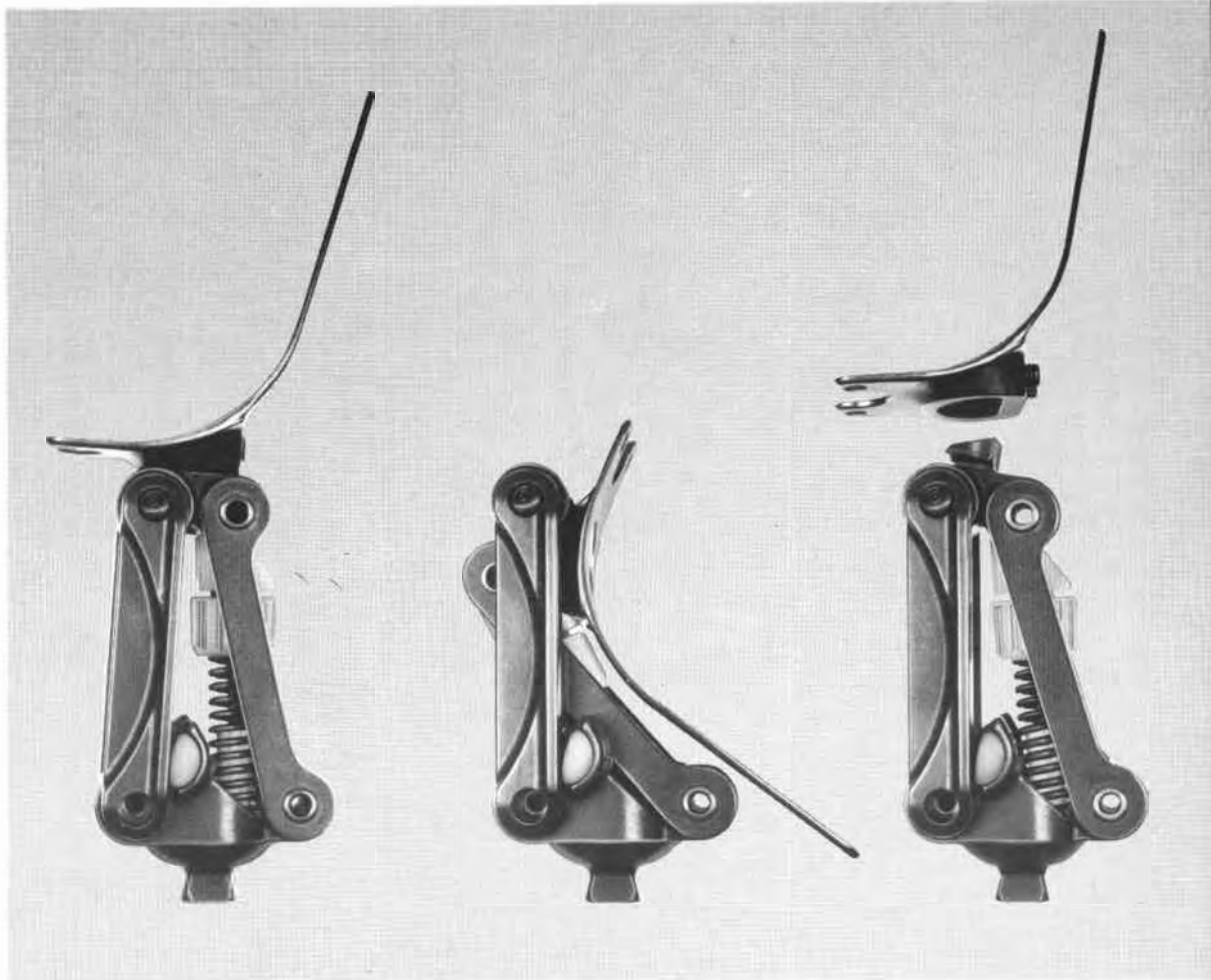




**The Journal of the International Society
for Prosthetics and Orthotics**

Prosthetics and Orthotics International

August 1980, Vol. 4, No. 2



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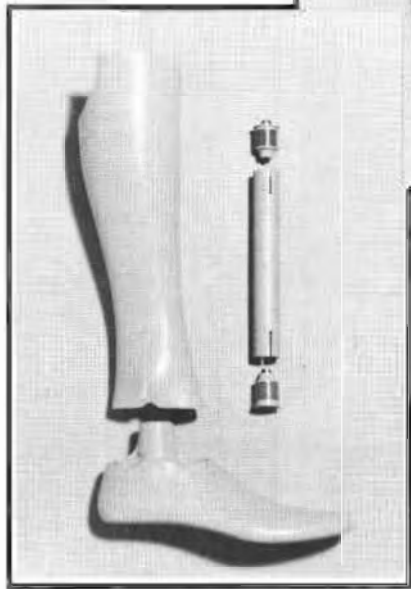
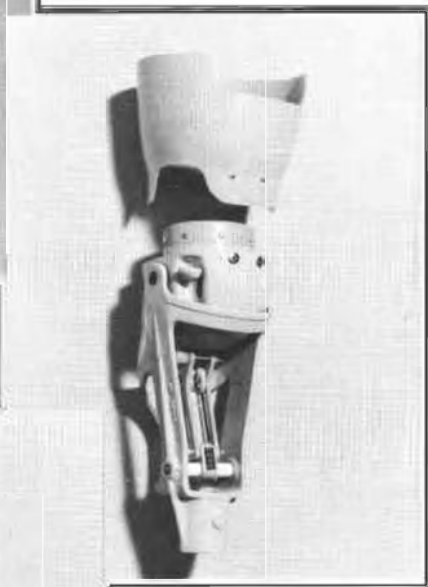


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August 1980, Vol. 4, No. 2

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Editorial

An annual financial statement has, since the society was founded, been presented to the Executive Board together with a budget forecast. Similar presentations have been made to the International Committee and the assembly at the World Congresses in Montreux 1974 and New York 1977. In the future the annual report will appear in the journal.

The financial administration of the society has constantly been a question of brinkmanship between the wish to expand and serve according to the purpose and function of our Society as laid down in the constitution and on the other hand an economy primarily based on personal membership fees. In consideration of the third world it has always been the aim to keep the membership fee modest. In fact the membership fee has only been increased according to the ongoing inflation and devaluation of the U.S dollar. This policy has seemingly been successful, as indicated by a growing membership, especially in countries where the membership fee may represent a greater financial burden.

During the years the Society has been substantially supported with secretarial staff, office space and facilities from Danish resources. Contributions of this kind do not appear in the accounts. A rough estimate suggests that the value of these contributions reduced the individual membership fee by U.S. \$ 11 per year. During the month of July this year the Copenhagen office will move from the County Hospital Gentofte to the main office of the Society and Home for Disabled in Copenhagen. ISPO are in debt for the invaluable support given to the society during the years the office was maintained in Gentofte. The Society and Home for Disabled has granted 75.000 D.Kr. (about U.S.\$ 14,000) per annum plus office space free of charge. However even with this substantial support, the International Society's own part of annual salary expenditure will increase by approximately 30.000 D.Kr. (about U.S.\$ 5,500).

