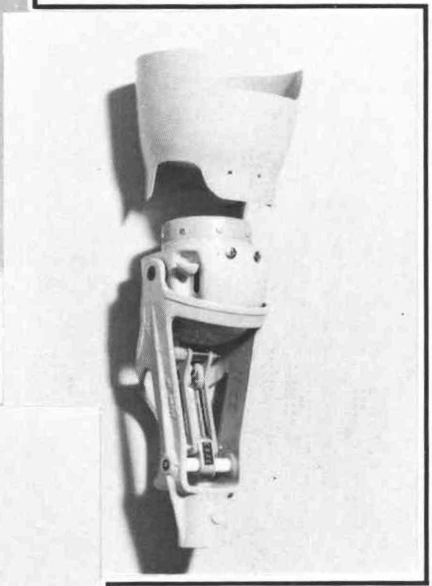

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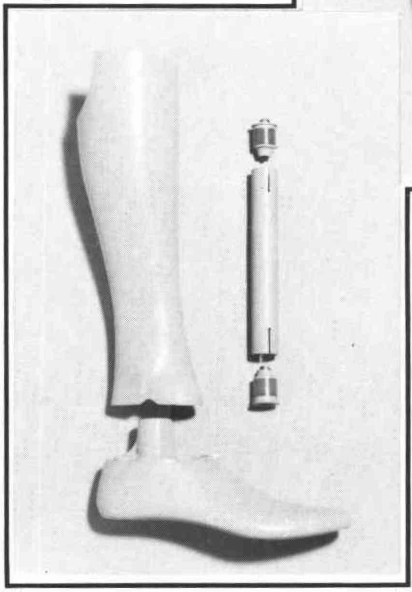

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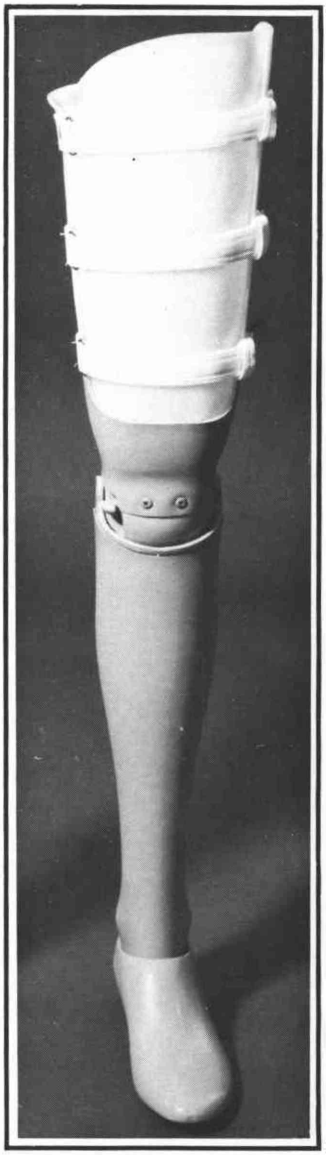

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Contents

Executive Board of ISPO

Obituary

Knud Jansen

Knud Jansen died on the 1st August after a long and painful illness with the added burden of the death of his lifetime partner, Elsa some months before. Despite that he remained active and working to the end. With his passing orthopaedic surgery, technical orthopaedics and rehabilitation has lost one of the foremost practitioners of this century.

Since his first appointment as Chairman in 1948 of the Board of Junior Doctors in Denmark he has had a profound influence on the practise of orthopaedic surgery. In his own country he has been Chairman of the Danish Orthopaedic Association and the Danish Society of Orthopaedic Surgery; in Scandinavia Secretary General of the Scandinavian Orthopaedic Association and since 1968 Editor of one of the most prestigious international journals, Acta Orthopaedica Scandinavica. He was Vice-President of SICOT from 1969–72 and Congress President of SICOT in relation to the Copenhagen meeting in 1975. He was President of the Society he founded, the International Society for Prosthetics and Orthotics from 1970–77 and President of the newly formed Trauma Foundation in 1975. His influence internationally has continued as Vice-President of World Orthopaedic Concern. His contributions to orthopaedic science were recognised in his appointment as Honorary Doctor of Science in the University of Strathclyde in 1980. He continued to subscribe to the literature of orthopaedics covering widely varying subjects such as deep venous thrombosis, poliomyelitis, arthrodesis, amputation, congenital defects and many others and has lectured in virtually all the main orthopaedic centres in the world during his career. Even this list of achievements, however, cannot tell the whole story of his enormous influence through his students and colleagues throughout the world. He has been the main protagonist of the concept of the clinic team which has had such an important influence on development of prosthetics and orthotics worldwide.

Knud strove for perfection and looked for it in others. Where they fell short of what he believed to be the necessary standard his use of his second language was at least incisive and at most little short of cold steel. In these circumstances he would immediately relent and demonstrate an abiding affection and understanding. His loyalty to colleagues and friends was unbending and was central to the development of our Society.

Uniquely, Knud Jansen welded together as equal professionals, therapists, engineers, prosthetists, orthotists and a variety of medical specialists dedicated to the disabled. They have carried his philosophy to the far corners of the earth. Their work in the "clinic team" is his memorial.

We shall miss his tall figure, always immaculately dressed, always accurately tuned to all the nuances of the occasion and above all, commanding attention wherever he chose to be.

He leaves behind two sons, one of whom is active in the practise of medicine, much cherished grandchildren and a wide family of relatives, friends and colleagues in his beloved Denmark. We join them in their grief and sorrow.

George Murdoch.

Prosthetics and Orthotics International, 1982, 6, 131–138

Angular displacements in the upper body of AK amputees during level walking

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Abstract

The angular displacements of the longitudinal axis of the trunk, and of the latero-lateral axes of pelvis and shoulder girdle were measured in five normal subjects and four AK amputees during level walking at different speeds. Amputees used single axis prostheses with the SACH foot. Spatial measurements were carried out in three dimensions by means of a photogrammetric technique. The time functions of the target angles underwent harmonic analysis. Based on the Fourier coefficients, comparison was made between normal subjects' and amputees' angular displacements. Relevant findings permitted the identification of compensatory mechanisms adopted by amputees at trunk level as well as the assessment of the relationship between these latter mechanisms and those put into action at lower limb level.

Introduction

The movement of the upper body constitutes an effective reference for the assessment of the quality of gait (Saunders et al. 1953; Murray et al. 1964; Lamoreux, 1971; Cappozzo et al. 1978a).

In this paper rotational displacements of the upper body during level walking of AK unilateral amputees and normal subjects are analyzed. The rotations taken into account were the frontal and horizontal rotations of the transverse axis of the shoulders and of the pelvis, and the frontal and sagittal rotations of the longitudinal axis of the trunk. This choice corresponds to a well established tradition in the field of biomechanics and refers to easily understandable kinematic quantities. The pelvic rotations have been classified as gait determinants by Saunders et al. (1953). The shoulder and trunk rotations are correlated with the maintenance of balance and with the mechanical energy efficiency of the locomotor act (Cappozzo et al. 1978a). The analysis of these rotations can provide useful data for both amputee's gait evaluation and improvement of prosthesis design, provided that it is carried out quantitatively and an easily readable synthetic description of the relevant time functions is devised.

Since walking is a cyclic movement, the related kinematic variables can be represented through a Fourier series. Each Fourier component is a sinusoid with a period equal to the stride period or to an integer submultiple of it; it is fully described by only two parameters: the amplitude and the phase. The harmonics associated with human locomotion are very few (Bernstein, 1966; Winter et al. 1975; Cappozzo et al. 1979a;), therefore the most relevant information relative to the investigated kinematic quantities is contained in a few numbers only.

Materials and methods

Five normal male subjects and four male amputees were tested during level walking at various speeds. A total of 29 tests were carried out. The subject anthropometric data and the main characteristics of the tests they were subjected to are shown in Table 1. During the walk trials all subjects wore their usual shoes. The experimental set-up has been completely

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*Now at Istituto di Automatica, Università di Ancona.

Table 1. Subject and test data.

	Subject	Age (yr)	Height (m)	Weight (kg)	Amp. side	Amp. level	Test	Speed (km/h)	Stride period (s)
Normal subjects	1	22	1·72	70			1	4·49	1·15
							2	4·95	1·10
							3	5·94	1·03
							4	5·94	1·01
	2	23	1·73	70			1	4·55	1·20
							2	4·96	1·13
							3	5·23	1·10
	3	21	1·76	66			1	3·57	1·24
							2	5·56	1·05
	4	32	1·81	72			1	4·30	1·31
							2	4·78	1·20
							3	5·80	1·05
	5	22	1·86	66			1	5·05	1·10
							2	6·01	1·02
Amputees	6	18	1·67	56	L	I	1	2·80	1·43
							2	3·00	1·37
							3	3·60	1·14
	7	18	1·68	56	R	II	1	3·20	1·29
							2	3·50	1·27
							3	3·50	1·30
							4	3·90	1·31
							5	4·60	1·20
							6	4·70	1·10
							7	5·00	1·09
							8	5·20	1·03
	8	31	1·68	91	L	II	1	2·34	1·42
							2	2·40	1·45
							3	2·50	1·34
	9	37	1·74	74	L	II	1	3·60	1·25

described previously (Cappozzo et al. 1978; Cappozzo, 1981), however, it is important to note its stereophotogrammetric nature, and that it yields an overall precision in the assessment of any body point position better than 5 mm, to which an indetermination less than 0·5 degrees on the considered rotations corresponds. Markers were placed on the acromial process and tubercule of the iliac crest of both the right and left side. Their position was sampled at a sampling frequency (fs) equal to 30 Hz and 60 Hz for low (less than 5 km/h) and high speeds respectively.

Results

Each considered rotation was described as follows:

$$\theta\,(t) = M_o + \sum_{i=1}^{N} M_i \sin\,(i\,\Omega\, t + \Phi_i)$$

where:

M_i = amplitude of the ith harmonic ($i = 1,\ldots,N$);
Φ_i = phase of the ith harmonic, with reference to a time origin coinciding with left heel strike;
Ω = fundamental frequency, corresponding to the stride period;
M_o = mean value of θ (t) over the stride period;
N = maximum order of the significant harmonics (never greater than 4).

As far as the resulting precision in calculated Fourier coefficients calculation (Cappozzo et al. must be stressed; precision is mainly affected by the eventual inexact correspondence of the stride period value to an integer multiple of the sampling period (maximum difference $\pm\frac{1}{2fs}$) and by the statistical characteristics of the residual measurement noise. The standard deviation of the latter was estimated by the procedure of Fourier coefficients calculation (Cappozzo et al. 1975) and was recognised to be never greater than 0·1 degrees. According to these figures the error on the amplitude and phase of each harmonic was estimated and resulted in values never greater than ± 0·5 degrees for the amplitude and ± 1 degrees for the phase.

An example of the quantities under study and the way they were represented is shown in Figure 1. Each harmonic is fully described by a vector in the polar plane. Figure 2 shows the effect of different harmonic phase values on the shape of the resultant $\theta(t)$ vs time plot. The harmonics that should be the only result of the Fourier analysis using the hypothesis of complete symmetry of the movements were termed intrinsic to the locomotor act, correspondingly the other harmonics were defined as extrinsic (Cappozzo et al. 1979a; Cappozzo, 1981). In accordance with elementary geometric considerations, the second and fourth harmonics are intrinsic for trunk sagittal rotation, while the first and third harmonics are intrinsic for all other rotations.

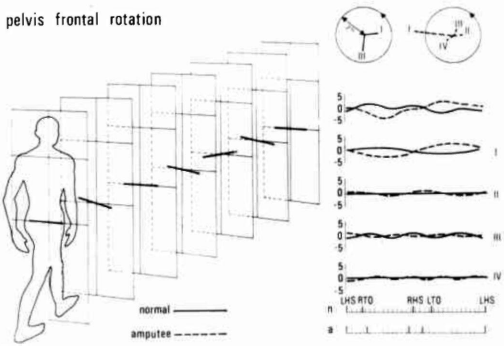

Fig. 1. Frontal rotation of the pelvis; the rotating element is the projection on the frontal plane of the segment. The angle vs time plot is represented together with the plots of its four harmonic components; at each time the value of the angle is the sum of the corresponding values of the harmonics plus the mean value (not represented). Each harmonic is described by the vector having its amplitude and its phase; the corresponding time law can be obtained by plotting the projection on the vertical axis of the actual position of the vector, provided it rotates with a constant velocity, equal to $i\Omega$, and starts from the plotted position at t = 0.

In Figures 3, 5 and 6 the envelope diagrams of the vectorial representation of the harmonics in the polar plane are given for all the tests performed on the normal as well as for the amputee subjects.

It is important to stress that, in general, the large scatter of phase and amplitude values shown by some intrinsic harmonics of the normal subjects cannot be correlated with the speed of progression. In general the harmonics of the same subject show good repeatability; the scatter of the diagrams is mainly due to the inter-

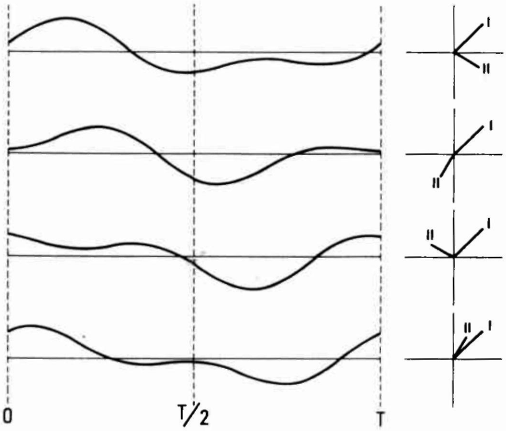

Fig. 2. The relationships between the phase values of the harmonics and the shape of the resultant functions are shown. The shapes of four functions resulting from two harmonics (first and second) equal in all except the phase of the second one is presented as a didactic example. Near each plots vs time the corresponding synthetic representation by means of vectors in the polar plane is shown.

subject differences. The same can be said with respect to the large scatter of the amputee's intrinsic harmonics.

Pelvic rotations (Fig. 3, 4)

1) Normal subjects

Both the frontal and horizontal rotations were found to be consistent with the findings of Murray et al. (1964) and Saunders et al. (1953). These rotations were remarkably well defined by the (intrinsic) first and third harmonics only.

With reference to the *frontal plane* the following was noted; (a) the first (intrinsic) harmonic covered a limited sector of the polar plane, ranging in phase from −15° to 70° and amplitude values centred at approximately 1·5°; (b) the third harmonic also covered a limited sector of the polar plane with the phase centred on −95° and the amplitude ranging from 0·7 to 1·8°; (c) the second and fourth (extrinsic) harmonics were minimal and could, thus, be disregarded.

Regarding the *horizontal plane;* (a) the first harmonic amplitude was relatively large (from 1·4° to 4°), its phase was widely scattered, but the repeatability within the same subject was good, as shown in Figure 4. The same characteristics were shown by all the intrinsic harmonics of the

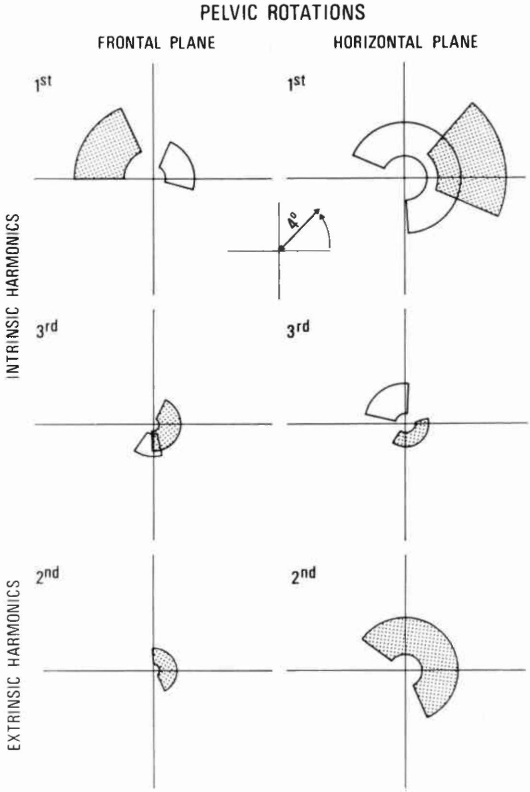

Fig. 3. Synthetic representation of the pelvic horizontal and frontal rotations in normal subjects and amputees; intrinsic and extrinsic harmonics are separately drawn. The field covered by amputee tests is represented by shaded sectors.

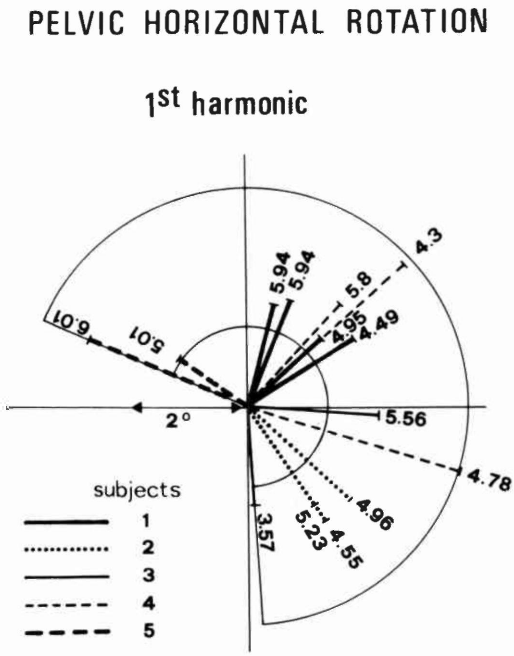

Fig. 4. First harmonic of the hip horizontal rotation in normal subjects. Each test is labelled with the corresponding speed of progression (km h^{-1}).

different rotations taken into account in this paper;
(b) the third harmonic was less scattered in phase and the amplitude ranged from 0·6° to 2·8°. This is the only harmonic showing a clear difference between high speed and low speed trials. The high speed amplitudes are greater and the low speed ones are lower than 1°;
(c) some of the tests indicated a significant contribution of the second harmonic which was largely scattered in phase. The corresponding sector was not drawn because the most part of the tests did not show these harmonics.

II) Amputees

Both the frontal and horizontal pelvic rotations had relevant extrinsic harmonic contributions. Concerning the rotations in the *frontal plane;* (a) the first harmonic covered a sector of the polar plane centred at 150°, the amplitudes ranged from 2° to 5·4°;
(b) the third harmonic covered a sector shifted in phase with respect to the normal one, while the amplitude range was similar for both categories of subjects;
(c) the second (extrinsic) harmonic was always significant and had an amplitude from 0·5° to 1·5° and a certain amount of within-subject repeatability.

With reference to the *horizontal plane;* (a) the first harmonic in the amputee tests fell in a sector ranging in phase from −30° to +50°, with amplitudes varying from 2·2° to 7·0°.
(b) the third harmonic covered a sector centred on −50°, with amplitudes from 0·7° to 1·7°, and comparison with normal subjects showed a neat phase opposition;
(c) the second harmonic had amplitudes between 1·1° and 3·5° and showed within-subject repeatability;
(d) in few cases only the fourth harmonic contribution was significant. Thus, it was not reported in the figure.

Shoulder rotations (Fig. 5)

I) Normal subjects

In normal subjects, both the horizontal and the frontal rotations are in accord with descriptions referred to in the literature (Murray et al, 1964). The Fourier analysis showed that these rotations are practically sinusoidal. All harmonics other than the first can be disregarded, since their amplitude was less than 0·5°. In the *frontal plane* the sector covered by the first harmonic ranged in phase from −80° to −185° and in amplitude from 0·5° to 3·5°. Comparison with the same rotation of the pelvis in Figure 3, showed that the shoulders and pelvis of normal subjects rotate in counterphase. On the horizontal plane the sector was centred on −70° of phase and the amplitudes ranged from 2° to 8°. Owing to the phase scatter of the corresponding pelvic harmonics, no phase relationship can be recognized.

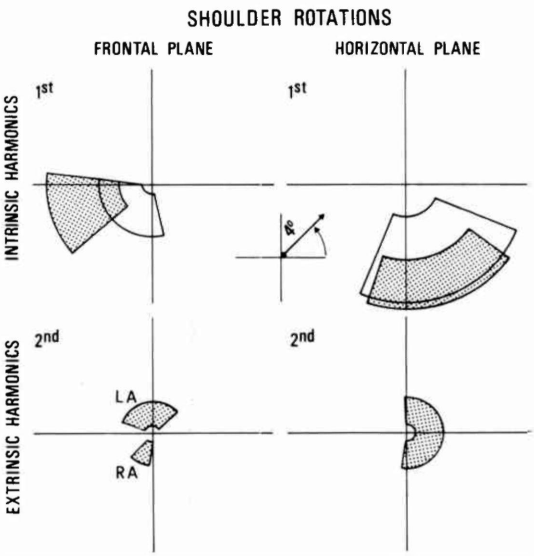

Fig. 5. Synthetic representation of the shoulder horizontal and frontal rotations in normal subjects and amputees: intrinsic and extrinsic harmonics are separately drawn. See also Fig. 3. LA = left amputation; RA = right amputation.

II) Amputees

The extrinsic (second) harmonics cannot be disregarded in either rotation. In contrast, the third harmonic can be disregarded. Moreover, in the *frontal plane;* (a) the first harmonic covered a sector more limited in phase than in normal subjects, with a phase range from −140° to −190° and amplitude variations from 1·9° to 7°;
(b) the second harmonic had phase values which were dependent upon the amputation side.

In the *horizontal plane;* (a) the first harmonic amplitude was larger than in normal subjects, phase values fell between −35° and −110° and amplitude from 5° to 8·5°;
(b) the second harmonic occupied the first and fourth quadrant of the polar plane with amplitudes ranging from 0·6° to 2·5°.

Trunk rotations (Fig. 6)

I) Normal subjects

In the *frontal plane* the rotation was described by the first harmonic only. Its phase varied from 30° to 110° with amplitudes from 0·6° to 2·5°.

In the *sagittal plane* rotation the intrinsic (second) harmonic covered a narrow sector centred on 160° of phase with amplitudes from 0·5° to 2°. This rotation had a first (extrinsic) harmonic that was significant, but with a large scatter on the phase, that covered 2 radians. Neither intraindividual nor speed dependent trends were recognized.

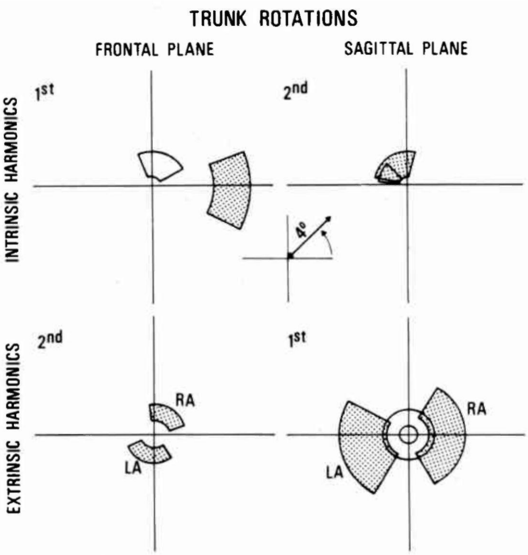

Fig. 6. Synthetic representation of the trunk sagittal and frontal rotations in normal subjects and amputees; intrinsic and extrinsic harmonics are separately drawn. See also Fig. 3. LA = left amputation; RA = right amputation.