As a consequence of inflation and the increase of expenditure mentioned above, it is necessary to increase the membership fee to U.S.\$ 37 for 1981.

The paramount, global, still unsolved problems and existing needs do obviously require funds over and above those acquired by the membership contributions. It is urged that members do consider any national or international funds which may be approached with regard to promotion and support of the scope of our society and its specific, pending projects.

Jørgen Kjølbye
Honorary Treasurer.

I.S.P.O. Statement of Accounts

Balance as at December 31, 1979

Income:

Membership fees	157.132,18	
Sponsorship fees	1.067,00	158.199,18

Contributions:

War Amputation of Canada 5.000 ca. \$		22.337,64
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Interest:

Bonds	6.700,00	
Bank accounts	16.561,72	23.261,72

Bonds—income		11.800,00
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Expenditure:

Part salary for secretary (Aase Larsson)	45.488,93	
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Printing expenses:

Journal: Prosthetics and Orthotics International:

Printing cost incl. airmail posting	99.052,03	
Production service	10.422,60	
Labels	2.400,00	

111.874,63

Less income:

Advertising	28.565,67	
+ debtors December 31. 1979	17.820,45	46.386,12

Subscriptions	22.490,57	42.997,94
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Stationery and printed matters	3.814,57	
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Postage and freight	5.424,65	
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Meeting and travelling expenses:

Miscellaneous	3.647,60	
Honorary Secretary (7 visits to Copenhagen)	16.358,08	
Executive Boards, incl.		
Meetings: (Frankfurt, Copenhagen, Gaithersburg, Washington)	17.576,35	37.582,03