II) Amputees

In both planes the extrinsic harmonics are larger than in normal subjects; (a) the first harmonic of the *frontal rotation* had amplitudes that ranged from 4° to 6·8° and occupied a sector with phase values between −30° and +20°;
(b) the second harmonic of the same rotation depended upon the side of amputation and its amplitude varied between 1° and 2°.

Concerning rotation in the sagittal plane, the extrinsic (first) harmonic became dominant; its amplitude went from 1·2° to 5° and the phase depended upon the side of amputation. The intrinsic (second) harmonic covered a larger sector than that of the normal subjects; this sector was centred on −130° of phase values. The amputee's second harmonic had an amplitude ranging from 0·5° to 2·4°.

Discussion

Since the normal tests considered in this work did not show significant variations with the progression speed, it seemed appropriate to collect all of them in one control sample for the comparison with amputee's data.

Amputee gait, compared with normal gait, is characterized by remarkably larger amplitudes of the harmonics in all rotations we investigated. Furthermore, extrinsic harmonics appear. This means that the amputee's upper body rotations are larger and asymmetrical.

Concerning the first harmonic of the pelvic frontal rotation in normal subjects, it corresponds to the fall of the pelvis on the side of the swinging leg, referred to by Saunders et al. (1953) as a gait determinant. In the amputee tests this harmonic is in counterphase with respect to normal, which means that there is an elevation of the pelvis, as opposed to a fall, on the side of the swinging leg. Such amputee behaviour can be correlated with the passive prosthetic ankle and the reduced efficiency of the stump abductor muscles on the amputated side. During prosthetic swing the artificial foot cannot be dorsiflexed; thus the corresponding hip must be elevated in order to gain clearance for the swinging leg. During prosthetic stance the sound hip is elevated and the trunk bends laterally toward the prosthesis in order to make equilibrium easier and to decrease the effort of the stump abductors (McLeish and Charnley, 1970).

The overall trend of the pelvic horizontal rotation may be described by the first harmonic alone. According to the relevant description given by Saunders et al. (1953) or by Steindler (1955), its phase values should fall between +90° and +180°. Actually the normal subjects' tests in this study showed the above feature only exceptionally and exhibited a very large inter-individual phase scatter (Fig. 4). This suggests that the pelvic horizontal rotation is an individual trait.

As far as the amputee is concerned the first harmonic of the pelvic horizontal rotation belongs to a sector centred on a phase value near zero. This means that the amputee's larger forward rotation of the pelvis occurs during mid-stance. This behaviour can be correlated with the structural and functional losses of the amputee. The forward movement of the normal hip during prosthetic stance is opposed by knee stability problems, reduction of the stump muscles efficacy and prosthetic ankle passivity. Because of the absence of an active push-off by the prosthesis, the pelvic rotation is reduced during normal leg stance.

With regard to the third harmonic of the pelvic horizontal rotation, the phenomena associated with it are not easily detectable. A third harmonic component may be engendered by two perturbations, equal and opposite, superimposed on a curve with period T, if the interval between the perturbations is T/2. The amplitude and phase of the third harmonic depend on the amplitude, duration and location within T of the perturbations. By inspections of the horizontal pelvic rotation plots vs time such perturbations can be only indistinctly seen, because of the small amplitude of the third harmonic itself and the large phase scatter of the first harmonic. If X be the mean direction of progression of the subject with respect to the laboratory frame, in a reference system moving with the subject itself at a medium speed of progression, then the plot of the difference between the X coordinates ($\Delta X(t)$) of the hip, purged from the contribution of the first and second harmonics, shows the perturbations very distinctly*. In Figure 7(a) a typical plot for a

*It can be easily proved that due to the characteristics of the hip movements, the pelvis geometry and the formal definition of the pelvic horizontal rotation, the perturbations of the angle are markedly reduced with respect to the corresponding $\Delta X(t)$ perturbations.

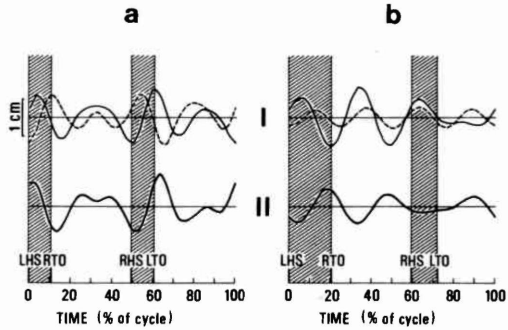

Fig. 7. $\Delta X(t)$ plots relative to a normal subject (a.II) and an amputee (b,II). In (a,I) the X(t) plots purged by the first and second harmonics' contributions, of right (continuous line) and left (dotted line) hip are shown. In (a,II) the large perturbations located in correspondence with the double support phases are evident. Larger contributions from the leg entering its swing phase are noticeable. In (b,I) the same quantities than in (a,I) relative to the amputated leg hip (continuous line) and to the sound leg hip (dotted line) are represented. In (b,II) the perturbation during double support is confined to the sound leg restraint and is opposite to the corresponding normal one. The larger values of perturbation happen during sound leg support and depend on the movement of the prosthetic hip.

normal subject is shown together with the corresponding hip coordinates. It is clear that the perturbations are located in correspondence with the double support phase, and that the larger contribution of each of them is due to the limb entering its swing phase. Both these features are common to all tested subjects. It can be verified that such perturbations engender a third harmonic with a phase value corresponding to that actually exhibited by normal subjects. Consequently it appears that the third harmonic corresponds to rapid pelvic movements depending upon the mechanisms operated during the double support, in particular during push-off for each leg. Based on the repetitive quality of the characteristic described by the third harmonic of the horizontal rotation of the pelvis, one can conclude that it is an invariant of human locomotion. As shown in the previous section under Results, this characteristic changes in the amputee's ambulation; in fact, the third harmonic was negligible in three of the tests, and had negative phase values in the others. For the sake of brevity only the negative phase results will be discussed. In Figure 7(b) an example of the corresponding $\Delta X(t)$ plot is shown. A perturbation appeared opposite to that of the normal subject during double support and had its maximum value during sound leg support. This behaviour seemed to be related to the following handicaps of the amputee; passive prosthetic ankle, which implies that the prosthesis is unable to push the hip forward during deploy; and prosthetic knee stability, for the sake of which the backward movement of the prosthetic hip during early stance is inhibited. A pelvic contribution to the prosthetic swing can be hypothesized, probably as a compensation for the passive push-off of the prosthesis.

With reference to the third harmonic of the pelvic frontal rotation, a discussion, parallel to that of the third harmonic of the pelvis horizontal rotation, could also be carried out. It should be noted that in normal subjects the third harmonic of the pelvic frontal rotation may be related to a perturbation occurring during the double support; thus it can be viewed as corresponding to an invariant of locomotion.

Conclusions

Two kinds of conclusions can be drawn from the above discussed results; (a) the usefulness of an analysis of the upper body segment rotations by means of harmonic components for the purpose of gait evaluation; (b) to improve prosthetic design some hypotheses concerning the mechanisms may be related to specific characteristics of the amputee's movement. The initial assumption that the upper body segment rotations can facilitate an assessment of the differences between the normal and the amputee's gait has been confirmed. In particular, substantial quantitative differences appear at pelvis level. Through the use of harmonic components more clear-cut identification and comprehension of these differences was established.

In that the above differences are apt to be correlated with increased metabolic costs of amputee gait and with increased mechanical loads on the spine, a focus on the upper body movements for the purposes of gait evaluation is justified. The representation of the harmonic components in polar plots seems to be particularly valuable due to its ability in discriminating between normal and abnormal characteristics.

With regard to the compensatory mechanisms the amputee has to perform and their tentative relationships with specific deficiencies of present day prostheses, the above analysis suggests a need for some active mechanisms in the prosthetic knee and ankle. These mechanisms should be devoted to ensuring a hip movement as similar as possible to the normal one, assuming that it defines an optimum condition (Cappozzo et al. 1979b). Possible suggestions for the design of such mechanisms are; (a) a knee-ankle mechanism able to dorsiflex the foot during knee flexion (Cappozzo et al. 1980), thus reducing hip elevation during prosthesis swing; (b) a knee equipped with some kind of energy recovery mechanism able to perform suitable knee flexion-extension during the early stance phase in order to reduce knee stability problems (Cappozzo et al, 1979b; Seliktar, 1971). Such mechanisms should allow an improvement of horizontal pelvic rotation.

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Bracing and supporting of the lumbar spine

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Abstract

The orthopaedic surgeon should be familiar with various supports and braces for the treatment of low back pain. Severe cases of spinal instability always need a Hohmann overbridging brace, whereas the milder form of motion-segment instability is treated with one of the elastic supports. In cases of osteoporosis of the spine and insufficiency of the lumbosacral junction the Lindemann 2/3 semi-elastic brace is prescribed.

Incidence of low back pain

Low back pain affects 80% of all persons during their lifetime. In 70% of the cases the patients recover within 1 month. After 3 months 90% are back to work. Of the remaining 10%, 50% never go back to work (Cailliet 1981).

Orthopaedic diagnoses of low back pain

The term "low back pain syndrome" includes diseases such as lumbosacral strain, facet syndrome, herniated disc, degenerative disc, spinal stenosis, unstable functional unit. Besides these, low back pain can be caused by degeneration and fatigue of the spine and inflammation within the spine (spondylitis). Another cause of pain can be the growth of a tumour.

Anatomy

Knowledge of the anatomy of the motion segment is mandatory to understand the function of the spine. The motion segment consists of an intervertebral disc, its two adjacent vertebral bodies and surrounding ligamentous tissue including the facet joints (Fig. 1). The total spine can be thought of as a motion segment (Kulak et al, 1975). Each vertebra can be divided into an anterior and a posterior element. The dividing line lies behind the posterior border of the body. The anterior elements provide the major support of the column and absorb various impacts. The posterior structures control the pattern of motion.

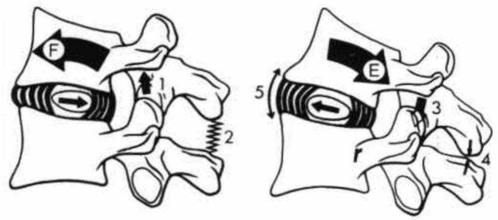

Fig. 1 Flexion (left) and extension (right) of the motion segment. The large arrows indicate nucleus shift (Kapandji, 1974).

Control of trunk motion is performed by different muscle groups. The cross section (Fig. 2) of the abdominal cavity shows that 4/5 of its circumference is made up of abdominal wall muscles. In addition to the trunk motion in the leg lifting position (knees slightly flexed and back straight) lifting is performed mainly by the quadriceps muscles.

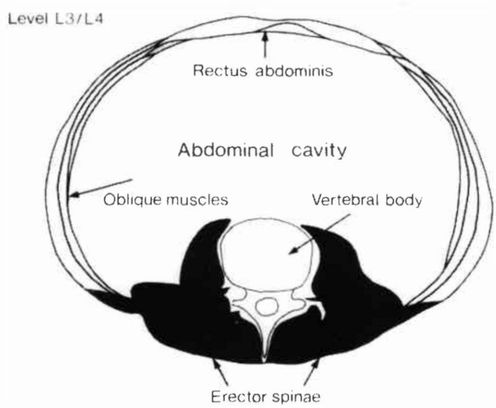

Fig. 2. Cross section of the trunk at level L3/L4.

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Origin of back pain

Low back pain can result from stimulation of nerve endings within the spine and its surrounding tissue. Hirsch et al (1963) studied pain receptors and found nerve endings arround the vertebral disc, vertebral periosteum, intervertebral joints and ligaments. The disc itself has no pain receptors.

Degenerative disc disease accounts for 90% of low back pain conditions in an average orthopaedic practice. The other 10% include spondylitis, tumours, deviation of spine axis, malformation of the spine, osteoporosis and other rare diseases.

Therapy

Bracing of the lumbar spine is mostly for degenerative spine disease, which includes disc disease and posterior facet joint disease.

The prescription of a lumbar brace or support is an important part of the therapy for low back pain. According to Perry (1970) only 14 out of 3410 American orthopaedic surgeons had never prescribed some kind of support for low back problems. Before prescription of a spinal support one has to select the type of brace or support and one has to know what a support or brace can do.

Types of braces

Braces can be grouped into two major categories (a) corrective and (b) supportive. Corrective braces such as the Milwaukee and Boston Brace for the treatment of scoliosis will not be discussed. Attention is directed to spinal braces and spinal supports used for treatment of low back pain. In this institution 245 lumbar braces or lumbar supports, mainly for degenerative diseases of the lumbar spine, were prescribed in 1980 (Table 1).

Table 1. Lumbar orthoses prescribed for low back disorders.

Hohmann overbridging brace	19
Lindemann 2/3 semi-elastic brace	24
Bauerfeind nonatrophic lumbar support	99
Tigges lumbar support	103
Total	245

These braces can be divided into the elastic, the semi-elastic and the rigid-elastic support groups. The elastic group includes the Tigges lumbar support (Fig. 4) and Bauerfeind nonatrophic support (Fig. 5), the semi-elastic group includes the Lindemann ⅔ semi-elastic brace (Fig. 6) (Lindemann and Kuhlendahl, 1953). The rigid-elastic group includes the Hohmann overbridging brace (Fig. 7) (Hohmann, 1965).

The efficiency of lumbar supports was studied by Morris et al. (1961). They found that lumbar braces increase the intrabdominal pressure of the wearer at rest by compressing the abdomen and turning the abdomen into a semi-rigid cylinder (Fig. 3).

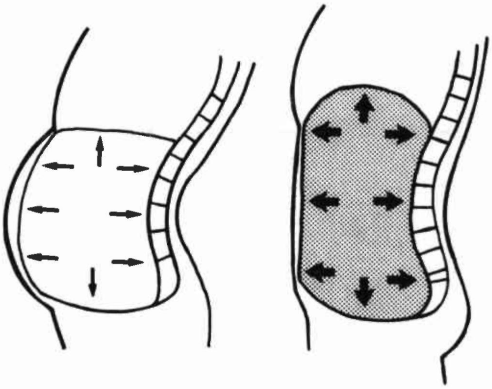

Fig. 3. The abdominal cavity may be considered as a water filled balloon. It can support some of the weight of the upper body if lateral deformation under load can be prevented by containment. The abdominal cavity is shown diagrammatically without lumbar support on the left and with lumbar support on the right (Morris et al, 1961; White and Panjabi, 1978; Radin et al, 1979).

The pressure within the abdominal cavity is believed to influence the load on the spine by supporting the trunk anteriorly. When a support is worn the weight of the upper half of the body rests on the semi-rigid cylinder and not only on the vertebral column. This results in a relief on the weight bearing spine. A lumbar support is constructed to replace the physiological function of the abdominal wall and designed to support the ventral muscles.

Norton and Brown (1957) studied the immobilizing efficiency of low back braces. In particular they examined their effects on the movement of the lumbosacral area and never found total immobilization. The effect of lumbar supports is a reduction of the arc of flexion and extension. Axial rotation and lateral bending is not reduced.

Tigges lumbar support

Function Support of lumbar spine. The immobilizing efficiency is low. The range of movement in the lumbosacral area during flexion and extension is slightly restricted. Supportive effect only below L3/L4.

Effectiveness of control

Axial rotation:	none
Lateral bending:	none
Flexion/extension:	minimal

Pad Flexible, segmental.

Indication Osteochondrosis of lumbar spine. Postoperative after surgery of the low back, slight instability of motion segment, muscle strain.

Cost 200DM.

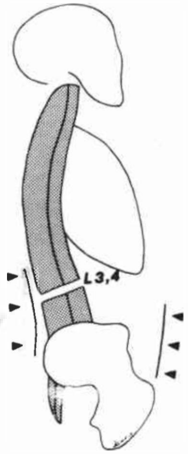

Fig. 4a. Force patterns of the Tigges lumbar support.

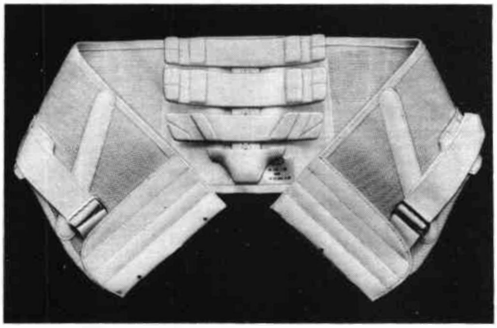

Fig. 4b. The Tigges lumbar support.

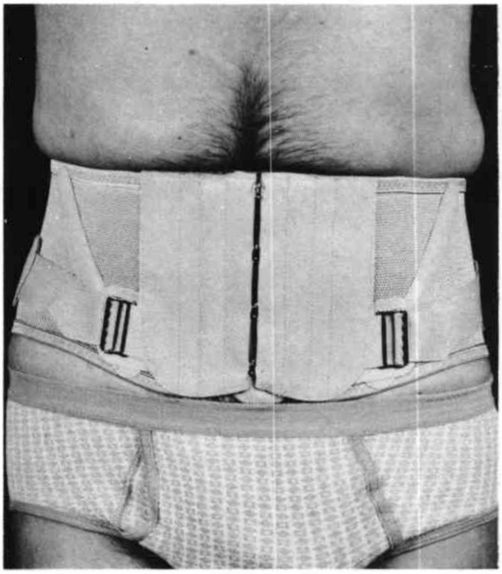

Fig. 4c. Frontal view.

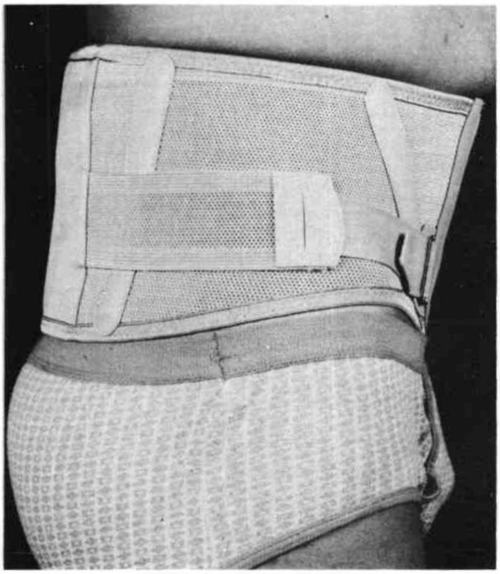

Fig. 4d. Lateral view.

Bauerfeind nonatrophic lumbar support

Function Support of lumbar spine. The immobilizing efficiency is low. The range of movement in the lumbosacral area during flexion and extension is slightly decreased. Supportive effect only below L3/L4.

Effectiveness of control

Axial rotation:	none
Lateral bending:	none
Flexion/extension:	minimal

Pad Semi-rigid covered with silicone.

Indication Osteochondrosis of lumbar spine. Postoperative after surgery of the low back.

Side effect None.

Cost 220DM.

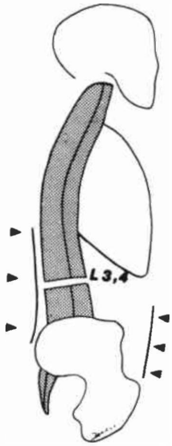

Fig. 5a. Force patterns of the Bauerfeind lumbar support.

Fig. 5b. The Bauerfeind nonatrophic lumbar support.

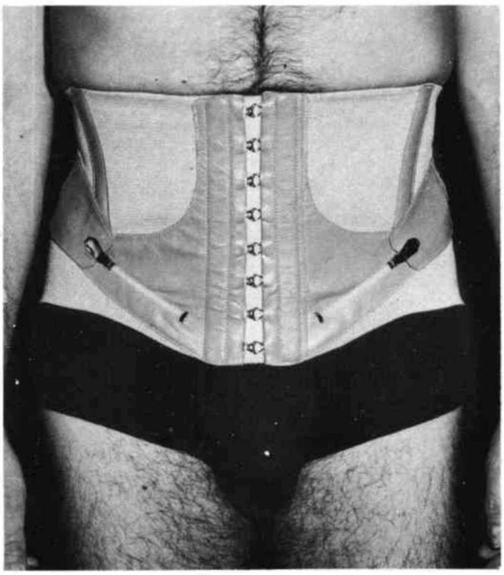

Fig. 5c. Frontal view.

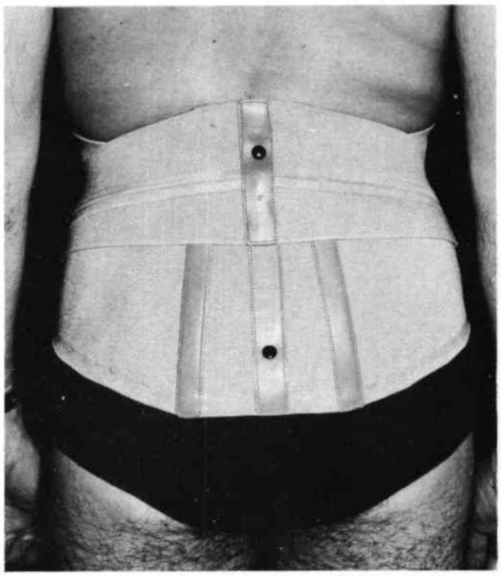

Fig. 5d. Posterior view.

The Lindemann 2/3 semi-elastic brace (Lindemann and Kuhlendahl, 1953; Bayerl and Schubje, 1965; Blomke, 1973).

Function Support of the lumbar spine, decrease of lumbar lordosis. Supportive effect only below T12.

Effectiveness of control

Axial rotation:	minimal
Lateral bending:	minimal
Flexion/extension:	minimal

Indication Insufficiency of back and abdominal wall muscles, slight osteoporosis. Lumbosacral instability.

Side effect Atrophy of back muscles by wearing for a longer time. Physiotherapy necessary.

Cost 200DM.

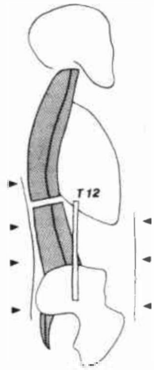

Fig. 6a. Force patterns of the Lindemann ⅔ semi-elastic brace.

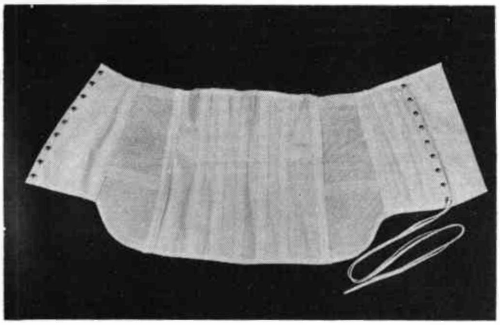

Fig. 6b. The Lindemann brace.

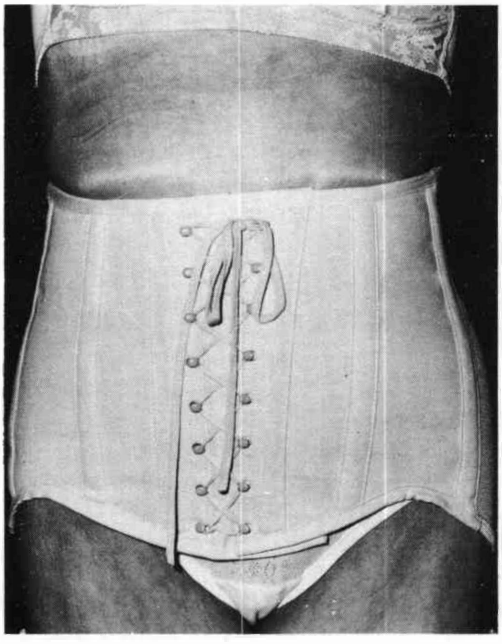

Fig. 6c. Frontal view.

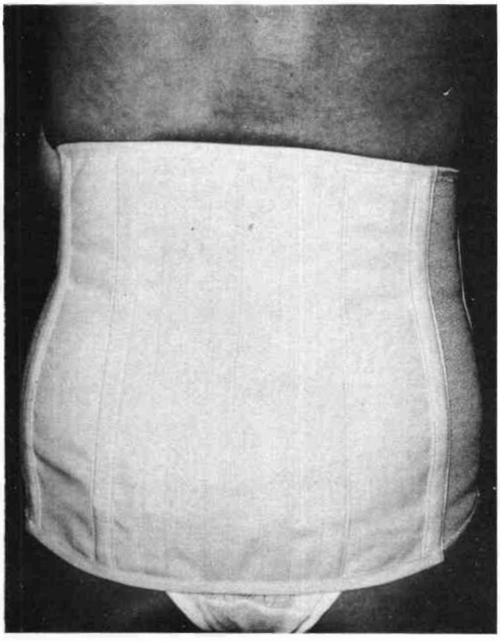

Fig. 6d. Posterior view.

The Hohmann overbridging brace (Hohmann 1965)

Function Support of lumbar spine, decrease of lumbar lordosis. Supportive effect only below L1/L2.

Effectiveness of control (White and Panjabi, 1978).

Axial rotation:	minimal
Lateral bending:	intermediate
Flexion/extension:	intermediate

Indication Severe osteochondrosis of lumbar spine, arthrosis of the facet joints, spondylolisthesis, osteoporosis (severe), lumbar scoliosis in adults. Severe instability of motion segments.

Side effects Atrophy of back muscles possible. Physiotherapy necessary.

Cost 800DM.

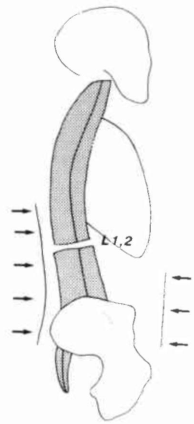

Fig. 7a. Force patterns of the Hohmann brace.

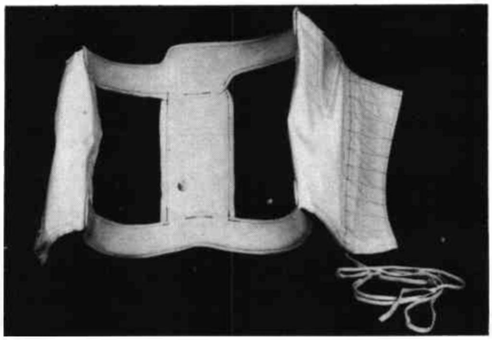

Fig. 7b. The Hohmann overbridging brace.

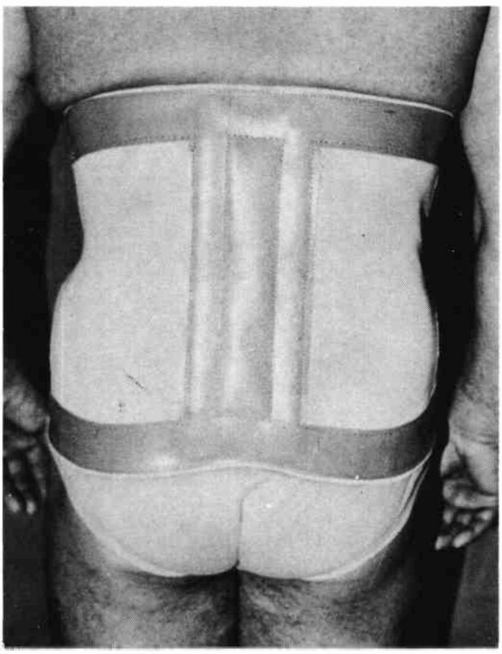

Fig. 7c. Posterior view.

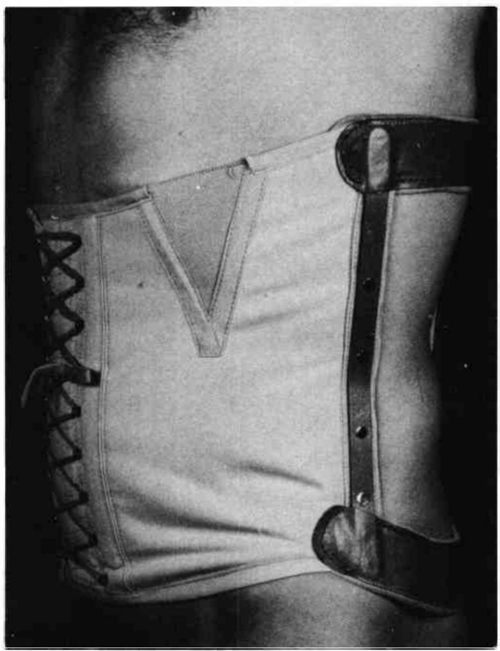

Fig. 7d. Lateral view.

The contribution of back muscles in low back pain

Weak back muscles as a contributory cause of chronic low back pain syndrome have been discussed by many investigators Schede (1966), Nachemson and Lindh (1969). Nachemson pointed out that the strength of the spinal muscles is of doubtful importance for the prevention of back pain, whereas he concluded that the muscle strength of the abdomen can protect the spine. It remains to be clarified whether a weakness is primary or secondary to back pain. It is believed in this Department that well trained muscles, especially abdominal wall muscles, can prevent back pain.

Walters and Morris (1972) studied the electrical activity of the trunk muscles and found no decrease of activity of back muscles and abdominal wall muscles in patients wearing lumbar supports during walking, whereas in standing they found a decrease in EMG activity.

Prescription indications

The purpose of supporting the lumbar spine is to permit ambulation while allowing local rest of the low back. In cases of persistent low back pain due to instability of posterior facet as a result of arthritis four different supports or braces are prescribed (Table 1).

Even when supports are used for acute episodes they sometimes have to be applied for a prolonged time. In these cases physical therapy is given to strengthen the trunk muscles and provide muscular stability. Good results have been obtained by training patients in Back Schools (Forsell, 1981).

The use of supports in cases of acute ruptured discs mostly increases the radicular pain because of increased venous blood flow through the intraspinal canal venous plexus. This can add additional compression to the irritated nerve root. Elastic lumber supports do not immobilize the spine. Extreme flexion and extreme extension is restricted, whereas lateral bending and rotation is unaffected.

Conclusions

A back support can restrict, but not prevent motion in the lower lumbar region. It seems highly unlikely that any device applied to the body can effectively splint the lumbosacral region.

A support produces primarily abdominal compression which transforms the abdominal cavity into a semi-rigid cylinder capable of transmitting stresses through the abdomen rather than through the spine (Morris et al. 1961; Morris, 1974).

Knowing this, the prescription of a low back suport or brace can be helpful in the treatment of low back pain. Many patients obtain symptomatic relief of pain from their use. For sure the relief of pain has also some physiological reasons.

There are many lumbar supports with the same basic construction but called by different names, they differ in the kind of materials used in their fabrication and in the pads.

Acknowledgements

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Measurement of maximal end-weight-bearing in lower limb amputees

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Abstract
Modern sockets for lower limb amputees utilize total contact and distribute some weight on the stump end. Its tolerance to bear weight varies but is better after joint disarticulation, however, systematic measures have been missing. Different levels, indications, shapes etc. were analysed with 102 measurements in 69 patients. The maximal-end-weight-bearing of the stump measured on a scale was much lower after transmedullar amputations than after disarticulations. Men had a mean tolerance more than 15 kg but women less than 10 kg. There was a positive correlation to body weight. Diabetics tolerated significantly more end-bearing and patients with phantom pain more than patients with stump pain. Within each category of stumps the range of maximal end-weight-bearing was large. Among all below-knee amputees the tolerance was between 2 to 55 kg or 3 to 79 per cent of body weight. Pointed stumps statistically tolerated about as much as rounded ones and the variability of contact surface was not measured as its sensitivity to pain must be unevenly distributed. It is concluded that this simplified method is helpful to analyse pain and to modify end-weight-bearing more individually.

Introduction

It is well known that knee disarticulation and Syme's amputation create stumps of high functional value. This is ascribed to the long lever arm for the movement of the prosthesis, to the reliable suspension due to the club shape of the stump and to the high end-weight-bearing capacity due to the rounded bone end and its large surface (Hornby and Harris, 1975). To create an increased surface of the bone end at a transmedullary amputation Swanson (1973) has tried a Silastic plug implanted into the marrow cavity to cover the end of bone. Dederich (1963) and others have suggested osteoplasty to bridge between fibula and tibia at below-knee amputation to enlarge and stabilize the end of bone. Foort (1981) has asked for attempts using the femoral condyles or similar bone trimmed and put back at the amputation level to create such an increased breadth of the surface to improve end-weight-bearing.

Older types of artificial limbs were either created for end bearing or for proximal bearing (hanging stumps) but most modern types of sockets distribute weight-bearing over the total stump, however, in spite of that some parts are given extra load. It is therefore not well-known to what extent stumps tolerate end-weight-bearing. Renström (1981) in a series of below-knee amputees, examined maximal end loading capacity using an ordinary weighing scale. Hornby and Harris (1975) examined a series of Syme's amputations also using a scale but combining the recorded total maximal end-weight-bearing with readings from a transducer pad, put into the bottom of the socket and relating to body weight what they called maximal end-weight-bearing capacity.

This paper represents a study of maximal end-weight-bearing capacity of the residual limbs, after lower limb amputation at different levels, with the intention of finding out how such values differ and how if possible this can be used in future for the design of the total contact socket or in analysis of pain.

Material and method

During 1981 102 measurements were taken of 69 patients, nine of whom were bilateral. Repeated measurements were made in 24 cases following an interval of between 1 and 9 months.

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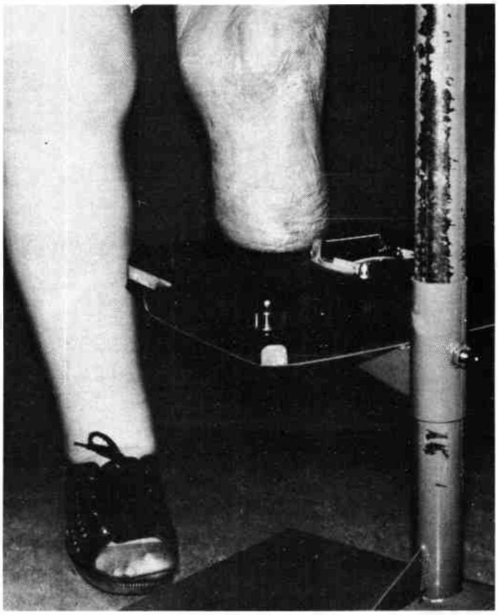

Fig. 1. Weighing scale mounted on adjustable table to measure maximal end-weight-bearing capacity of amputation stumps.

The method of measuring the maximal end-weight-bearing capacity is shown in Figure 1. A weighing scale of spring type (EKS, 0-120 kg, Holland) constructed for ordinary body weight measurements was mounted on a table. This was adjusted to a height to suit the individual when standing, allowing comfortable pressure with the stump on the scale. The patient watched the scale to see how much weight he could put on gradually for a few seconds. This was repeated two or three times and the maximum reading which the patient had been able to reproduce was recorded. The top of the scale had a cover of a soft plastic material 3 mm thick, however, when the measurements for 10 below-knee amputees were repeated with a hard wooden surface, there was no change in tolerance. At the same time basic notes were collected concerning age, sex, body weight, reason for amputation including diabetes level, date of amputation, general activity, shape of stump and phantom and stump pain problems.

Results

The mean age of the examined group was 67 years, the below-knee male group was 68 (SD 15) and the below-knee female group 76 (SD 11) years. The mean body weight was 64 kilograms, the below-knee males 70 (SD 10·6) and the below-knee female 57 (SD 11·4). The mean maximal end-weight-bearing capacity (MEW) of the entire population was 13 (SD 12·0), for the below-knee male group 13.3 (SD 10·7) and the below-knee female 7·9 (SD 5.3) kilograms.

Separated into different levels of amputation Figures 2-3 show the recorded end-weight-bearing capacities. Amputation through joints (hip, knee and ankle) had a much higher end-weight-bearing tolerance than transmedullary (AK and BK) amputations. Above-knee amputees tolerated 13·7 compared to below-knee 11 kilograms. Ischaemic below-knee amputees had a mean of 10·7 (SD 9·0) compared to other indications 13·9 (SD 10·9) kilograms.

There was a significantly higher MEW-value in patients with a higher body weight (Fig. 4). Tested on the entire group there was no increase by time following amputation (p=0·45). When looking at the below-knee level only there was still an increased MEW-value with increasing body weight (p=0·01) but none with increasing postoperative time (p=0·47). The male group had a significantly higher value than the female, (15·7 versus 9·4 kilograms). Among below-knee amputees active walkers tolerated more than less active walkers.

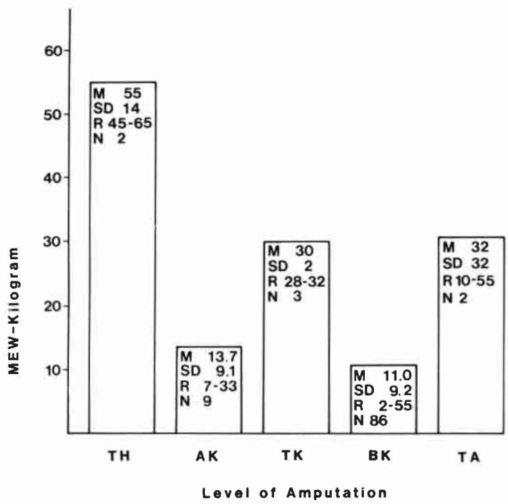

Fig. 2. Maximal end-weight-bearing (MEW) and level of amputation: TH=through hip, AK=above knee, TK=through knee, BK=below knee and TA=through ankle. M=mean, SD=standard deviation, R=range, N=number.

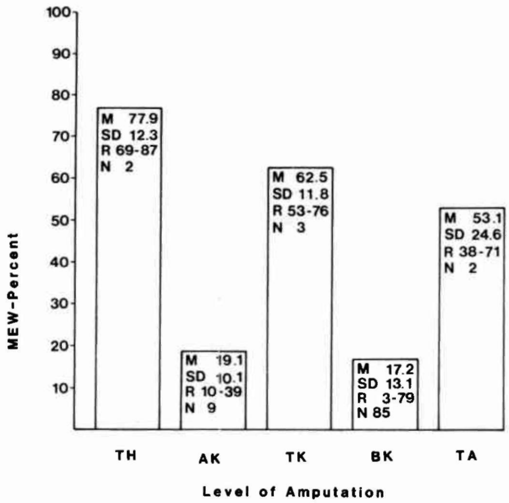

Fig. 3. Maximal end-weight-bearing (MEW) as a percentage of body weight and level of amputation.

It was noted that some patients with very high MEW-values after below-knee amputations were diabetic and when tested for this correlation it was found to be, for the below-knee level among diabetics, 21·5 (SD 17·5) and non-diabetics 14·3 (SD 8·5) kilograms (Fig. 5). This difference was the same when tested as absolute values (MEW-kilograms) or in relation to body weight (MEW-per cent). The lack of protective sensibility of diabetic patients could be expected to cause an increased number of patients with skin damage. In this material, however, there was no such difference with a quarter of the patients in both groups having skin damage. In addition, there was no correlation to diabetes with stump pain and phantom pain.

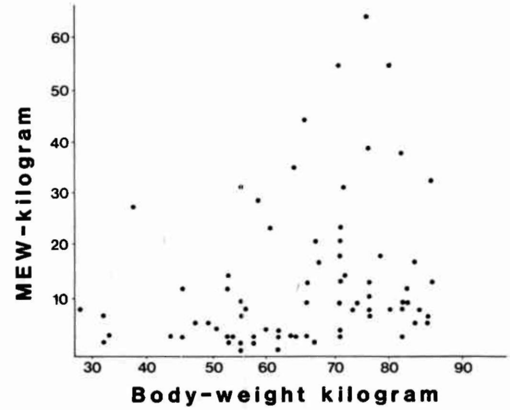

Fig. 4. Maximal end-weight-bearing (MEW) and body weight in BK. N=101, p=0·01, y=0·3+0·2x.

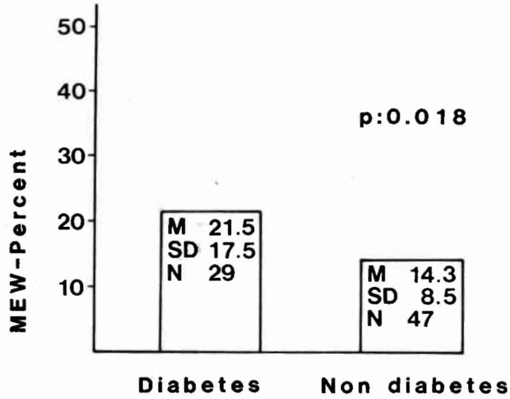

Fig. 5. Maximal end-weight-bearing (MEW) as a percentage of body weight among BK amputees for ischaemia with and without diabetes.

The maximal end-weight-bearing (MEW) is limited by tolerance of pain during the procedure. Patients with stump pain or phantom pain were separately analysed. Stump pain was correlated to significantly lower MEW-value (Fig. 6) but phantom pain was not (Fig. 7). To a certain extent the shape of the stump end could be correlated to perception of pain when testing MEW-values. There was no such difference between pointed and rounded stumps when analysed on all (Fig. 8) but when tested on stumps older than one year there was such a tendency but it was not statistically significant.

Discussion

Measurements of mechanical loading of stumps after amputation has not been used often according to the literature although weight-bearing capacity is critical for function with a

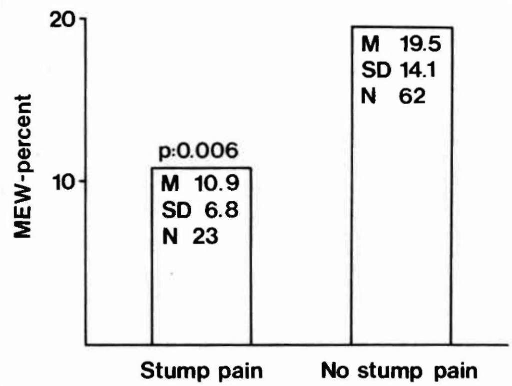

Fig. 6. Maximal end-weight-bearing (MEW) and stump pain in BK amputees.

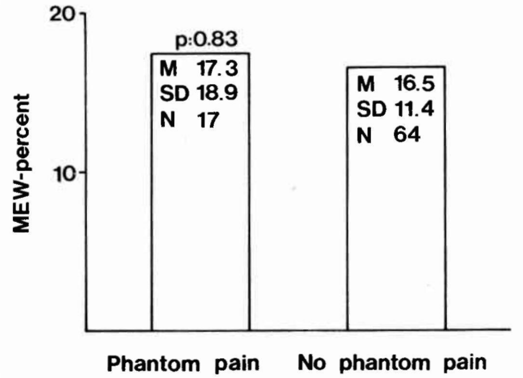

Fig. 7. Maximal end-weight-bearing (MEW) and phantom pain.

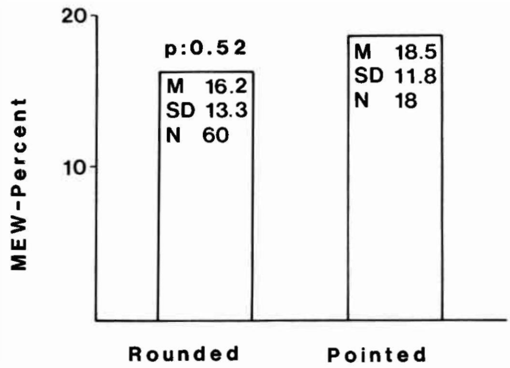

Fig. 8. Maximal end-weight-bearing (MEW) in per cent of body weight in BK amputees with rounded and pointed stump ends.

prosthesis and for construction of the socket. Baker and Stableforth (1969) found only five out of 67 Syme amputees unable to bear full weight on their stumps when standing, and Hornby and Harris (1975) found 19 out of 68 traumatic Syme patients unable to stand on their bare stump. They recorded "end-weight-bearing values" between 28 and 100 per cent of the body weight with a mean value around 75 per cent and noted that "those who could tolerate full end bearing on their bare stumps did well no matter what type of prosthesis they used".

The positive correlation between increased body-weight and end-weight-bearing capacity makes it reasonable to use MEW-values as a percentage body weight (MEW-per cent) rather than absolute values (MEW-kilograms), but both units have been used in this study because it is believed that it is easier to measure in kilograms. Newton is the correct SI-unit for force but when comparing to body weight it is pragmatic to retain kilogram for end-weight-bearing.

It seems possible that an enlarged series would prove the findings that through-knee amputations tolerate more than Syme and that through-hip tolerate more than through-knee and that these joint disarticulations as a group tolerate several times higher end-weight-bearing values than transmedullary levels do (Figs. 2 and 3).

It is highly interesting that diabetics had higher MEW-values though they did not have a higher proportion of skin damage. It was known that they have a better healing potential at below-knee level (Persson 1974) and that they might have a polyneuropathy which can explain their higher MEW-value. There is no information about how they manage with their prosthesis as a group compared to non-diabetic ischaemic patients but it is known that they are about 4 years younger. It is possible that longstanding diabetes gives higher MEW-values than old-age diabetes but the material did not allow that distinction.