Telephone	6.298,45	
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Repairs and maintenance	0,00	
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Miscellaneous expenses: Data system	8.712,49	
Sundry	108,23	8.820,72

Auditing	2.122,40	
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	152.549,69	215.598,54
Surplus as at December 31., 1979	63.048,85	

Kr. 215.598,54	Kr. 215.598,54
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Balance as at December 31, 1979**Assets**

Cash on hand		3.769,12
--------------	--	----------

Bank accounts:

Handelsbanken, Chech no. 524.052	6.778,73	
Handelsbanken, Book no. 398.871	8.487,11	
Handelsbanken, Book no. 705.154	200.151,53	215.417,37

Debtors: Advertising		17.820,45
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Bonds:

Nominal value kr. 18.000 10% Østifternes Kreditforening 18/2003 (price 63.80: 58 ¼ value kr. 10.485)		12.690,00
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Advance to:

World Congress, 1980		29.326,43
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Liabilities

Auditing	637,30	
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Reimbursement to Gentofte Hospital	8.080,74	8.718,04
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Balance as at December 31, 1979, (capital account):

January 1 1979	207.256,48	
+ surplus for the period 1.1—31.12.1979	63.048,85	270.305,33

Kr. 279.023,37	Kr. 279.023,37
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The above mentioned Accounts, which have been examined, are in Accordance with the book-keeping for year 1979.

Bagsvoerd, January 1980.

GUNNER PETERSEN,
Registered Accountant,
Denmark.

The halo-shoulder brace and the mandibular-shoulder brace as postoperative supports following spinal fusion.

N. VAN KEMPEN DE WITTE

Slotervaartziekenhuis, Amsterdam, The Netherlands

Abstract

Bracing of the cervical spine in patients with rheumatoid arthritis, ankylosing spondylitis and instability due to metastases poses special problems.

Because of asymmetry, a tender bony or cutaneous swelling or tender skin, difficulties arise in fitting a mass-produced brace.

In order to overcome these difficulties a carefully moulded made-to-measure halo-shoulder brace and also a mandibular-shoulder brace were developed.

The halo-shoulder brace (a halo connected with 4 rods to a shoulder girdle) provides an effective means of postoperatively controlling the unstable cervical spine until the graft unites. The brace is well tolerated by the patient and facilitates early postoperative mobility.

The mandibular-shoulder brace (a similar shoulder girdle with a mandibular and an occipital part), also well tolerated by the patient, is used after the halo-shoulder brace during consolidation of the graft and also to support the neck in patients who for other reasons require a collar but who cannot tolerate a normal ready-made appliance.

The manufacture of the braces, their effectiveness and a series of 13 patients are described.

Introduction

Cervical fusion is often necessary for the treatment of instability due to rheumatoid arthritis, metastatic destruction of part of the cervical spine or trauma and is routine following cervical osteotomy for correction of deformity in ankylosing spondylitis. The relief of pain is also an important reason for operation especially in patients with metastases.

Early postoperative mobilization of the patient with rheumatoid arthritis or ankylosing spondylitis is desirable in order to maintain general mobility and of the cancer patient to avoid a considerable portion of a limited life expectancy in traction. Although not essential early safe mobilization of the trauma patient is also desirable. It has been our recent practice to support the cervical spine during the first 6-12 weeks, until the graft has united, in a halo-shoulder brace and thereafter, to protect the neck, in a mandibular-shoulder brace whilst consolidation of the graft progresses. However, bracing of the cervical spine in patients with rheumatoid arthritis, ankylosing spondylitis and instability due to metastases poses special problems.

In the patient with rheumatoid arthritis;

- the neck is often short (with a squashed appearance) due to collapse of cervical vertebrae)
- the chin is often small
- the neck, shoulder and upper torso are often asymmetrical
- collarbones and shoulder blades are often unduly prominent
- the skin is thin and easily damaged
- there may be rheumatoid nodules
- sweating is often excessive
- the cervical spine is often painful
- cervical instability often has to be controlled at more than one level
- there is a posterior midline scar.

In the patient with ankylosing spondylitis following corrective osteotomy or treatment of a fracture;

- there is often some degree of residual rotational deformity
- the total rigidity of the spine requires an orthosis to fit perfectly in order to be comfortable

The patient with metastatic destruction of the cervical spine may exhibit;

All correspondence to be addressed to Ms. N. van Kempen de Witte, Orthopaedische Werkplaats, Slotervaartziekenhuis, Louwesweg 6, 1066 EC Amsterdam, The Netherlands.