An increase in the MEW-value with time following amputation was expected. There was such a tendency but it was insignificant. The study was not, however, designed to study this as it would have needed a series of patients individually followed at regular intervals. Hornby and Harris (1975) state that: "With the passage of time the Syme stumps toughened and became less sensitive". Renström (1981) examined 21 below-knee stumps (19 men, 2 women) 6-90 months postoperatively before and after 10 weeks of muscular training and observed that the loading capacity of the bare stump end increased from 11·9 ±2·9 (3-35) to 14·5±2·2 (3-40) kilograms as measured on a weighing scale. He did not compare this to any control group without training and the group contained amputees of traumatic, tumorous and ischaemic types with and without diabetes. Therefore detailed comparison with the present study is not possible.

Except for Syme and below-knee levels as cited above no reports of maximal end-weight-bearing tolerance have been found in literature. Analysing pain Weiss et al. (1971) measured surface pain and deep pressure sensitivity around the circumference of stumps and found very significant correlation with psychological self-rating criteria. Their findings probably correspond to the low ratings found in this study of maximal end-weight-bearing (MEW) in patients with stump pain. They measured around one circumference 2·5 cm below the medial tibial plateau or perineum in 44 below— and 56 above-knee amputees respectively and compared the findings to the unamputated side. The readings were taken by using a piston rod spring, with the tip one quarter inch square. Deep cutaneous pressure tolerance per square centimeter could thus be recorded ranging from 0 to 20 kg/cm^2, and was between 5 and 20 in the best rehabilitated cases. Deep pressure sensitivity had a mean of 4·3 kg/cm^2 in above-knee patients and 5·7 kg/cm^2 in below-knee patients (p 0·05). For the entire sample the below-knee stumps were less sensitive but deep sensitivity was the same in below— and above-knee stumps among diabetics. No reports are given concerning difference of sensitivity between diabetics and non-diabetics as found in the present study. The difference found between above— and below-knee levels in this study was not significant and is contradicted by the finding that below-knee stumps had a higher tolerance of load per square inch around a distal circumference in the above mentioned study (Weiss et al. 1971).

Older stumps become more pointed by atrophy at the same time as they may become toughened by training. Differences in MEW-values between rounded and pointed below-knee amputees could not be demonstrated. Extremely pointed stumps of course must tolerate less total end loading due to the small surface. Theoretically maximal end-weight-bearing should be analysed with account taken of the area of contact but this would make a more elaborate method necessary as it can not be assumed that the tolerance is evenly distributed at all. The most sensitive part limits the load irrespective of the total contact surface. The lack of correlation between shape of end and MEW-value illustrates this and simple measurement of the maximal end-weight-bearing disregarding the contact area is thus preferred.

The difference found between patients with stump pain and phantom pain seems highly interesting as an objective method to differentiate pain problems and to refine the socket distribution of pressure during casting for the prosthetic socket. The total contact socket should distribute weight-bearing differently in different individuals allowing the patient to put at least his body-weight on the artificial limb with a minimum of pain and adverse skin reactions.

Acknowledgement

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Biomechanics of functional electrical stimulation

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Abstract

Patients with hemiplegia frequently have difficulty in walking due to lack of eversion and dorsiflexion capability of the foot. One method of treating these patients utilizes functional electrical stimulation (FES). The effect of FES on locomotion, co-ordination, proprioception and balance sense was assessed using instrumented gait analysis and a postural sway test. In general patients treated with FES showed either a marked improvement or very little change. Any improvement was reflected in postural sway and ankle control during locomotion. Changes in hip and knee control were insignificant.

Introduction

This paper describes the influence of functional electrical stimulation (FES) on locomotion and co-ordination/proprioception assessed by tests carried out on hemiplegic patients using the underknee peroneal stimulator (Malezic et al. 1978). Tests included gait analysis and measurement of the displacement of the centre of pressure while standing still on both feet. During the locomotion test kinetic and kinematic data were collected using a Kistler force platform and television cameras interfaced to a digital computer. Forces and moments transmitted at the ankle, knee and hip levels were calculated and used for comparative assessment together with hip/knee angle variation and postural sway test results.

Method and apparatus

The underknee peroneal stimulator (FESE–L2) which was developed in Yugoslavia,* assists the swing phase of the gait by correcting the spastic equinovarus of a hemiplegic patient.

Fig. 1. The underknee peroneal stimulator (FESE–L2).

The FESE–L2 consists of a small compact stimulator unit attached to an elastic knee support and is powered by a 1·5 volt battery; the external electrodes are fixed in the elastic knee support and are placed over the tibialis communis and peroneal nerve points, in the popliteal fossa and behind the fibular head respectively. The stimulator is controlled by a heelswitch placed in the shoe which is switched on automatically on lifting the heel from the ground and stays on until "heelstrike" occurs or for a duration of 3 seconds whichever is less. The stimulator has a fixed delay time and provision for a variable delay time to simulate a more physiological walking pattern. The first delay, adjustable up to 350 ms, occurs at the start of the stimulus trigger allowing the plantarflexors to continue to be active until the instant of "toe off". If spasticity in the inverters and plantarflexors persists strongly and inhibits forward pivoting in the ankle joint, in late stance, this delay of stimulus trigger can be omitted and thus the eversion and dorsiflexion action can inhibit the spasticity in the

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antagonistic muscles. The second delay is non-adjustable at 100 ms and occurs at the end of the stimulus trigger allowing the dorsiflexors to be active from "heelstrike" until "foot flat". The introduction of these two delays and the location of the device close to the point of application is a great improvement over the earlier developed devices.

Two main tests were used to assess the patients: instrumented gait analysis and postural sway measurements.

Gait analysis

Kinetic and kinematic data were collected during both the swing and stance phases.

The patient was fitted with retro-reflective markers on the shank and spinae anterior iliacus and at the top part of the sacrum. These markers were illuminated by a light source fitted underneath the television cameras, whereby displacement data in the frontal and lateral planes were acquired using an interface and transmitted to the PDP 11 computer; corresponding measurements were taken from the Kistler force platform including the three ground reaction forces and their moments about the reference axes of the platform (X being antero-posterior, Y being vertical and Z being medio-lateral). After parallax correction of the displacement data the joint axes, ankle, knee and hip on the affected side were identified and moments about these axes were calculated considering external loading; gravity and inertia loading effects were included in the calculations for the knee and hip. For this particular test the main features during stance were knee angles and ankle moments while during the swing phase special attention was paid to hip and knee angles.

Postural sway measurements

Standing upright is a dynamic process and is maintained by input from visual, proprioceptive and vestibular systems. Measurements of sway were first attempted in the last century. In 1853 Romberg directed attention to the diagnostic significance of increased postural sway while standing still or while performing different tasks, in subjects with posterior column disorders. In 1886 Mitchell and Lewis estimated sway by observing the movements of the subject's head against a scale placed behind him.

Since then various methods have been developed to assess postural sway in "normal subjects" and in patients with neurological disorders.

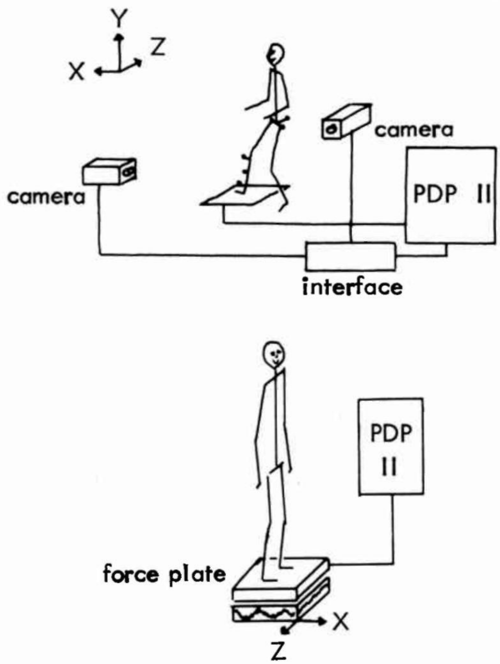

Fig. 2. Setup for instrumented gait analysis (top) and postural sway measurements (bottom).

Although measurement of the displacement of the centre of pressure between ground and feet is not a direct measure of the magnitude of body movement it is closely related to balance sense, co-ordination/proprioception and the ability of the body to correct. The patient or "normal" subject was placed with both feet on a single Kistler force platform without any external support.

Measurements were made of the vertical force, shear forces and their moments, while the subject stood still with eyes open and then closed. Duration of the measurement was 40 seconds and the data was sampled at a frequency of 20 Hz. From these, the displacement of the centre of pressure between ground and feet was derived in the antero-posterior (XO) and medio-lateral (ZO) direction. From the displacement of XO and ZO the length of the trajectory traced by the centre of pressure in the given time was calculated.

Data analysis

Hip and knee angles were calculated from the TV data in the gait analysis and are presented as

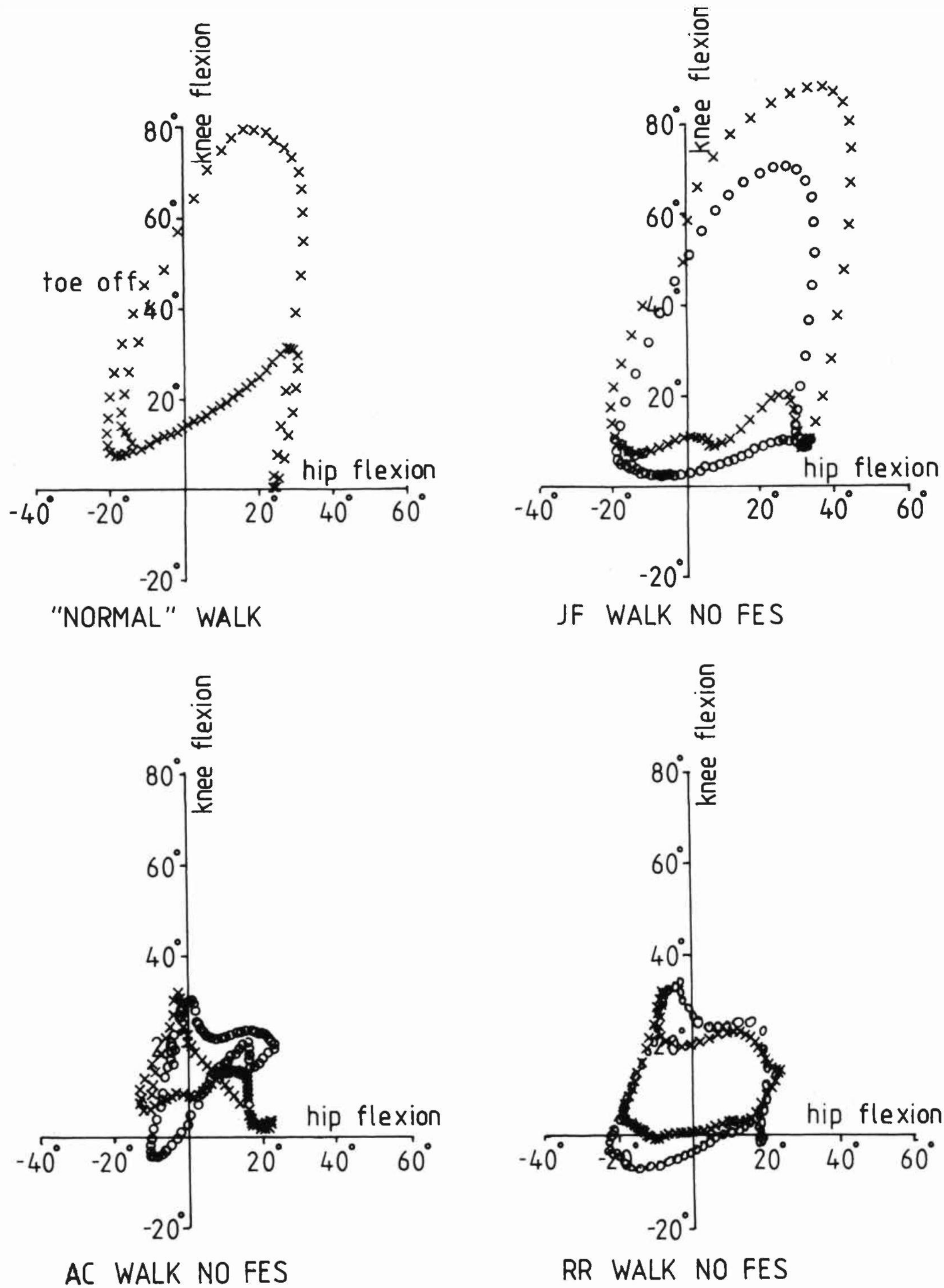

Fig. 3. Hip and knee angles—see text.

characteristic angle/angle diagrams of the hip and knee (Grieve, 1968), in Figure 3. Although the changes in hip and knee angles are small for the individual patient, when the curves for several patients are compared a marked difference in the shape of the diagrams is apparent.

A patient with a dropfoot and only slight spasticity shows a diagram approaching the "normal" (Fig. 3, top left and right); a patient with a dense hemiplegia with little hip and knee control shows a sharp triangular shape (Fig. 3, bottom left) and a patient with marked spasticity and reduced knee action during swing shows a rectangular shaped diagram (Fig. 3, bottom right).

The characterization of this type of patient is variability in performance from step to step and also from one occasion to another.

As mentioned earlier, the length of the trajectory traced by the displacement of the centre of pressure was calculated. In Figure 4 the length of this trajectory is represented for all of the patients reviewed and for each occasion of review the points corresponding to each patient are connected by a full line and these are presented to a base of time according to the scale indicated.

The three subjects (C1; C2 and C3) are patients who did not receive FES treatment, but conventional physiotherapy, they show some small changes. The subjects F1 to F11 are patients who during the course of this investigation received FES treatment. All patients were "stabilized" having received the normal course of physiotherapy treatment before the commencement of the trial. During the test period the controls and the patients treated with FES received normal physiotherapy. Figure 4 shows that the patients treated with FES showed a great variety of changes.

These changes correspond greatly with subjective clinical observations. For example subject F11 had an ischaemic transient attack during the period of treatment; his second assessment just after this attack showed large deterioration; the third assessment shows that

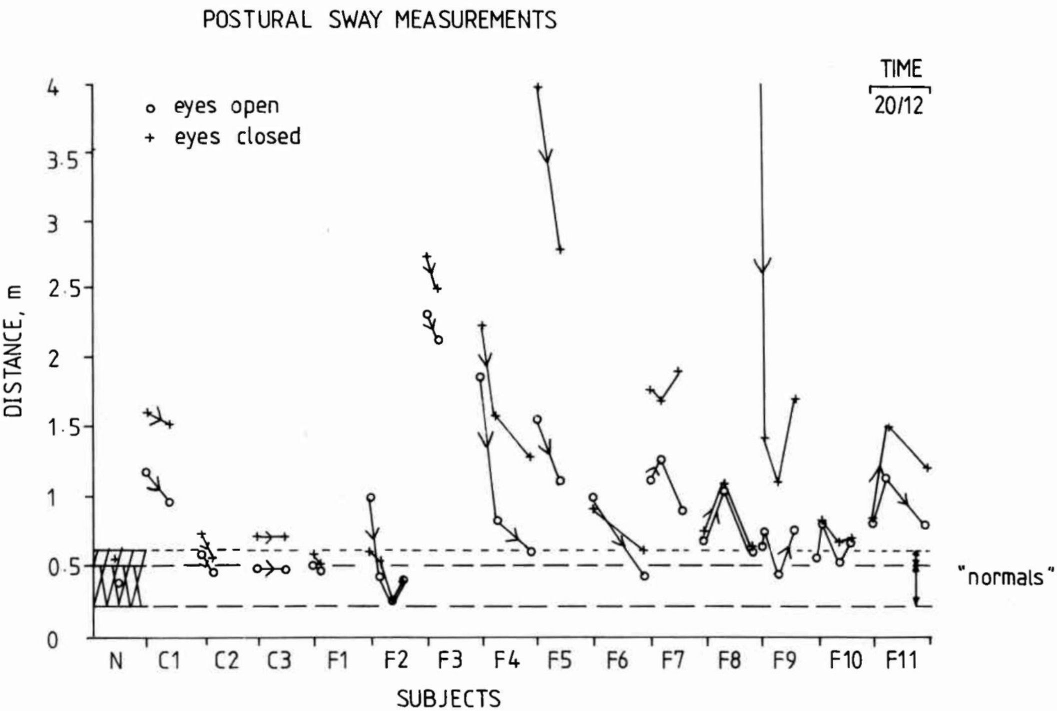

Fig. 4. Postural sway measurements for all patients reviewed.

with the eyes open he had recovered to the same level as before, but with his eyes closed he had improved but not to the level of his first test. Clinically this patient showed after this intermediate attack some difficulties in concentration but his walking ability had hardly changed.

These transient strokes are not always remarked upon but do hold the patient's progress back. This is also one of the drawbacks when stroke patients are compared with each other, either as a control group or for assessment of one patient over any length of time.

Conclusions

In general, patients treated with FES show either marked improvement or barely assessable improvement. Since patients in this trial were all "old", well established hemiplegic patients, who were considered to have reached the optimum point in their rehabilitation programme, the improvement may be considered to be due to the influence of FES, and it may be concluded that for some patients FES offers the chance of considerable improvement. It is not clear, however, how such patients may be identified.

The underknee peroneal brace is an improvement over the earlier developed devices; nevertheless it still needs further improvement in durability. A hemiplegic patient is inevitably a clumsy patient and cannot always be as careful as he would like to be. Nevertheless, patients were very quick to learn how to apply and use this device. Generally patients' aptitude in fitting the brace was satisfactory, as judged by an assessment by the researcher the first day after primary fitting.

During this trial it was remarked upon that the postural sway measurements may reflect the progress of the patient more accurately than the instrumented gait analysis which may exhibit the great variability in performance from step to step.

Acknowledgements

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An improved above-knee prosthesis with functional versatility

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Abstract

An above-knee prosthesis is described which is designed to permit the patient to assume easily the squatting and sitting cross legged postures which are a part of routine living in Afro-Asian countries. The prosthesis incorporates a multibar linkage mechanism which co-ordinates knee flexion and extension with ankle dorsiflexion and plantarflexion, and a thigh rotation system fitted at the level of the knee axis.

Introduction

The conventional above-knee prosthesis denies the user the freedom to squat and sit cross-legged (SCL). While this is not a serious limitation to Western users, in Afro-Asian countries where squatting and SCL postures (Fig. 1) are a part of routine living, the limitation is gravely felt. Therefore, there has been intensive research and development effort in this direction with the goal being near normal function with simplicity and economy in design. An above-knee prosthesis incorporating a thigh turntable with a manually operated lock was reported by Natarajan (1971). A unilateral amputee using this type of prosthesis first squatted on the normally functioning leg with the prosthesis extended forward, thereafter, following manual unlocking of the thigh turntable, the lower segment of the prosthesis was lifted by hand to the final cross-legged position (Fig. 2). When rising the reverse sequence was followed. The entire procedure was quite different from the normal and unaesthetic. Hence, there was a clear need for an improved system which did not involve any hand manipulations and looked normal as far as the movement was concerned.

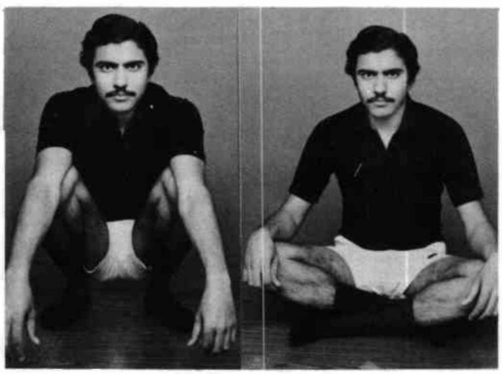

Fig. 1. Demonstration of normal symmetrical squatting posture and sitting cross-legged (SCL) posture.

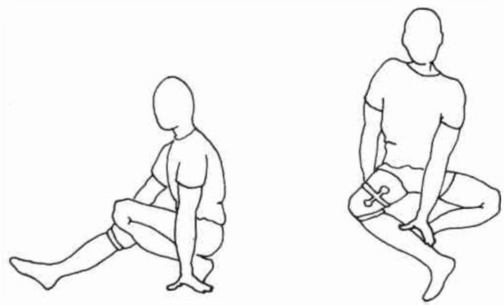

Fig. 2. Above-knee prosthesis with manually locked turntable (see text).

More recently some improved designs have been reported (Madhvan et al. (1977); Guha et al. (1977); Chaudhry et al. 1981). In these a spring loaded thigh turntable provided automatic rotation during the SCL manoeuvre and a cam-follower linkage between the knee and the ankle provided proper ankle flexion during squatting. Although these features

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permit squatting and SCL without awkwardness, the system was found to have some practical problems. It was observed that during normal walking if the subject happened to step on a big stone, the thigh turntable would rotate. Increasing the tension in the spring was not a satisfactory solution because it led to slipping of the stump in the socket during SCL. Therefore, it was necessary to redesign the device with a totally new concept. In addition, the cam-follower arrangement necessitated a large cam area at the knee joint which resulted in poor cosmesis. Also, due to wear and tear at the cam surface after a moderate period of use the mechanism required periodic adjustments. Once again the need was felt for an alternative approach.

A more serious problem was encountered in patients with long stumps including those with through-knee amputations. The combination of the cam-follower arrangement and thigh turntable occupied a fairly large space and therefore long stumps could not be accommodated. A design which incorporated the mechanism at or about knee level and yet permitted all the required functions was called for.

Design of the squatting mechanism

Detailed trials were carried out to evolve an optimum type of linkage mechanism which would give co-ordinated flexion of the ankle with respect to knee flexion so as to bring about a smooth squatting posture. The additional requirements to be met were simplicity in operation and maintenance, light in weight and of a size so as to fit completely within the shank portion of the prosthesis. A multibar linkage mechanism (Fig. 3) meets the requirements more or less fully. The first link connects the knee axis to the auxiliary axis which is slightly below the knee axis. The auxiliary axis movement caused by the knee flexion/extension is transmitted by the upper link to another movable link (circular disc) which is constrained to rotate only about a fixed axis. To this movable link is attached the lower link which causes downward movement of the posterior portion of ankle causing it to rotate from plantarflexion to dorsiflexion as the knee flexion increases progressively and vice versa. Thus, flexion and extension of the knee causes dorsi- and plantarflexion of the ankle respectively. From

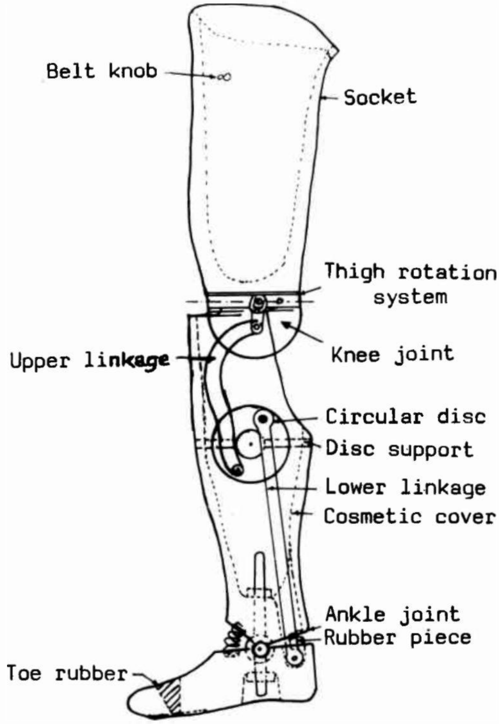

Fig. 3. Above-knee prosthesis with squatting and SCL mechanism.

the work of Lamoreux (1971) it can be seen that during stance phase, which accounts for 60% of the walking cycle, the knee angle varies from 3° extension at heel strike to 37° flexion at toe off. The ankle angle was set at 3° dorsiflexion at the mid stance phase (that is, from 10% to 40% of the gait cycle) and the multibar linkage mechanism was carefully set so that the ankle angle remained more or less the same with respect to knee flexion throughout the stance phase. This ensured a stable stance phase for the amputee. The soft rubber heel cushion allows the knee angle to be in its neutral position at heel strike and at around 4° of plantarflexion at foot flat. In addition the soft toe rubber in the anterior portion of the foot allows about 10° extension which, combined with 3° of dorsiflexion of ankle, gives effectively 7° of plantarflexion at toe-off. With this the gait looked more or less natural. As the ankle flexion is increased progressively to 165°, the multibar linkage mechanism causes 50° dorsiflexion at the ankle and a smooth squatting posture takes place. In addition a coil spring was incorporated anterior to the ankle axis to facilitate return of the ankle to the initial stage.

Design of the SCL mechanism

A kinematic study was carried out on a number of male and female normal subjects to identify the distinct phases of movements in the SCL cycle (Guha and Kaur, 1978). This cycle starts with a stance phase followed by squatting phase, knee spread, foot slide and finally the SCL posture. In addition the forces and torques arising during the sitting cross-legged posture were also analysed. It was found that the floor reactions on two legs were not equal and consequently the forces and torques on both legs were not equal. This asymmetry is primarily due to the fact that one leg crosses in front of the other leg. This data has been further quantified by electromyographic studies (Guha, 1979). The data thus obtained from the normal subjects was quite useful in the design of the squatting mechanism for the unilateral amputees.

A special turntable provided with a spiral spring was designed in such a way so as to be incorporated at the knee joint axis (Fig. 4) to allow cross-legged posture. In this way the design was suitable for all stump lengths. Further the spring was so selected that it allowed adjustment in the initial torque over the range necessary for different subjects. This turntable system is novel in that it provides rotation of the upper segment but at the same time provides a firm foundation for coupling the links of the ankle-knee linkage system which does not rotate about the longitudinal axis. At the same time another arrangement keeps the thigh locked against any rotation during normal walking. However, during the squatting phase of SCL, in the mid-squat phase, the lock is automatically released. A spring loaded pin projects from the turntable system and gradually glides over an inclined plane formed by the stirrups of the leg. Thus, while the subject is going into the squatting posture, the pin is pressed at mid-squat phase (around 80° flexion) and releases the thigh lock. Once again while the thigh rotates, the pin mechanism does not rotate. With this arrangement, the subject could go from the erect posture to the SCL posture in the normal manner simply by placing the prosthetic leg ahead of the normal leg at the beginning of the SCL posture. During rising also, no hand manipulation is required and the spring torque itself restores the leg to the zero rotation state where it is locked automatically by the spring loaded pin as rising takes place. Thus to an observer, both sitting and rising look quite natural as if performed by an individual with no disability.

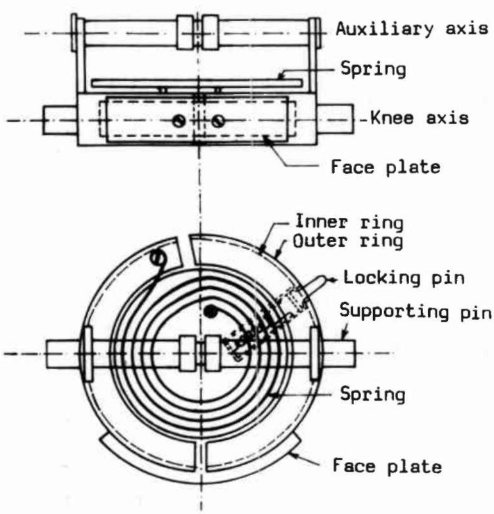

Fig. 4. Thigh rotation system at knee axis.

Clinical trials

The first phase of clinical assessment was carried out on two unilateral amputees. One amputee with a very heavy body build and another amputee with an average Indian light body build were selected. Both patients had medium stump length. Figures 5 and 6 show the first subject using the prosthesis. For most positions, a simple pelvic belt support was seen to be quite adequate. Even in asymmetrical squatting (Fig. 5), there was no stump slippage. However, during symmetrical squatting (Fig. 6), there was a tendency for the stump to slip out from the socket. Suitable strapping extending over the gluteal region prevented slippage. An alternative solution, which has still to be tried might be the use of a suction socket.

When kneeling on a smooth floor, there is a problem of the prosthetic leg slipping backward on the floor because the area of contact is limited to the upper margin of the shin and the front edge of the toe of the shoe of the prosthesis. This situation can be corrected by providing rubber padding at the outer periphery of the top edge of the shin so as to enhance the coefficient of friction of the prosthesis with the floor.

Movements in walking, squatting and sitting cross-legged were normal. At times, while

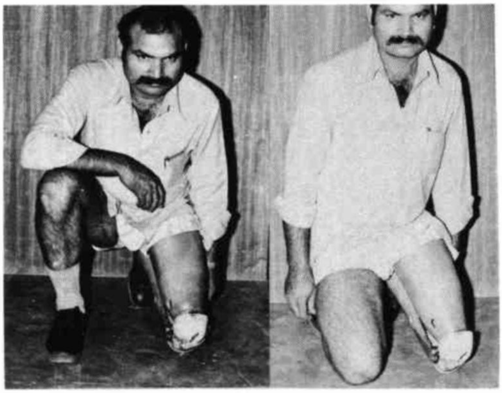

Fig. 5. Amputee in asymmetrical squatting and kneeling postures.

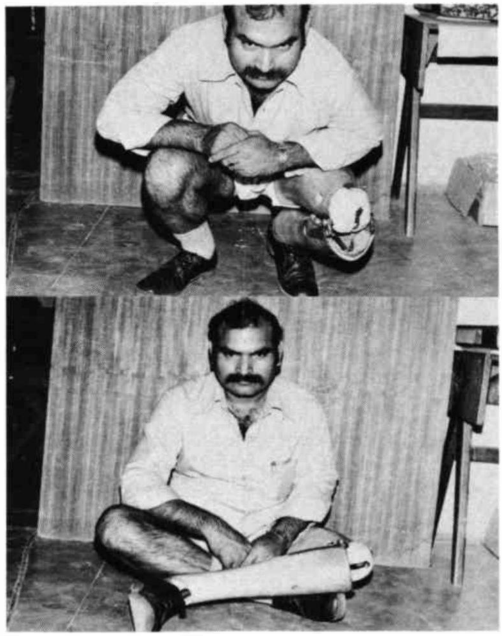

Fig. 6. Amputee in symmetrical squatting and SCL postures.

getting up from the floor, a slight upward thrust using the arm was necessary. The only complaint from the patients was that when sitting on a chair with the normal foot flat on the floor, the prosthetic foot remained somewhat dorsiflexed. Although a casual observer did not notice any abnormality, the patients themselves were concious of this deviation from the normal position of the foot. Work is underway to find the appropriate prosthesis linkage parameters which would enable this defect to be rectified without compromising the requirements of ankle-knee relationships during walking, squatting and sitting cross-legged.

Conclusions

The above-knee prosthesis described is simple in construction and has considerable functional versatility, it provides two additional important features of squatting and sitting cross-legged which are necessary for Indian conditions. Further it enables the user to assume the squatting and SCL positions as well as to rise from these positions without any manual intervention and with movements very much like normal.

Acknowledgements

This work was supported in part by the Government of India Department of Social Welfare and the Government of India Department of Science and Technology. The authors are grateful to Mr. Vijay Gulati who assisted in many ways in the present work.

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Prosthetics and Orthotics International, 1982, 6, 161–162

Letters to the Editor

Dear Sir,

Knud and Elsa Jansen

I have just heard from Birgit Cederholm of the deaths of Knud Jansen and of his gentle and talented wife Elsa but a few months previously. I write as a founding member and past Chairman of the Membership Committee of ISPO to express my profound sense of loss of these two fine people. It was Knud's dynamic leadership that fashioned the old sub-committee into the only one of all the subgroups of the International Society for Rehabilitation of the Disabled to provide a practical functioning facility for education and research and to lead us into a breakaway from the parent organization by the formation of ISPO. He was acknowledged by all of us who shared in this venture as the rightful person to be the first President of the infant organization—a decision endorsed by the first Congress—and under his benign yet firm guidance that infant thrived. It is largely through its functions that the spread of up-to-date, informed practice of Prosthetics/Orthotics has reached so many parts of the globe.

There will be many abler pens than mine who will pay tribute to Knud's high professional abilities but it is the memory of his and Elsa's friendship that I will always cherish. I wish also to extend my sympathy to their boys. It was a devoted family and their loss must be sore indeed.

Dr. D. S. McKenzie,
"The Killicks",
Charlwood, Horley,
Sussex RH6 0DR, U.K.

Dear Sir,

It is now 14 years since the Holte Conference was held in Denmark ("Inter-Regional Seminar on Standards for the Training of Prosthetists").*

The international representation was comprehensive and the recommendations were clear, concise, agreed upon by the delegates as an aim, and are freely available.

With regard to Prosthetic/Orthotic services, the Seminar was of the opinion, among other things, that:—

1. "Service should be located within a large general hospital . . . (and) an integral part of an orthopaedic or medical rehabilitation centre."
2. That "the Prosthetic/Orthotic service (be recognised) as a part of medical care".
3. That "one prosthetist per 300 of the amputee population meets the minimum requirement" (and) . . . "the supporting staff include prosthetic technicians, . . . shoemakers, etc".

Although the meeting was titled "Standards for the Training of Prosthetists", quite rightly, the recommendations detailed a system by which the musculoskeletally disabled in need of external aids, would benefit. This system appeared, and still appears, to be logical and capable of application without large capital outlay. It seems to me to be merely a method of integrating the treatment of these patients into its rightful place.

No matter what literature one reads—newspapers, magazines, scientific journals, etc.—the needs of patients requiring prostheses and/or orthoses do not seem to be satisfied. I would suggest this is because their treatment is not coordinated nor completed by the hospital that commenced it.

"*Aorta* do something about it" is a common plea, with the usual response being that they who ought

*Report of the United Nations Interregional Seminar on Standards for the Training of Prosthetists, Holte, Denmark, 19 July, 1968.

to (government welfare agencies), cannot afford to. I doubt if it has a lot to do with welfare agencies *per se*. I think the dissatisfaction is a result of uncoordinated and incomplete medical treatment—a 'health' rather than 'welfare' problem.

I have revisited Holte mentally many times in my own country with the hope that doctors, administrators, educators and patients will see the recommendations of this meeting in context—coordinated, continuing and complete medical treatment.

This country has had a school for the training of prosthetist-orthotists for 5 years. The whole impetus for its instigation was the Holte report, but this concept also seems to be a typical example of part treatment.

The graduates (diplomates with 3 years full time education) have difficulty in finding employment because hospital based prosthetic-orthotic departments have yet to be appreciated as the norm—the revisit to Holte has been too short or perhaps too shortsighted.

For several decades the Repatriation Artificial Limb and Appliance Centres have maintained treatment centres and had provided formal inservice training prior to the establishment of the prosthetic-orthotic school. Several of these centres are located in hospital grounds with outpatient clinics established as a routine hospital service for continued treatment of patients using prostheses and/or orthoses.

The Holte proposal for the employment of "technicians", to support qualified prosthetist orthotists, has been instigated as part of these treatment facilities.

The International Society for Prosthetics and Orthotics should be justifiably proud of its Holte deliberations, but perhaps Holte is due for revisiting.

I continue to hope that these recommendations will be followed in all countries as conditions permit, enabling patients to complete their treatment and be followed through.

Dr. R. Klein,
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Central Development (P/O) Unit,
Department of Veterans' Affairs,
131 Sturt Street,
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Prosthetics and Orthotics International, 1982, 6, 163–170

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August 1982, Vol. 6, No. 2

Deutsch

Mechanische Eigenschaften der Velcro-Verschluesse
D. L. Bader und M. J. Pearcy
Pros. Orth. Int. **6:2,** *93–96*

Zusammenfassung
Verschiedene in der Orthopädie gebräuchliche Klettenverschlüsse (Velcro) wurden auf ihre mechanischen Eigenschaften hin untersucht. Die Prüfung erfolgte mit einem Instron-Testgerät unter verschiedener mechanischer Belastung. Die Kraft-Dehnungskurven wurden ausgewertet inbezug auf Steifigkeit und Stärke der verschiedenen Verschlüsse mit besonderer Berücksichtigung der Veränderungen unter mechanischer Belastung. Der übliche Klettenverschluss war am stärksten und erwies sich bei rhythmischer Dauerbelastung den beiden andern Qualitäten überlegen. Es wurde versucht, die Anwendungsbereiche der verschiedenen Velcro-Verschlüsse gegeneinander abzugrenzen.

Ein Neuer Teststuhl
G. I. Bardsley und P. M. Taylor
Pros. Orth. Int. **6:2,** *75–78*

Zusammenfassung
Schwierigkeiten bei der Abklärung der bestmöglichen Sitzgelegenheit bei körperlich Behinderten führten zur Konstruktion eines verstellbaren Teststuhles. Seine beweglichen Teile lassen sich hydraulisch und mechanisch steuern. Verschiedene Stützpelotten stehen nach Bedarf zur Verfügung. Ein Vakuumkissen dient zur Bestimmung der optimalen Sitzfläche. Der Teststuhl hat sich bei der abklärung von Sitzproblemen klinisch gut bewährt.

Akustischer Feedback der Winkelstellung des Knies von Bein-Prothesen
J. A. Gilbert, G. M. Maxwell, R. T. George, Jr. und J. H. McElhaney
Pros. Orth. Int. **6:2,** *103–104*

Zusammenfassung
Für Oberschenkelamputierte und Exartikulierte im Hüftgelenk wurde dieses Therapiegerät entwickelt. Die Kontrolle der Winkelstellung des Prothesenknies erfolgte beim Gehtraining bisher rein visuell. Unser Gerät vermittelt nun dem Patienten ein akustisches Signal in Form verschiedener Tonfrequenzen je nach Winkelstellung des Prothesenknies.

Die Wirkungsweise von Lendenorthesen
N. D. Grew und G. Deane
Pros. Orth. Int. **6:2,** *79–87*

Zusammenfassung
Untersuchung der Wirkungsweise von Orthesen für die Lendenwirbelsäule an zwei Versuchsgruppen von Patienten mit und ohne Kreuzschmerzen. Die Auswirkungen von fünf verschiedenen Arten Lendenmieder auf die Hauttemperatur, Beweglichkeit der Wirbelsäule und den intraabdominalen Druck wurden registriert. Die Ergebnisse sind sich überraschend ähnlich obwohl die Lendenmieder sich voneinander recht stark unterscheiden. Das Tragen einer Lendenorthese über längere Zeit führt zu einer gewissen Abhängigkeit vom Hilfsmittel. Unsere Untersuchungen sollen der Verbesserung der Indikationsstellung und Verordnung für Lendenorthesen bei Kreuzschmerzen dienen.

Unterschiede im Energieaufwand Beim Normalen und Bein Prothesengang
H. Lanshammar
Pros. Orth. Int. **6:2,** *97–102*

Zusammenfassung
Der Aufwand an mechanischer Energie beim Gehen auf horizontaler Ebene wurde untersucht bei normalen und bei unterschenkelamputierten Versuchspersonen. Untersucht wurde auch der Einfluss des Gewichtes der Prothese auf den Energieaufwand.

Die Messungen wurden mit dem ENOCH-System verarbeitet. Dieses besteht aus einem Minicomputer (HP 21 MX), einem optoelektronischen Gerät zur Messung der Fortbewegung (Selspot) und einer Messplatte (Kistler) für die Bodendruckkräfte.

Die Ergebnisse der Untersuchungen von Winter und Mitarbeitern (1976) über den Kraftaufwand bei normalen Gehen anhand der Wegstrecke gemessen an einem Bein wurden überprüft mit Messungen an beiden Beinen und am Rumpf. Bei den Amputierten stieg der Kraftaufwand am Stumpf mit dem Gewicht der Prothese. Für die übrigen Körperabschnitte konnten indessen keine signifikanten Unterschiede festgestellt werden.

Klinische Erfahrungen mit Einer Knie-fuss-orthese fuer Hemiplegiker
Y. Morinaka, Y. Matsuo, M. Nojima und S. Morinaka
Pros. Orth. Int. **6:2,** *111–115*

Zusammenfassung
Erfahrungsbericht über eine neue Orthese mit physiologischem Knie- und Sprunggelenk, die an 25 Hemiplegikern getestet wurde.

Schuheinlagen Bei Leichten Fussdeformitaeten
R. G. S. Platts, S. Knight und I. Jakins
Pros. Orth. Int. **6:2,** *108–110*

Zusammenfassung
Moderne Werkstoffe und bessere Kenntnisse der biomechanischen Erfordernisse ermöglichen eine saubere und einfache Einlagenversorgung, wenn der leicht deformierte Fuss gut Platz findet in einem Serienschuh. Ein selbstschäumendes Polyurethan legt sich zwischen Schuh und Fuss oder dessen Gipsmodell. Bei 75 patienten wurde diese Technik mit Erfolg angewendet. Diese Art Einlagen ist zugleich dauerhaft und wirtschaftlich.

Wundheilungsstoerungen nach Beinamputationen
J. Steen Jensen, T. Mandrup-Poulson und M. Krasnik
Pros. Orth. Int. **6:2,** *105–107*

Zusammenfassung
Eine Reihe von 320 Amputierten wurden auf Wundheilungsstörungen und Nachamputationen untersucht. Bei 111 Oberschenkelamputierten war die Wundheilung gestört in 15/111 Fällen, eine nachamputation war erforderlich in 2/111 Fällen.

Bei der Knieexartikulation beliefen sich diese Ziffern auf 20/66 (30%) bzw. 13/66 (20%) Nachamputationen im Oberschenkel.

Bei Unterschenkelamputationen traten in 40% (57/143) Wundheilungsstörungen auf und führten bei 20% (28/143) zu Nachamputationen. Ist bei einem Unterschenkelstumpf eine Nachamputation notwendig, soll diese besser auf Höhe des Knies und nicht im Oberschenkel durchgeführt werden.

Rahmenschaft-Stumpfeinbettung in der Beinprothetik
R. Volkert
Pros. Orth. Int. **6:2,** *88–92*

Zusammenfassung
Bei der hier vorgestellten Technik wird die Prothese am Amputationsstumpf mittels eines Rahmenschaftes fixiert. Neben den zur Führung notwendigen festen Flächen werden die Weichteile elastisch eingebettet. Hierdurch wird bei gewahrten gutem Prothesensitz eine selbständige Regulation von Umfangs- und Volumens-veränderungen erreicht.

Español

Propiedades del material para tensores de Velcro
D. L. Bader and M. J. Pearcy
Pros. Orth. Int. **6:2,** *93–96*

Resumen
Se presenta una valoración de las propiedades de tres tipos de cierres de Velcro en ortopedia.

Los materiales fueron probados bajo varios regímenes con una máquina de pruebas Instron. Las curvas de fuerza se han analizado y determinando la dureza y resistencia de las diversas piezas con especial referencia a las piezas de ucción después del ciclo de carga.

La fuerza del Velcro standard está menos afectado después de un ciclo de carga para simular un uso continuo. Se hacen recomendaciones de la aplicación específica de cada tipo de Velcro basadas en las propiedades de los materiales.

Silla adaptable para el disminuido fisico
G. I. Bardsley and P. M. Taylor
Pros. Orth. Int. **6:2,** *75–78*

Resumen
Las dificultades en producir sillas para los disminuidos físicos nos ha llevado a una investigación de un proceso para prescribir la silla según los pacientes. Se ha desarrollado una silla con diferentes posibilidades de valoración con objeto de identificar las necesidades de los pacientes. Las principales variedades de la configuración de la silla se controla por varios sistemas hidraúlicos y mecánicos.

Se pueden montar sobre la silla diferentes superficies de apoyo simulando diferentes características de asiento. Empleamos una bolsa de vacío con bolas de plástico que simula un molde.

La experiencia nos dice que esta silla de valoración juega un papel clínico importante para configurar la forma ideal para sentarse.

Nota tenica—Informacion auditora del angulo de la rodilla para amputados
J. A. Gilbert, G. M. Maxwell, R. T. George, Jr. and J. H. McElhaney
Pros. Orth. Int. **6:2,** *103–104*

Resumen
Se ha desarrollado un nuevo aparato de entrenamiento de la marcha que suministra una información auditora del ángulo de rodilla en los amputados por encima de la rodilla y en desarticulados de cadera.

Tradicionalmente en los nuevos amputados se ha empleado una información visual de la posición de la rodilla durante el entrenamiento (Van Griethuysen, 1979). El nuevo sistema de información elimina la información visual dando un tono de frecuencia correspondiente al ángulo de rodilla.

Efectos fisicos de los aparatos de soporte de la columna lumbar
N. D. Grew and G. Deane
Pros. Orth. Int. **6:2,** *79–87*

Resumen
Se ha hecho un estudio de los efectos físicos de los aparatos de soporte de la columna lumbar. Se han estudiado dos grupos, uno de sujetos masculino normales y otro de pacientes con dolores en región lumbar.

Se han investigado cinco diferentes ortesis de columna vertebral y sus efectos sobre la temperatura de la piel, movimiento de la columna, presión intra-abdominal. Los resultados son muy similares en los varios diferentes modelos. Los hallazgos también sugieren que el llevar por mucho tiempo la ortesis de columna lleva a un grado de dependencia física. Los resultados de este estudio indican que se debe mejorar la prescripción y el uso en el tratamiento de dolores lumbares.

Variaciones de los niveles mecanicos de energia para marcha normal y protesica
H. Lanshammar
Pros. Orth. Int. **6:2,** *97–102*

Resumen
Se han investigado los niveles de enrgía para personas normales, y para amputados durante la marcha a nivel. El peso de la protésis se ha variado añadiendole 0·5 Kg.

Las medidas y los análisis se han hecho con el sistema ENOCH consistente en un microcomputador (HP 21 MX), un mecanismo optoelectronico para medida de los desplazamientos y una plataforma para medir la fuerza de reacción del suelo.

Los resultados según Winter y al. (1976) de los cambios de energía durante la marcha normal obtenidos con los datos de desplazamientos en una pierna solo fueron verificados usando datos de ambas piernas y el tronco.

Para los amputados se observó que los cambios de energía aumentaban en la pantorilla, cuando se aumentaba la carga. No se encontraron diferencias en los otros segmentos del cuerpo ni en el cuerpo en total.

Evaluacion clinica de una ortesis rodilla-tobillo-pie para pacientes hemiplegicos

Y. Morinaka, Y. Matsuo, M. Nojima and S. Morinaka

Pros. Orth. Int. **6:2,** *111–115*

Resumen

Se ha desarrollado una ortesis de rodilla-tobillo que incorpora una articulación geocéntrica de rodilla y un diseño similar de la articulación del tobillo. Se discute su diseño y se hace una evaluación de su uso en 23 pacientes hemiplégicos.

Adaptaciones para pequeñas deformidades del pie

R. G. S. Platts, S. Knight and I. Jakins

Pros. Orth. Int. **6:2,** *108–110*

Resumen

Los modernos materiales y un mejor conocimiento de las necesidades biomecanicas permiten adaptaciones al calzado faciles y rapidas en casos en que el pie deformado sea suficientemente pequeño para adaptarse a calzados normales. Se usa una espuma que se genera ella misma en el interior del calzado. Se expande a la forma interna del calzado y a la externa del pie. Puede usarse directamente con el pie del paciente o con un molde positivo de escayola. La técnica se ha usado en 75 pacientes, con buenos resultados. Es además de gran duración y económico.

Complicaciones de la curacion de la herida en amputaciones de la extremidad inferior

J. Steen Jensen, T. Mandrup-Poulson and M. Krasnik

Pros. Orth. Int. **6:2,** *105–107*

Resumen

Se han analizado una serie de 320 amputados con respecto a las complicaciones en la curación de la herida y los porcentajes de reamputación.

Entre 111 amputaciones por encima de la rodilla se encontró un 14% los casos (15/111) que tuvieron complicaciones, con un 2% de reamputación (2-111).

En amputados a través de la rodilla hubo problemas en 30% (20/66) con reamputación en 20% (13/66) a nivel encima de la rodilla, comparado con 40% con complicaciones de curación de la herida (28/143) y 20% de reamputaciones (28/143) por debajo de la rodilla.

Como el fallo en amputaciones debajo de la rodilla lleva a reamputaciones por encima de la rodilla, se recomienda elegir la amputación a través de la rodilla en casos dudosos.

Encaje marco para protesis de miembro inferior

R. Volkert

Pros. Orth. Int. **6:2,** *88–92*

Resumen

Esta técnica presenta el uso de un encaje marco para la fijación de la protésis al muñón. Aparte de las areas rígidas para su estabilización y control, el tejido blando del muñón está envuelto en material flexible. Ello permite que se adapte por si mismo a los cambios de circunferencia y volumen del muñón, conservando la buena adaptación del encaje.

Français

Propriétés des fixations Velcro

D. L. Bader et M. J. Pearcy

Pros. Orth. Int. **6:2,** *93–96*

Résumé

Une étude de 3 types de matériel de fixation Velcro (mini-crochets sur velours épais à presser surface contre surface) est présentée.

Ces différents matériaux ont été testés par une machine Instron. Les courbes force-extension ont été analysées et les valeurs de rigidité et résistance déterminées. Les altérations de la force d'attache ont été particulièrement étudiées après une charge cyclique.

La force du Velcro standard était moins modifiée après une charge cyclique que continuelle. Une recommandation est faite quant à l'application spécifique de chaque type de Velcro selon ses propriétés.

Fáuteuil de malade permettant des tests
G. I. Bardsley et P. M. Taylor
Pros. Orth. Int. **6:2,** *75–78*

Résumé
Les difficultés de depart à la prescription d'un fauteuil pour invalide ont conduit à étudier le processus de la détermination d'un siège. Un fauteuil adaptable a été construit pour reconnaître les exigences du patient.

La plupart des variations possibles sont contrôlées par un système hydraulique et mécanique.

Différents appuis peuvent être fixés au fauteuil. Un système sous vide peut simuler un siège-baquet moulé.

L'expérience actuelle a montré que ce fauteuil-test permet une évaluation clinique valable lors de la décision du type de fauteuil.

Note technique: signal acoustique selon l'angulation de l'articulation du genou pour amputés
J. A. Gilbert, G. M. Maxwell, R. T. George, Jr. et J. H. McElhaney
Pros. Orth. Int. **6:2,** *103--104*

Résumé
Un nouveau système de training à la marche a été développé: c'est un signal acoustique renseignant sur l'angulation du genou pour les patients après amputation à la cuisse et après désarticulation de la hanche. Jusqu'à présent, les nouveaux amputés avaient un contrôle visuel. Ce système auditif supprime le contrôle visuel en produisant un son codifié selon l'angulation.

Les effets physiques d'une orthèse lombaire
N. D. Grew et G. Deane
Pros. Orth. Int. **6:2,** *79–87*

Résumé
Nous avons étudié les effets physiques de supports de la colonne lombaire sur 2 groupes, l'un comprenant des sujets mâles normaux, l'autre des hommes souffrant de lombalgies. Cinq supports différents ont été testés quant à la température de la peau, les mouvements de la colonne et la pression intraabdominale. Les résultats sont étonnament identiques malgré la grande variété de ces supports. Ils suggèrent également une dépendance physique certaine lorsque l'orthèse est portée longtemps. Les résultats de cette étude tendent à améliorer la prescription et l'utilisation d'orthèses lombaires dans le traitement des lombalgies.

Variations du niveau d'énergie mécanique à la marche chez le sujet normal et chez l'amputé appareillé
H. Lanshammar
Pros. Orth. Int. **6:2,** *97–102*

Résumé
Nous avons étudié le niveau d'énergie mécanique à la marche à plat chez le sujet normal et chez l'amputé de la jambe. Nous avons varié le poids de la prothèse en y fixant 500 gr.

Les mesures et analyses ont été faites par syst eme ENOCH composé d'un mini-computer (HP 21 MX), d'un appareil optoelectronique Selspot de mesure du déplacement et d'une plaque (Kistler) de mesure des forces de réactions au plancher.

Les résultats de létude Winter et coll. (1976) sur les changements dénergie durant la marche normale obtenus par les données de déplacement sur une jambe seulement ont été vérifiés en utilisant les données des 2 jambes et du tronc.

Pour les amputés, les changements d'énergie augmentent au membre amputé appareillé lorsque le poids de la prothèse augmente. Pour les autres parties testées, il n'y a pas de différence.

Evaluation clinique d'une orthèse genou-cheville-pied pour hémiplégique
Y. Morinaka, Y. Matsuo, M. Nojima et S. Morinaka
Pros. Orth. Int. **6:2,** *111–115*

Résumé
Une orthèse avec 2 articulations centrées l'une sur le genou, l'autre sur la cheville a été développée. On en discute la forme et son évaluation clinique sur 25 cas d'hémiplégie.

Semelles orthopédiques pour déformités légères des pieds
R. G. S. Platts, S. Knight et I. Jakins
Pros. Orth. Int. **6:2,** *108–110*

Résumé
Des matériaux modernes et une meilleure compréhension des exigences biomèchaniques permettant des adaptations rapides et faciles lorsque le pied déformé est assez mince pour trouver place dans un soulier de confection. On place un polyuréthane souple auto-moussant dans le soulier. Il s'étale en prenant la forme interne du soulier et la forme du pied. Il peut être utilisé directement sur le pied du malade ou sur un modèle en plâtre. Cette téchnique a été utilisée dans 75 cas avec succès de façon durable et économique.

Complications à la cicatrisation après amputations majeures du membre inférieur
J. Steen Jensen, T. Mandrup-Poulson et M. Kransik
Pros. Orth. Int. **6:2,** *105–107*

Résumé
Nous avons analysé une série de 320 amputations quant aux complications de plaie et à la fréquence de réamputation.

Sur 111 amputations de cuisse, nous avons trouvé 15 cas de complications (14%) obligeant une réamputation dans 2 cas (2%).

Les désarticulations du genou ont été suivies de problèmes de cicatrisation dans 30% (20 sur 66) des cas et réamputation à la cuisse dans 20% (13 sur 66).

Les amputations de jambe ont conduit dans 40% (57 sur 143) à une réamputation.

Lorsqu'une réamputation après amputation de jambe est nécessaire, il est recommandé de l'envisager d'abord à la hauteur de l'articulation du genou et non pas à la cuisse.

Appareil pour amputation de la jambe: Emboitement du moignon dans un cadre
R. Volkert
Pros. Orth. Int. **6:2,** *88–92*

Rèsumè
Dans la technique représentée ici, la prothèse est attachée au moignon à l'aide d'un cadre à tiges fixes. La partie rigide sert de cadre à des pièces souples et élastiques. La prothèse possède ainsi son propre moyen de règlage, s'adaptant à tout changement de circonférence et de volume du moignon.

Italiano

Proprieta' materiali dei dispositivi di fissaggio Velcro
D. L. Bader e M. J. Pearcy
Pros. Orth. Int. **6:2,** *93–96*

Riassunto
Viene presentata una valutazione delle proprietà fisiche di tre tipi di fissaggio con chiusura a contatto (Velcro) generalmente impiegati in campo ortopedico.

I materiali sono stati collaudati in diversi regimi di carico utilizzando un apparecchio Instron. Sono state analizzate le curve forza-estensione e sono stati determinati i valori sia della rigidità sia della resistenza dei vari accessori. Si è inoltre fatto particolare riferimento alle eventuali alterazoni nella resistenza degli accessori dopo l'applicazione dei cicli di carico.

Si è riscontrato che la resistenza dei Velcro standard risulta alterata solo in minima parte dopo l'applicazione dei cicli di carico che simulano un impiego continuativo. Per ciascun tipo di Velcro se ne raccomanda l'utilizzazione in casi specifici di impiego sulla base delle singole proprietà fisiche.

Realizzazione di una nuova sedia "assessment"
G. I. Bardsley e P. M. Taylor
Pros. Orth. Int. **6:2,** *75–78*

Riassunto

Le iniziali difficoltà emerse nella fabbricazione di sedili per portatori di handicaps fisici hanno condotto ad un'indagine più approfondita dei criteri di scelta che stanno alla base dell'adozione di un determinato tipo di sedile. Allo scopo di identificare più correttamente le esigenze posturali dei pazienti è stata messa a punto una nuova sedia regolabile per l' "assessment", per meglio valutare cioè la fondatezza di tali esigenze.

Le principali variabili nella configurazione della sedia rispondono ad un certo numero di comandi idraulici e meccanici.

Varie superfici di supporto possono poi essere fissate alla sedia in modo tale da riprodurre diverse caratteristiche posturali. Attualmente per riprodurre sedili conformati si utilizza un sistema di consolidamento sotto vuoto con "bead bag".

I risultati ottenuti fino ad ora confermano l'importanza del ruolo clinico svolto dalla sedia "assessment" nella scelta del tipo di sedile da adottare per il singolo paziente.

Nota tecnica—Feedback uditivo dell'angolo del ginocchio per amputati

J. A. Gilbert, G. M. Maxwell, R. T. George, Jr. and J. H. McElhaney

Pros. Orth. Int. **6:2,** *103–104*

Riassunto

E' stato messo a punto un nuovo dispositivo per la rieducazione deambulatoria basato sul principio del feedback uditivo delle informazioni relative all'angolo del ginocchio per gli amputati di coscia e con disarticolazione dell'anca. Fino ad ora, i neoamputati facevano esclusivo affidamento al feedback visivo della posizione del ginocchio durante la rieducazione deambulatoria (van Griethuysen, 1979). Questo nuovo sistema di feedback uditivo elimina invece la necessità di disporre di un feedback visivo in quanto fornisce un codice di frequenza tonale che corrisponde all'angolazione assunta dal ginocchio durante la marcia.

Effetti fisici delle ortesi spinali lombari

N. D. Grew e G. Deane

Pros. Orth. Int. **6:2,** *79–87*

Riassunto

E' stata effettuata un'indagine circa gli effetti fisici delle ortesi spinali lombari. Sono stati studiati due gruppi, di cui uno costituito da soggetti normali di sesso maschile e l'altro da pazienti di sesso maschile affetti da lombalgia. Sono stati esaminati cinque diversi tipi di ortesi spinali e se ne sono studiati gli effetti sulla temperatura della cute, i movimenti spinali e le pressioni intra-addominali a carico dei soggetti portatori di ortesi. I risultati si sono rivelati sorprendentemente analoghi nonostante la varietà realizzativa dei modelli impiegati. Si è anche riscontrato che l'impiego protratto nel tempo di ortesi spinali può causare una certa dipendenza fisica. Avvalendosi dei risultati ottenuti nel presente studio sarà quindi possibile individuare più opportunamente i casi specifici in cui prevedere l'utilizzo di ortesi spinali nel trattamento delle lombalgie.

Wariazioni dei livelli di energia meccanica nella marcia norma le e in quella protesica

H. Lanshammar

Pros. Orth. Int. **6:2,** *97–102*

Riassunto

Sono stati studiati i livelli di energia meccanica in soggetti normali e in amputati di gamba nel corso della deambulazione in piano. Il peso delle protesi è stato modificato aggiungendovi un carico supplementare di 0.5 kg.

Le misurazioni e le analisi sono state effettuate utilizzando il sistema ENOCH, costituito da un minicomputer (HP 21 MX), da un dispositivo ottoelettronico per la misurazione dei dati relativi allo spostamento (Selspot) e da una piastra di forza (Kistler) per la misurazione delle forze di reazione al suolo.

I risultati ottenuti da Winter et al. (1976) sule variazioni energetiche durante la deambulazione normale, ricavati dai dati relativi ad una sola gamba, sono stati verificati utilizzando dati relativi ad entrambe le gambe e al tronco.

Se ne è concluso che, per quanto riguarda gli amputati, le modificazioni energetiche a livello della gamba protesizzata risultavano maggiori quanto maggiore era il peso. Per le altre parti del corpo nonché per il corpo nella sua totalità non sono state riscontrate differenze significative.

Valutazione clinica di un'ortesi ginocchio-caviglia-piede per emiplegici
Y. Morinaka, Y. Matsuo, M. Nojima e S. Morinaka
Pros. Orth. Int. **6:2,** *111–115*

Riassunto
E' stata messa a punto un'ortesi ginocchio-caviglia-piede nella quale sono incorporate un'articolazione del ginocchio genucentrica e un'articolazione della caviglia di simile realizzazione. Se ne analizza il concetto realizzativo e se ne presenta la valutazione clinica relativa all'impiego in venticinque soggetti emiplegici.

Scarpette interne per piedi malformati di piccole dimensioni
R. G. S. Platts, S. Knight e I. Jakins
Pros. Orth. Int. **6:2,** *108–110*

Riassunto
L'adozione di materiali moderni e l'individuazione dei necessari requisiti biomeccanici consentono di ottenere soluzioni rapidamente e facilmente adattabili alla scarpa nei casi in cui il piede sia sufficientemente piccolo da adeguarsi in modo soddisfacente alla conformazione della calzature tradizionalmente in commercio o delle normali calzature ortopediche. All'interno della scarpa si utilizza un composto elastico in espanso poliuretanico auto-gonfiabile, che si adatta alla sagoma interna della calzatura e alla forma esterna del piede. Allo scopo, ci si può servire sia del piede stesso del paziente sia di un'impronta positiva del piede. La suddetta tecnica è stata sperimentata su 75 pazienti con buoni risultati, e la scarpetta interna così ottenuta si è rivelata economica e duratura.

Complicanze nella cicatrizzazione delle ferite in seguito ad amputazione dell'arto inferiore
J. Steen Jensen, T. Mandrup-Poulson e M. Krasnik
Pros. Orth. Int. **6:2,** *105–107*

Riassunto
Si è analizzato una casistica di 320 amputazioni in relazione alle complicanze nella cicatrizzazione delle ferite e all'incidenza della ri-amputazioni.

In una casistica di 111 amputazioni di coscia si sono riscontrate complicanze nella cicatrizzazione delle ferite nel 14% dei casi (15/11), con conseguente ri-amputazione nel 2% (2/111).

Nelle amputazioni con disarticolazione del ginocchio si sono riscontrati problemi di cicatrizzazione delle ferite nel 30% dei casi (20/66) con il 20% di ri-amputazioni (13/66) a livello di coscia, rispetto al 40% (57/143) di complicanze nella cicatrizzazione delle ferite e al 20% (28/143) di ri-amputazioni negli amputati di gamba.

Poiché un eventuale insuccesso nell'amputazione di gamba conduce inevitabilmente ad una ri-amputazione a livello di coscia, nei casi dubbi è da preferirsi la disarticolazione del ginocchio.

Invasatura a telaio per protesi dell'arto inferiore
R. Volkert
Pros. Orth. Int. **6:2,** *88–92*

Riassunto
La tecnica presentata in questa sede si avvale di una invasatura a telaio onde fissare la protesi al moncone. Mentre talune parti dell'invasatura sono mantenute espressamente rigide per scopi di stabilizzazione e controllo, i tessuti molli del moncone sono circondati di materiale elastico in modo tale che l'invasatura stessa si adatti naturalmente alle eventuali variazioni nella circonferenza e nel volume del moncone pur conservando una buona aderenza.

Prosthetics and Orthotics International, 1982, 6, 171–173

Calendar of events

National Centre for Training and Education in Prosthetics and Orthotics

Short-Term Courses and Seminars 1983

Seminars

NC 702 Biofeedback and Behavioural Engineering; 19th January, 1983.
NC 703 Seating for patients with Tissue Sensory Loss; 16th March, 1983.

Courses for Physicians and Surgeons

NC 102 Lower Limb Orthotics; 14–18 February, 1983.

Courses for Physicians, Surgeons and Therapists

NC 501 Functional Electrical Stimulation (Peroneal Brace); 21–24 February, 1983.

Courses for Prosthetists

NC 205 Above-Knee Prosthetics; 7–18 March, 1983.
NC 211 Patellar-Tendon-Bearing Prosthetics (Cuff and Supracondylar Suspension); 10–21 January, 1983.

Courses for Orthotists

NC 203 Knee-Ankle-Foot and Hip-Knee-Ankle-Foot Orthotics; 21–31 March, 1983.
NC 206 Upper Limb Orthotics; 24–28 January, 1983.

Courses for Occupational and Physiotherapists

NC 301 Lower Limb Orthotics; 28 February–4 March, 1983.

Courses for Prosthetic Technicians

NC 603 Above-Knee and Hip Disarticulation Modular Prosthetics; 31 January–11 February, 1983.

Further information may be obtained by contacting Prof. J. Hughes, Director, National Centre for Training and Education in Prosthetics and Orthotics, University of Strathclyde, Curran Building, 131 St. James' Road, Glasgow G4 0LS. Tel: 041–552 4400.

New York University Medical Center
Prosthetics and Orthotics Short Term Courses 1983

Courses for Physicians and Surgeons

741 C Lower Limb Prosthetics; 14–18 February, 1983.
754 A Foot Orthotics; 19 February, 1983.
751 B Lower-Limb and Spinal Orthotics; 21–25 March, 1983.
741 D Lower-Limb Prosthetics; 18–22 April, 1983.
754 B Foot Orthotics; 23 April, 1983.
751 C Lower-Limb and Spinal Orthotics, 9–13 May, 1983.
744 B Upper-Limb Prosthetics and Orthotics, 6–10 June, 1983.

Courses for Therapists

742 B Lower-Limb Prosthetics; 28 February–11 March, 1983.
752 B Lower-Limb and Spinal Orthotics; 21–25 March, 1983.
752 C Lower-Limb and Spinal Orthotics; 9–13 May, 1983.
742 C Lower-Limb Prosthetics; 16–27 May, 1983.
757 Upper-Limb Orthotics; 20–24 June, 1983.
745 Upper-Limb Prosthetics; 27 June–1 July, 1983.

Courses for Orthotists

756 Spinal Orthotics; 3–14 January, 1983.
758 Upper-Limb Orthotics; 31 May–10 June, 1983.
753 Lower-Limb Orthotics; 5–22 July, 1983.

Courses for Prosthetists

746 Upper-Limb Prosthetics; 17–28 January, 1983.
743 Above-Knee Prosthetics; 13 June–1 July, 1983.

Courses for Rehabilitation Counsellors

750 B Prosthetics and Orthotics; 11–15 April, 1983.

Further information may be obtained from Ms. Sandy Kern Registrar, Prosthetics and Orthotics, New York University Post-Graduate Medical School, 317 East 34th Street, New York, NY 10016. Tel: (212) 340–6686.

Oxford Study Days 1983

Wheelchair Seating and Pressure Problems for the Severely Disabled; 19 January, 1983.
Rehabilitation after Stroke; 31 January and 1 February, 1983.
Management of Motor Neurone Disease; 16 February, 1983.
Psychological Management of Physical Disability and Chronic Pain; 2 March, 1983.
Orthoses for the Hand; 30 March, 1983.
Information: The Secretary, Demonstration Centre, Mary Marlborough Lodge, Nuffield Orthopaedic Centre, Headington, Oxford.

Aids Centre-Day Courses 1983

Communication Aids; 13 or 14 January, 1983.
Hoists; 10, 11 or 14 March, 1983.
Personal Toilet and the Problems of Incontinence; 12 or 13 May, 1983.
Children's Equipment; 14 or 15 July, 1983.
Information: Course Secretary, Aids Centre, .D.L.F., 346 Kensington High Street, London W14 8NS.

1983

26–30 January, 1983
Annual meeting of the American Academy of Orthotists and Prosthetists, San Diego, California.
Information: American Board for Certification in Orthotics and Prosthetics, Inc., 717 Pendleton Street, Alexandria, VA 22314.

10–12 February, 1983
Evaluation and Treatment of Chronic Pain, Houston, USA.
Information: Martin Grabois, MD. Chairman, Department of Physical Medicine, Baylor College of Medicine, 1333 Moursund Avenue, Houston, Texas 77030.

April, 1983
2nd Caribbean Conference of the Caribbean Association of Rehabilitation Therapists, Kingston, Jamaica.
Information: Ms. Eyanthe Husbands, Secretary-Treasurer, CART, P.O. Box 1068, Castries, St. Lucia.

4–18 April, 1983
7th Asia and Pacific Conference of Rehabilitation International, Kuala Lumpur, Malaysia.
Information: Malaysian Council for Rehabilitation, 12 Long Kongan Jenjarom, Off Jalan Klang, Kuala Lumpur, Selangor, Malaysia.

6–8 April, 1983
1st European Conference on Research in Rehabilitation Theme: Measurement of Outcome in Rehabilitation, Edinburgh.
Information: Mr. W. Campbell, University of Edinburgh, Centre for Industrial Consultancy and Liaison, 16 George Square, Edinburgh EH8 9LD, Scotland, U.K.

10–16 April, 1983
7th Rehabilitation International Asia and Pacific Regional Conference on theme, "Prevention and Rehabilitation: A Task for the Community, the Family and the Disabled Person," Kuala Lumpur, Malaysia.
Information: Malaysian Council for Rehabilitation, 12 Lengkongan Jenjarom, Off Jalan Klang, Kuala Lumpur, Selangor, Malaysia.

11–13 April, 1983
Annual Scientific Meeting of the American Spinal Injury Association, Denver, Colorado, USA.
Information: ASIA's Meeting Co-ordinator, Mr. Lesley Hudson, Shepherd Spinal Centre, 3200 Howell Mill Road, NW Atlanta, Georgia 30327, U.S.A.

14–15 April, 1983
International scientific meeting—Biomechanical Measurement in Orthopaedic Practice, Nuffield Orthopaedic Centre, Oxford, England.
Information: J. D. Harris, Director, Oxford Orthopaedic Engineering Centre, Nuffield Orthopaedic Centre, Headington, Oxford OX3 7LD. Tel: 0865-64811 ext. 514/510.

18–22 April, 1983
Occupational Therapy—Balancing Environment and Individual, Portland, Oregon.
Information: Betty Cox, COTA, ROH, AOTA, Director of Communications, The American Occupational Therapy Association, Inc. 1383 Piccard Drive, Rockville, Maryland, 20850.

28 April–2 May 1983
3rd Congress of the International Society of the Knee, Gleneagles Hotel, Scotland.
Information: International Society of the Knee, 70 W. Hubbard, Suite 202, Chicago, IL 60610, U.S.A.

Prosthetics and Orthotics International, 1982, 6, 174–188

1983 World Congress

5–9 September, 1983, London

PATRON:	Her Royal Highness The Duchess of Gloucester		
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ORGANISERS:
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Telephone: 01 584 4226
Telex: 916054 Confer G

Message from the Secretary-General

The 1983 World Congress of the International Society for Prosthetics and Orthotics is the fourth occasion on which the state of the art in prosthetics and orthotics, related surgery, and other aspects of rehabilitation engineering will be reviewed. In the Plenary Sessions a selected list of invited speakers will provide status reports on the technology and procedures associated with our areas of interest. Discussion sessions following the plenary events will permit all participants to offer comment and address themselves to problems displayed in the contributions.

As before, we propose to present a series of Instructional Courses covering a wide range of subjects as shown in this provisional programme. These courses can be seen as presenting material which is up-to-date and, more important, proven in practice. Thus, those attending these courses will receive information which may be taken home and applied immediately in the treatment of their patients.

A number of concurrent sessions will take place in the afternoons of the Conference when papers selected from those submitted will be presented. Selection will be made on the basis of original content, presentation and relevance to the objectives of the Congress. To support these sessions there will be opportunities for contributors to present information in poster form. Moreover the film and videotape programme will supplement the proceedings by allowing participants to see for themselves devices, techniques and management procedures offered by a variety of disciplines and organizations. One other format for presentation of the products of research and development will be in the scientific exhibits.

A major part of the Congress will be the commercial exhibition which will provide a valuable educational experience. Again an important feature of this part of the event lies in the fact that the products displayed are immediately available for application in patient treatment. Much of what will be presented is already tried and tested in clinics worldwide, or has been newly produced in response to declared clinical need. In support of this commercial exhibition it is planned that all coffees, teas and refreshments as well as light lunches will be taken within the exhibition area.

You will find in this provisional programme the official call for papers, posters, scientific exhibits, films and videotapes. The instructions with regard to abstracts are detailed and intending participants are reminded that abstracts should be submitted as soon as possible and certainly not later than 28th February 1983.

Imperial College is an Institution of world renown with many features of interest to the participants and sited near the major museums of London. It is close to Hyde Park and there is a wide selection of hostels and hotels nearby. London itself is, of course, an ancient city which paradoxically has all the modern amenities. A review of the social programme contained herein will give an insight to the depth and breadth of what London and its environs has to offer the discerning participant.

George Murdoch
Secretary General.

Call for Papers/Posters/Films/Videotapes/Scientific Exhibits

Contributions can be accepted only if an ABSTRACT FORM is completed and returned to the Congress Office by the following dates:

Papers/Posters	28th February 1983
Films/Videotapes/Scientific Exhibits	15th May 1983

Abstract forms may be obtained from Conference Services Ltd., 3-5 Bute Street, London SW7 3EY, U.K. Telephone 01 584 4226, Telex: 916054, Confer G.

Abstracts should be in ENGLISH ONLY and TYPEWRITTEN in the box provided. This will be used as camera ready copy for inclusion in the Book of Abstracts, so please ensure that all information is correct at the time of submission.

Display boards 800×1600 mm will be provided for Poster Displays and the allocation of boards will be advised nearer the Congress. Films can be accepted *only* in the following formats 8/Super 8mm and 16mm. Videotapes can be accepted in U-MATIC format *only* to PAL, SECAM and NTSC standards.

For Scientific Exhibits please include a covering note detailing the space and facilities required.

The Committee will consider the Abstracts and advise whether papers, posters and scientific exhibits have been accepted by the end of May 1983. It is hoped that all films and videotapes submitted will be included in the programme.

TIME AND PLACE

The meeting will take place at the Imperial College of Science and Technology, Exhibition Road, London SW7, from 5th to 9th September 1983.

The Imperial College of Science and Technology is situated in a very pleasant area of London close to Hyde Park, with a wide selection of hostels and hotels nearby. The venue offers excellent conference facilities combined with a large exhibition area for both the trade and scientific exhibits. All areas are accessible to the disabled.

PROGRAMME

The programme has been divided into two main areas; Instructional Courses and the main Congress Programme.

Instructional Courses

Instructional Courses covering the following topics have been planned for Sunday, 4th September, all day, and from 08.00–10.00 hrs. Monday-Friday, 5th-9th September 1983:
Amputation Surgery, Neuromuscular Disorders, Prosthetics, Paediatric Orthopaedic Problems, Orthotics, Rehabilitation Engineering.

The Courses have been arranged on the basis of 2-hour or multiples of 2-hour sessions and full details of these are enclosed. Those wishing to register for the Courses should complete the appropriate section of the enclosed registration form.

Congress Programme

The Congress programme will offer morning plenary sessions and afternoon concurrent sessions covering prosthetics, orthotics and all other aspects of rehabilitation engineering. Amongst the main topics to be discussed are amputation surgery, neuromuscular disorders, relative to extremity orthotics, spinal disorders, spinal cord injury, multiple sclerosis, arthritis and the multiply-handicapped person.

There are seven afternoon periods for concurrent sessions—two each day on Monday, Tuesday and Thursday, and one on Friday. There will be two panel discussions and three sessions of submitted papers in each concurrent session. One panel will cover each day's plenary topic employing the same chairman and plenary speakers; the other will cover a topic of particular importance.

Those wishing to submit papers should read the instructions above. Papers will be vetted from abstracts and are expected to report innovation and to promote discussion.

Films and Videotapes

Presentations in the form of film and videotape will be invited for screening on weekdays nominally from 13.30–18.00 hrs. and in parallel with the submitted paper sessions. A schedule of the film sessions will be included in the Congress documentation. If you wish to submit a film or videotape please read the instructions above.

Poster Sessions

There will also be facilities for the display of papers by poster. Those wishing to submit a poster should read the instructions above.

Scientific Exhibits

Space will be available for scientific exhibits from non-commercial institutions and organizations. Those wishing to exhibit should read the instructions above.

EXHIBITION

There will be a trade exhibition from Monday-Friday, 5th-9th September 1983 and participants will have ample time to visit the exhibits during the Congress.

LANGUAGE

The official language of the Congress is English and there will be no simultaneous translation.

Instructional Course Programme

*Course Organiser

	Sunday 4th September 0900-1300 1400-1800	**Monday 5th September 0800-1000**	**Tuesday 6th September 0800-1000**	**Wednesday 7th September 0800-1000**	**Thursday 8th September 0800-1000**	**Friday 9th September 0800-1000**
A	Introductory Biomechanics and Normal Locomotion (2 hrs) D. Jones (UK)* Below-Knee and Syme Prosthetics (6 hrs) N. A. Govan (UK)*	Above-Knee and Knee Disarticulation Prosthetics (Cont.) (2 hrs) W. Krieger (FRG)*	Above-Knee and Knee Disarticulation Prosthetics (Cont.) (2 hrs) W. Krieger (FRG)*	Above-Knee and Knee Disarticulation Prosthetics (Cont.) (2 hrs) W. Krieger (FRG)*	Hip Disarticulation Prosthetics (2 hrs) J. J. Bray (USA)*	Management of the Bilateral Lower Limb Amputee (2 hrs) R. G. Redhead (UK)*
B	Spinal Orthotics (4 hrs) N. Berger (USA)* Lower Limb Orthotics (4 hrs) M. Stills (USA)*	Lower Limb Orthotics (Cont.) (2 hrs) M. Stills (USA)*	Lower Limb Orthotics (Cont.) (2 hrs) M. Stills (USA)*	Upper Limb Orthotics (2 hrs) Margaret Ellis (UK)*	Upper Limb Orthotics (Cont.) (2 hrs) Margaret Ellis (UK)*	Upper Limb Orthotics (Cont.) (2 hrs) Margaret Ellis (UK)*
C	Communication Aids (4 hrs) M. A. Le Blanc (USA)* Clinical Gait Analysis (4 hrs) J. P. Paul (UK)*	Wheelchairs (incl. Adaptations and Prescription (2 hrs) A. B. Wilson (USA)*	Wheelchairs (incl. Adaptations and Prescription) (Cont.) (2 hrs) A. B. Wilson (USA)*	Seating for the Severely Disabled (2 hrs) R. L. Nelham (UK)*	Seating for the Severely Disabled (Cont.) (2 hrs) R. L. Nelham (UK)*	Functional Electrical Stimulation (2 hrs) A. Kralj (Yugoslavia)*
D	Rehabilitation of Stroke Patients (4 hrs) W. H. Eisma (Netherlands)* Cerebral Palsy (4 hrs) D. N. Condie (UK)*	Amputee Gait Training (2 hrs) Gertrude Mensch (Canada)*	Scoliosis (2 hrs) A. Bahler (Switzerland)*	Scoliosis (Cont.) (2 hrs) A. Bahler (Switzerland)*	Spina Bifida (2 hrs) G. K. Rose (UK)*	Spina Bifida (Cont.) (2 hrs) G. K. Rose (UK)*
E	Fracture Bracing (4 hrs) D. Wardlaw (UK)* Amputation Surgery (4 hrs) G. Neff (FRG)*	Amputation Surgery (Cont.) (2 hrs) G. Neff (FRG)*	Amputation Surgery (Cont.) (2 hrs) G. Neff (FRG)*	Amputation Surgery (Cont.) (2 hrs) G. Neff (FRG)*	Paediatric Problems (Perthes: CDH: Clubfoot) (2 hrs) J. Kjølbye (Denmark)*	Extension Prostheses (2 hrs) H. J. B. Day (UK)*
F	Partial Foot Prosthetics (2 hrs) R. G. S. Platts (UK)* Upper Limb Prosthetics (6 hrs) B. Klasson (Sweden)*	Upper Limb Prosthetics (Cont.) (2 hrs) B. Klasson (Sweden)*	Footwear and Adaptations (2 hrs) G. Veres (Norway)*	Footwear and Adaptations (Cont.) (2 hrs) G. Veres (Norway)*	Footwear and Adaptations (Cont.) (2 hrs) G. Veres (Norway)*	Footwear and Adaptations (Cont.) (2 hrs) G. Veres (Norway)*

Plenary Sessions

Monday 5th September
Knud Jansen Lecture
G. Murdoch (UK), Chairman: E. Lyquist (Denmark), Co-Chairman: E. G. Marquardt (FRG).
Lower Limb Amputations
Chairman: R. Baumgartner (Switzerland), Co-Chairman: J. Zettl (USA).
Prostheses for Lower Limb Amputees, J. Fischer (Denmark). The Rehabilitation Training of Lower Limb Amputees, Joan Edelstein (USA).

Tuesday 6th September
Lower Limb Disabilities
Chairman: E. Lyquist (Denmark), Co-Chairman: A. K. Mukherjee (India).
Surgical and Orthotic Treatment of Patients with Neurological Deficit in Lower Limb, W. J. W. Sharrard (UK). Future Trends in Treatment, J. Foort (Canada). Current Practice in Europe for Treatment of Patients with Lower Limb Disabilities, W. H. Eisma (Netherlands). Assessment and Description of Lower Limb Disability, M. Stills (USA).

Wednesday 7th September
Upper Limb Prosthetics and Orthotics
Chairman: D. Lamb (UK), Co-Chairman: B. Klasson (Sweden).
Upper Limb Prosthetics, D. Childress (USA). Upper Limb Prosthetics, J. Ober (Poland). Orthoses of the Upper Limb.

Thursday 8th September
The Severely Disabled
Chairman: B. Sankaran (India), Co-Chairman: P. Dollfus (France).
Spinal Cord Injury, P. R. Meyer (USA). Mobility, D. A. Hobson (USA). Communication Aids, M. Milner (Canada). Environmental Aids, H. Funakubo (Japan).

Friday 9th September
Spinal Problems
Chairman: A. Bahler (Switzerland), Co-Chairman: R. G. S. Platts (UK).
Spinal Problems and their Treatment by Surgery and Orthosis, J. O'Brien (UK). Measurement Systems Related to Spinal Problems, J. D. Harris (UK). Orthotic Treatment of Spinal Problems, M. E. Miller (USA).

Concurrent Sessions

Day	Hall 1	Hall 2	Hall 3	Hall 4	Hall 5	Hall 6
Monday 5th September 1983	Lower Limb Amputation *R. Baumgartner (Switzerland)	The Special Problems of the Elderly *M. Devas (UK)	Submitted papers	Submitted papers	Submitted papers	Submitted films/ videotape
	Back Pain–Management and Social Problems *J. Angel (UK)	Establishing Services in Developing Countries *S. Heim (FRG)	Submitted papers	Submitted papers	Submitted papers	Submitted films videotape
Tuesday 6th September 1983	Lower Limb Disabilities *E. Lyquist (Denmark)	Prosthetics and Orthotics Education *S. Fishman (USA)	Submitted papers	Submitted papers	Submitted papers	Submitted films/ videotape
	Gait Analysis *K. Oberg (Sweden)	The Patient's Viewpoint combined with Psycho-social considerations *C. Dunham (UK)	Submitted papers	Submitted Papers	Submitted papers	Submitted films/ videotape
Wednesday 7th September 1983	FREE AFTERNOON FOR TOURS OR INFORMALLY ARRANGED VISITS					
Thursday 8th September 1983	The Severely Disabled *B. Sankaran (India)	Arthritis and the hand *A. B. Swanson (USA)	Submitted papers	Submitted papers	Submitted papers	Submitted films/ videotape
	Upper Limb Prosthetics and Orthotics *D. Lamb (UK)	The Foot and Footwear *G. Veres (Norway)	Submitted papers	Submitted papers	Submitted papers	Submitted films/ videotape
Friday 9th September 1983	Spinal Problems *A. Bahler (Switzerland)	Biofeedback *M. Milner (Canada)	Submitted papers	Submitted papers	Submitted papers	Submitted films/ videotape

* Chairmen

SOCIAL PROGRAMME

A programme of social events has been arranged for the enjoyment of delegates and registered accompanying persons.

Monday, 5th September 1983—Welcome Reception

Following the close of sessions on Monday evening there will be a Welcome Reception in the Exhibition Area at Imperial College to enable participants to meet the exhibitors and get together with their friends.

Tuesday, 6th September 1983—Government Reception

The Secretary of State for the Disabled has kindly agreed to host a reception for the participants at the Congress. Attendance will be limited and by invitation, with priority being given to overseas delegates.

Wednesday, 7th September 1983—River Trip and Disco

In order that participants may enjoy the splendid river views of London we are arranging an evening boat trip and disco, departing from Tower Pier at around 20.30 hrs. Following a cruise down to the new Thames Barrage the boat will return to Westminster to see London by floodlight. Coach transport will be available from the Congress Hotels.

Thursday, 8th September 1983—Congress Gala Evening

To end the Congress social programme we have planned an evening of dining, dancing and entertainment at the Porter Tun Room, Whitbread Brewery, in the City of London. Built around 1750, the Porter Tun Room was originally used for the fermentation of porter in huge tuns. Its massive unsupported King post timber roof is the second largest of its kind in Europe and the room has now been converted to an attractive banqueting hall. The price of the tickets includes all transport to and from the Congress hotels to the dinner, pre-dinner drinks, the dinner and accompanying drinks, and the evening's entertainment.

ACCOMPANYING PERSONS PROGRAMME

In addition to the above, a special tour programme for accompanying persons has been arranged.

Monday, 5th September—Hever Castle

This beautiful Castle is famous as the home of the Bullen family who become so entangled with Henry VIII. Mary became his mistress, Anne became his wife but was beheaded for adultery and treason, whilst George was also beheaded on a charge of adultery with his sister—The Queen.

This delightful castle was built in the 13th and 15th centuries with a Tudor-style village added as an annexe in the twentieth century. The gardens and pleasure grounds are famous for their beauty and overlooking the lake a huge loggia and colonnaded piazza were built.

The Italian gardens with fountains, cascades and grottos were formed to provide a setting for the numerous statues and sculptures collected by Mr. Astor who purchased Hever in 1903. The Castle is currently up for sale but it is hoped that it will be preserved for the nation.

Day Tour

Monday, 5th September 1983—Windsor Castle

This favourite Royal residence of the Queen was first established by William the Conqueror although the stone defences were not built till the 12th and 13th centuries. When the Queen is not in residence the State Apartments can be visited where many fine paintings, furniture and beautiful porcelain can be seen. St. George's Chapel is one of the finest examples of perpendicular architecture and is the burial place of Royalty. Our present Queen's grandparents, Queen Mary and George V are buried here and their finely carved tombs can be seen. Following a traditional English lunch at Great Fosters the tour will continue with a coach drive through the famous Great Park to Runnymede where in 1215 King John was forced to sign the Magna Carta by the English Barons.

Day Tour

Tuesday, 6th September 1983—Blenheim and Oxford

The Nation's gift to the First Duke of Marlborough, Blenheim Palace was built in the years 1705–22 by Sir John Vanburg and has been the home of the Marlboroughs ever since. Birthplace of Winston Churchill, the house has a special display about this famous Statesman. The Palace has a beautiful Great Hall and the many drawing rooms and state rooms housing magnificent collections of furniture and paintings.

Following lunch nearby the tour will continue into Oxford, a University City of dreaming spires, turrets and towers. We have arranged a special tour of Magdalen College, founded in 1458, and if time permits other colleges may be visited before the return to London.

Day Tour

Tuesday, 6th September 1983—Hatfield House

It was at the old palace at Hatfield that Elizabeth I heard of her accession to the throne of England on the death of her father, Henry VIII. In 1607 the Salisbury family built the present Jacobean Palace which is now the family home. Following popular designs of the time the House is built in the shape of an "E" for Elizabeth and contains many fine paintings as well as relics and manuscripts of Elizabeth.

Day Tour

Wednesday, 7th September 1983—Syon House

Syon House was founded in 1415 as a nunnery until its dissolution by Henry VIII in 1534. Henry's wife, Catherine Howard was a prisoner here before her execution. Elizabeth I granted the house to the Earl of Northumberland to be his London home. Robert Adam was commissioned to renovate the interior of the House and many examples of his work can be seen here as well as a fine collection of furniture and paintings.

Afternoon Tour

Wednesday, 7th September 1983—Westminster Abbey and the Royal Mews

Westminster Abbey is the most beautiful Gothic Church in London and was founded by Edward the Confessor in the 11th Century. Since the 11th Century the Abbey has been the usual place for the coronation of English Monarchs and many of the medieval kings since the time of Henry III are buried here. There is carving and statuary in every part of the building which also has wonderful stained glass windows.

The Royal Mews houses the Queen's Gold State Coach with its panels painted by the Florentine artist Cipriani as well as other state coaches and carriages, including a miniature barouche presented to Queen Victoria's children in 1846.

Afternoon Tour

Wednesday, 7th September 1983—Hampton Court Palace

Thomas Wolsey, Cardinal and Lord Chancellor of England, began this enormous palace in the early 16th Century. When he fell from power he offered the Palace to Henry VIII in an attempt to gain favour and it remained a Royal Palace until 1760. Five of Henry VIII's wives lived here and the closed tennis court where he arranged tournaments can still be seen.

Afternoon Tour

Thursday, 8th September 1983—Cambridge and the Colleges

The first University in this famous City was founded in 1284—today there are over thirty. Many of the Colleges are open to the public and following a visit to these, including King's College Chapel, home of Rubens' "The adoration of the King", participants will lunch in the beautiful dining hall of Corpus Christi College. Those who wish to shop will find the streets of Cambridge fascinating with the many lanes and passages lined with attractive small houses.

Day Tour

Thursday, 8th September 1983—Woburn Abbey

Although the lands and buildings of this Abbey were granted to John Russell, later First Duke of Bedford, in 1539, the family did not live at Woburn until the 17th Century when the present mansion was built. The house contains a magnificent collection of pictures including works by Cannaletto, Rembrandt, Van Dyck, Gainsborough, Reynolds and Holbein as well as fine French and English 18th Century furniture and silver.

Day Tour

Thursday, 8th September 1983—London Diamond Centre/Fashion Show

The London Diamond Centre houses the largest collection of diamonds, precious and semi-precious stones in London. Visitors will also see how diamonds are transformed from rough stones into glittering gems and will have an opportunity to make tax-free purchases. Following the tour the group will proceed to the Scotch House in Regent Street for coffee and a fashion show by this famous store.

Morning Tour

TRANSPORT

London is one of the most easily reached capitals in the world. To assist you with your travel British Caledonian Airways have been appointed Official Carrier for the Congress.

British Caledonian Airways is Europe's largest independent scheduled air carrier with services from USA, the Caribbean, South America, North-west and Central Africa, the Middle and Far East, Europe and within the United Kingdom to London Gatwick Airport. London Gatwick is far less crowded than Heathrow and has its own built-in railway station with a Rapid City Link service every 15 minutes, to the centre of London. The journey time is just 40 minutes. When you return home from the congress you can check in at the British Caledonian terminal at Victoria Station to save you having to take your baggage to the airport. Further details of British Caledonian services and fares may be obtained from your travel agent.

REGISTRATION FEES

Instructional Course Fees include:

Attendance at the Course booked.
All relevant documentation.

Congress Fees—Delegates include:

Attendance at all Congress Sessions (excluding Instructional Courses).
All Congress Documentation including the Book of Abstracts.
Morning coffee and afternoon tea when applicable.
Welcome Reception Ticket.
Attendance at the Exhibition.

Congress Fees—Students include:

As for Delegates.
Applications for Student Attendance must be accompanied by a letter from the Head of the Institution involved certifying full-time student status.

Day Tickets

Attendance on the day booked to the Congress Session and the Exhibition.

Accompanying Persons Fees include:

Welcome Reception Ticket.
Choice of one full-day tour.
(Please indicate your choice by marking the appropriate box on the Registration Form "£00.00").

Where applicable all fees are inclusive of Value Added Tax.

ACCOMMODATION

Accommodation has been booked in a variety of facilities ranging from University Halls of Residence to four-star hotels. The rates quoted on the accommodation form include the following:

Halls of Residence

Single room accommodation with washing facilities on a bed/breakfast basis including service charge and VAT @ 15%.

Hotels:

Single or twin room accommodation with private bathrooms on a bed/continental breakfast basis including service charge and VAT @ 15%.

Should VAT rates vary the necessary adjustment will be made at the Conference.

CANCELLATION

In the event of cancellation of registration or accommodation bookings, provided written notice of cancellation is received by Conference Services Ltd. prior to 30th June 1983 there will be an 80% refund of all pre-payments. After that date no refunds will be permitted although substitutions may be made.

Should there be insufficient support for any of the Tours, Conference Services Ltd. reserves the right to cancel the tour concerned and refund all monies received in full.

INSURANCE

Delegates are recommended to take out their own travel insurance and extend their policy for personal possessions as the Congress does not cover persons against cancellation of bookings or theft of belongings.

DRESS

The weather in London in September can be delightful and sunny, however delegates are advised to bring their umbrellas and a light coat as the evenings can be chilly.

Lounge suits and informal evening wear are suitable for all of the social events.

POST CONGRESS TOURS

To enable overseas participants to visit some of the specialist centres in Scotland and Ireland the following Post Congress Tours have been arranged:

IRISH TOUR

Departing London Saturday, 10th September, returning London Wednesday, 14th September.

Itinerary

Saturday 10th September 1983

Coach transfer from Congress Hotels to Airport to join flight to Belfast.

Arrival Belfast, transfer to Conway Hotel, Dunmurry, where the group will stay for four nights.

Welcome Dinner at the hotel.

Sunday 11th September 1983

City coach tour including visits to the Royal Victoria Hospital, Queen's University and Belfast City Hall followed by an afternoon visit to the Ulster Folk Museum where Mr. George Thompson, OBE, Director of the Museum will guide you around the farm houses, cottages, watermills and other traditional buildings on display.

Dinner at the hotel.

Monday 12th September 1983

Coach tour to the "Eighth Wonder of the World"—the Giants Causeway. The Causeway now in the care of the National Trust, consists of over 37,000 many sided stone columns formed millions of years ago and now given fanciful titles as The Giants Organ, The Wishing Chair or Lord Antrim's Parlour. The tour will include a visit to Bushmills Distillery to see this famous Irish Whiskey at the early stages of growth.

Government Reception and Dinner.

Tuesday 13th September 1983

Free morning for visit to the City Centre for shopping and lunch.

Afternoon visit to the Rehabilitation Engineering Centre, Musgrave Park Hospital, where demonstrations and exhibitions will be arranged.

Farewell Dinner at the hotel.

Wednesday 14th September 1983

Transfer to the Musgrave Park Hospital for further demonstrations, etc., at the Rehabilitation Engineering Centre. Following lunch at the Hospital the group will transfer to the Airport for the return flight to London.

Coach transfer from London Heathrow to Central London if required.

The prices include all travel costs, accommodation in Belfast on a bed and breakfast basis (based on twin room occupancy), lunches on Sunday, Monday and Wednesday and dinner each evening.

Price: £335.00 per person
Single Room Supplement: £40.00

CALEDONIAN TOUR

Departing London Saturday 10th September, returning London Wednesday 14th September.

Itinerary

Saturday 10th September 1983

Coach transfer from Congress Hotels to Airport to join flight to Edinburgh. Arrival in Edinburgh and transfer to George Hotel for dinner and overnight stay.

Sunday 11th September 1983

Coach tour of Edinburgh with lunch at the George Hotel.

Afternoon visit to Edinburgh Castle.

Scottish Evening at the George Hotel.

Monday 12th September 1983

Coach transfer to the Princess Margaret Rose Hospital to view facilities.
Lunch at the George Hotel.
Coach transfer to Dundee with dinner and overnight stay at the Angus Hotel, Dundee.

Tuesday 13th September 1983

Visit to the Dundee Limb Fitting Centre.
Lunch at the Angus Hotel, Dundee.
Coach transfer to Glasgow with stop to visit a Whisky Distillery.
Overnight stay with dinner at the Holiday Inn Hotel, Glasgow.

Wednesday 14th September 1983

Visit to the National Centre for Training and Education in Prosthetics and Orthotics and the Bioengineering Unit at the University of Strathclyde.
Lunch at the University.
Afternoon flight to London.

The price includes all travel, meals and accommodation throughout the tour based on twin room occupancy but all drinks are extra.

Price: £385.00 per person
Single Supplement: £40.00

Closing Date for Bookings

Those wishing to join the tours are asked to advise their participation by 31st July 1983 at the latest.

Cancellation

Should there be insufficient demand for these tours we reserve the right to cancel the arrangements and refund monies in full.

Should you wish to cancel your booking for the tour, provided written notice of cancellation is received in the Congress Office by 31st July 1983 there will be an 80% refund of the prepayment. After that date no refunds can be made. It is recommended that travel insurance cover is arranged through your local travel agency.

FURTHER INFORMATION

Should you require further information please do not hesitate to write to:

Conference Services Ltd.
3-5 Bute Street,
London SW7 3EY

Pre/Post-Congress Courses and Visits

The following Courses and Visits have been arranged and if you would like further details please complete this form and return it to the Congress Office, 3-5 Bute Street, London SW7 3EY, UK.

Name ....

Address ....

....Telephone: ....

PLEASE SEND ME DETAILS OF THE FOLLOWING COURSES/VISITS (✓) tick

Thursday, 1st September
Oxford Orthopaedic Engineering Centre and Mary Marlborough Lodge
Nuffield Orthopaedic Centre, Headington, Oxford OX3 7LD

A) Course at Oxford Orthopaedic Engineering Centre: "The Scientific Basis for Orthotic Research" (6 hours) A) ☐

B) Visit to the Oxford Orthopaedic Engineering Centre and Mary Marlborough Lodge B) ☐

Royal National Orthopaedic Hospital and Institute of Orthopaedics, Stanmore, Middlesex HA7 4LP

C) Course: "Brachial Plexus Injury Management" (4 hours) C) ☐

D) Course: "Early Post-operative Care of Lower Limb Amputees" (4 hours) D) ☐

E) Visit to Limb Fitting Centre, Spinal Injuries Unit, Scoliosis Unit, Orthotic Workshop E) ☐

Friday, 2nd September
Limb Fitting Centre, Queen Mary's Hospital, Roehampton, London SW15 5PR

F) Visit to Limb Fitting Centre, Limb Surgery Unit and Bioengineering Centre F) ☐

Saturday, 3rd September
Bioengineering Centre, University College London, Roehampton, London SW15 5PR

G) Course: "Shapeable Matrix Seating System." (7 hours) G) ☐

Monday, 12th September
Chairley Heritage Hospital and School, Lewes, Sussex BN8 4EF

H) Course: "Team Approach and management of Severe Arthrogryposis" (4 hours) H) ☐

Tuesday, 13th September
Chailey Heritage Hospital and School, Lewes, Sussex BN8 4EF

K) Visit to Hospital and Rehabilitation Engineering Unit K) ☐

Robert Jones and Agnes Hunt Orthopaedic Hospital, Orthotic Research and Locomotor Assessment Unit, Oswestry, Shropshire SY10 7AG

L) Visit to Orthotic Research and Locomotor Assessment Unit L) ☐
Demonstration of the use of Clinical Gait Assessment Laboratory together with the use of Orthoses for high lesion paraplegics to ambulate.

Wednesday, 14th September
Chailey Heritage Hospital and School, Lewes, Sussex BN8 4EF

M) Course: "Team Approach and Management of Severe Scoliosis" (4 hours) M) ☐

Monday, 12th September—Friday, 23rd September
National Centre for Training and Education in Prosthetics and Orthotics, University of Strathclyde, Glasgow G4 0LS

N) Course: Orthotists: "Knee-Ankle-Foot and Hip-Knee-Ankle-Foot Orthotics" (10 days) N) ☐

O) Course: Prosthetists: "PTB Prosthetics (Cuff and Supra-Condylar Suspensions)" (10 days) O) ☐

International Society for Prosthetics and Orthotics
IV World Congress, London

5th-9th September 1983

Please complete and return to:
ISPO World Congress Office,
3-5 Bute Street,
London SW7 3EY, U.K.

REGISTRATION FORM

Please use BLOCK LETTERS or type 304

AA	**Surname**	35
	Title (Prof/Dr/Mr/Mrs/Miss)	28
	First Names	35
AB	**Profession**	35
AD	**Address to which correspondence should be sent**	35

ISPO Membership Number ______________________

Telephone Number ______________________

For office use only

B

Please list below accompanying persons whom you wish to enrol for the Meeting (spouse, family members, etc.—NOT professional associates).

	Surname	Title (Mr/Mrs/Miss)	First Names	35
H1				
H2				
H3				

I wish to register for the Congress and enclose the following fees:

				For office use	No. of persons	
ISPO Members	Prior to	18th April 1983	£125.00	KA	1	£
	After	18th April 1983	£145.00	KB	1	£
Non-members	Prior to	18th April 1983	£160.00	KC	1	£
	After	18th April 1983	£185.00	KD	1	£
Students*	Prior to	18th April 1983	£55.00	KE	1	£
	After	18th April 1983	£75.00	KF	1	£
Day Tickets	Monday	5th September 1983	£40.00	KG	1	£
	Tuesday	6th September 1983	£40.00	KH	1	£
	Wednesday	7th September 1983	£40.00	KI	1	£
	Thursday	8th September 1983	£40.00	KJ	1	£
	Friday	9th September 1983	£40.00	KL	1	£
Accompanying Person's Fee			£45.00	LA		£

***Applications must be accompanied by a letter of certification from the Institution Head.**

INSTRUCTIONAL COURSES

Please complete the section below if you wish to participate in the Instructional Courses. Reference should be made to the Course Timetable on page 177 when making your choices to ensure no clash of interests.

A	Hours		For office use	No. of persons	
Introductory Biomechanics and Normal Locomotion	2	£12.00	MA	1	£
Below-knee and Syme Prosthetics	6	£36.00	MB	1	£
Above-knee and Knee Disarticulation Prosthetics	6	£36.00	MC	1	£
Hip Disarticulation Prosthetics	2	£12.00	MD	1	£
Management of the Bilateral Lower Limb Amputee	2	£12.00	ME	1	£
B					
Spinal Orthotics	4	£24.00	MF	1	£
Lower Limb Orthotics	8	£48.00	MG	1	£
Upper Limb Orthotics	6	£36.00	MH	1	£
C					
Communication Aids	4	£24.00	MI	1	£
Clinical Gait Analysis	4	£24.00	MJ	1	£
Wheelchairs	4	£24.00	MK	1	£
Seating for the Severely Disabled	4	£24.00	ML	1	£
Functional Electrical Stimulation	2	£12.00	MM	1	£
D					
Rehabilitation of Stroke Patients	4	£24.00	MN	1	£
Cerebral Palsy	4	£24.00	MO	1	£
Amputee Gait Training	2	£12.00	MP	£	
Scoliosis	4	£24.00	MO	1	£
Spina Bifida	4	£24.00	MR	1	£

TOTAL, carried forward: £

TOTAL, brought forward: £

E	Hours		For office use	No. of persons	
Fracture Bracing	4	£24.00	MS	1	£
Amputation Surgery	10	£60.00	MT	1	£
Paediatric Problems	2	£12.00	MU	1	£
Extension Prostheses	2	£12.00	MV	1	£
F					
Partial Foot Prosthetics	2	£12.00	MW	1	£
Upper Limb Prosthetics	8	£48.00	MX	1	£
Footwear and Adaptations	8	£48.00	MY	1	£

LUNCH TICKETS

Sunday, 4th September 1983	£1.50	NA		£
Monday, 5th September 1983	£1.50	NB		£
Tuesday, 6th September 1983	£1.50	NC		£
Wednesday, 7th September 1983	£1.50	ND		£
Thursday, 8th September 1983	£1.50	NE		£
Friday, 9th September 1983	£1.50	NF		£

SOCIAL PROGRAMME

Wednesday, 7th September 1983	River Trip and Disco	£10.00	OA		£
Thursday, 8th September 1983	Gala Evening	£30.00	OB		£

TOUR PROGRAMME

Monday,	Hever Castle	£25.00	QA		£
5th September 1983	Windsor Castle	£25.00	QB		£
Tuesday,	Blenheim Palace and Oxford	£25.00	QC		£
6th September 1983	Hatfield House	£25.00	QD		£
Wednesday,	Syon House	£12.50	QE		£
7th September 1983	Westminster Abbey, Royal Mews	£12.50	QF		£
	Hampton Court Palace	£12.50	QG		£
Thursday,	Cambridge and the Colleges	£25.00	QH		£
8th September 1983	Woburn Abbey	£25.00	QI		£
	London Diamond Centre and Fashion Show	£12.50	QJ		£

POST CONGRESS TOURS

		Price per person			
Irish Tour	Single room	£375.00	RA		£
	Twin room	£335.00	RB		£
Caledonian Tour	Single room	£425.00	RC		£
	Twin room	£385.00	RD		£

TOTAL, carried forward: £

TOTAL, brought forward: | £ |

ACCOMMODATION

Please complete this section by indicating the hotel or hostel you prefer, your arrival and departure dates, and the number and type of room(s) required. Prices quoted are inclusive of room and service charge, continental breakfast and V.A.T. at 15%.

HOTELS: A deposit to cover 1 night's accommodation per room booked must accompany this form. Bookings will not be effective until this deposit is received in the Congress office. Whilst every effort is made to place you in the hotel of your choice this cannot be guaranteed and we reserve the right to place you in another hotel.

		Price per room per night	For Office use	No. of rooms	
***Penta Hotel**	**Single with bath**	**£35.00**	**SA**		**£**
	Twin with bath	**£39.50**	**SB**		**£**
Kensington Close Hotel	**Single with bath**	**£30.00**	**SC**		**£**
	Twin with bath	**£37.00**	**SD**		**£**
Bailey's Hotel	**Single with shower**	**£26.00**	**SE**		**£**
	Twin with bath	**£36.00**	**SF**		**£**
De Vere Hotel	**Single with bath**	**£24.00**	**SG**		**£**
	Twin with bath	**£35.00**	**SH**		**£**

***Suitable accommodation for the disabled.**

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Prosthetics and Orthotics International, 1982, 6, 189–194

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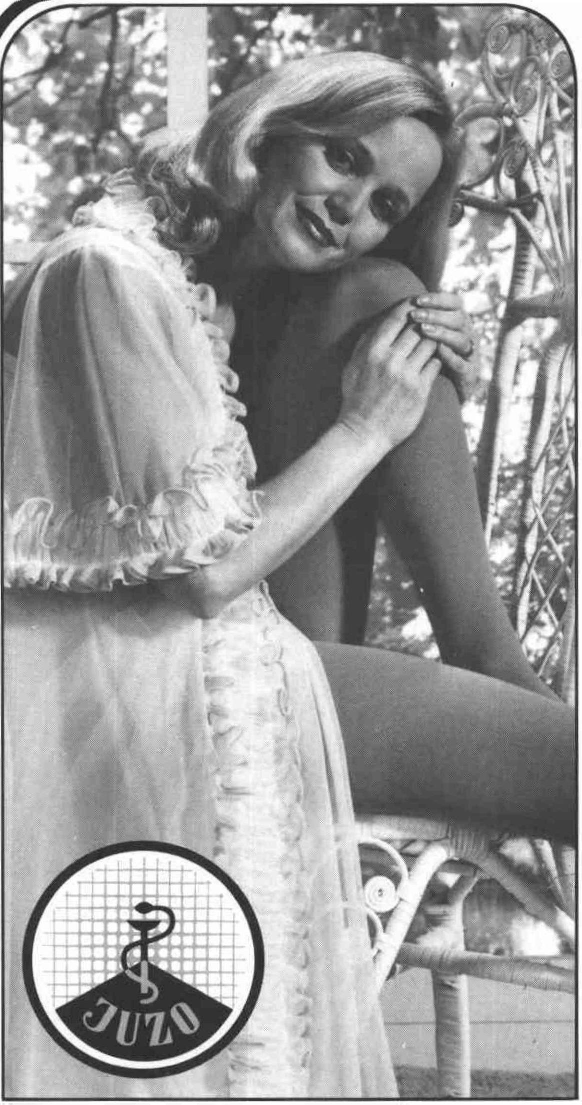

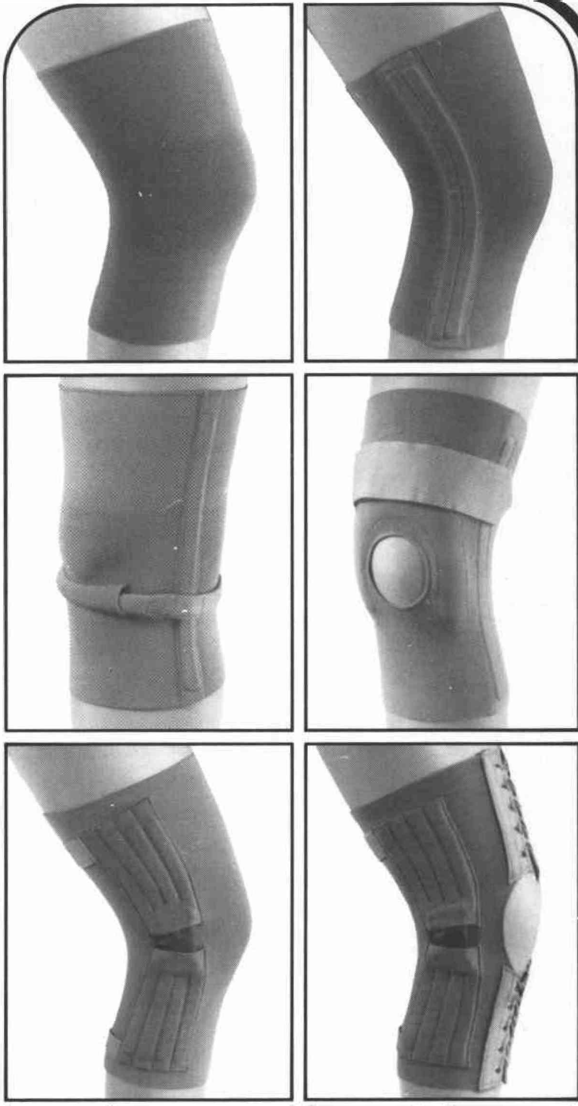

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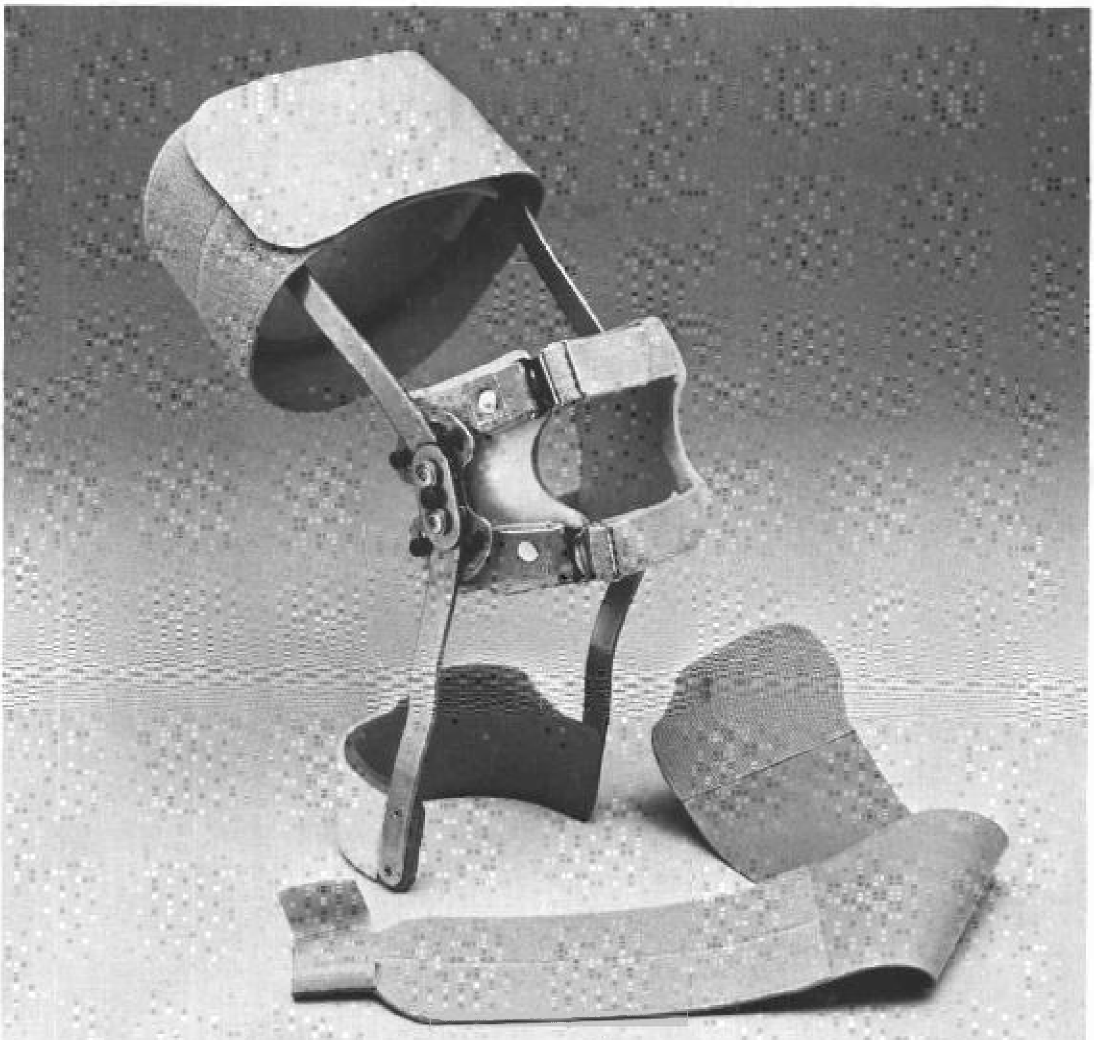

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