- asymmetry of the neck due to tumour tissue
- asymmetry of the upper torso, for example following a mastectomy
- tenderness of irradiated areas
- cutaneous or superficial bony metastases which must be taken into consideration.

In order to overcome these problems two made-to-measure orthoses were developed two years ago; the halo-shoulder brace and the mandibular-shoulder brace. These braces are made individually for each patient in order to obtain a comfortable appliance with the best possible fit and to provide effective stabilization of the cervical spine. From our previous experience with cervical braces and collars we concluded that a new orthosis must be light and the contact with the shoulder and neck area must be spread out as much as possible in order to avoid pain or pressure necrosis of the vulnerable skin. When immobilizing the neck it is essential that the mouth, larynx and arms remains as free as possible so that the general mobility of the patient is maintained. The orthosis has to be easily removable and replacable to facilitate personal hygiene, wound care and irradiation treatment.

Construction of the orthoses

Plaster model

Both orthoses are constructed on a plaster model which is made before the operation, if possible with the patient in a sitting position. Before the plaster is applied, the following points are marked on the patient;

- the middle of the chin
- the suprasternal notch
- the xiphoid process
- both clavicles
- the acromioclavicular joint
- the thyroid cartilage
- spinous processes from C1 to T5
- superior and medial borders of the scapulae
- the spines of the scapulae
- any other prominent bony points, cutaneous nodules or painful areas.

The skin is smeared with release agent except for the marked areas and the hair is held out of the way in a piece of tubigrip or tubular bandage. A plastic tube is placed on each side of the head and shoulder to facilitate cutting the cast. The plaster of Paris is then applied around the neck from just below the lower lip, over the ear lobes

to the occipital protuberance and downwards to the xiphoid process and to the 5th thoracic spinous process. During the application of the plaster the head is held in *neutral rotation* with the nose and the marks on the chin, the suprasternal notch and the xiphoid process maintained in one vertical line. Furthermore the head is maintained in a *neutral horizontal position* with the inferior orbital margins and the external auditory meati in the same horizontal plane. The arms should hang freely by the side of the body. The plaster is then allowed to dry.

The positions of the plastic tubes are marked on the plaster and a few horizontal lines marked over the vertical tube line to facilitate reassembly. The cast is cut with a cast saw on the marked tube lines on both sides. This negative plaster of Paris is then reassembled. After greasing, the inside is filled with plaster of Paris in order to produce a positive cast. On the positive cast an extra 4mm of plaster is added over the following areas;

- the thyroid cartilage
- both collarbones
- the shoulder blades
- the spinous processes
- any prominent bony points, cutaneous nodules or painful areas.

The halo-shoulder brace

Figure 1 shows the materials necessary for the construction of a halo-shoulder brace.

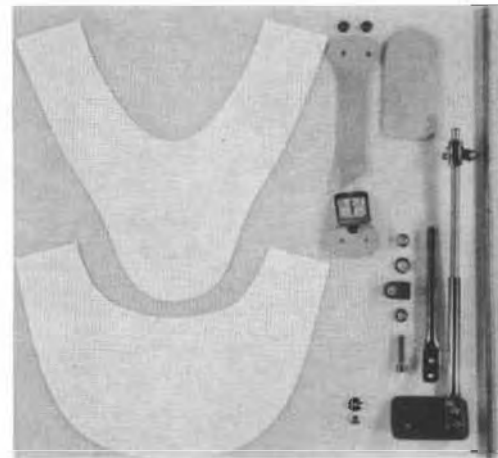


Fig. 1. Components of the halo-shoulder brace showing the anterior (top) and posterior (bottom) paper patterns, strap, buckle and leather tongue and elements of the halo connecting rods.

Two paper patterns are made so that the resulting shoulder brace will reach from T1 to T4 and rest on the skin between the spinous processes and the shoulder blades. Anteriorly the brace reaches from the suprasternal notch to the xipoid process. The brace passes over the shoulders, between the root of the neck and the acromio-clavicular joints which are left free.

With the aid of the paper patterns, the anterior and posterior parts of the brace are sawn out of 3mm orthopaedic Plexidur. The edges of the Plexidur are smoothed round with a sander and both sides are matted with fine wet and dry sandpaper for a more aesthetic effect.

Using the same patterns, the anterior and posterior linings are cut out of 6mm Plastazote. The anterior and posterior paper patterns are glued together along one shoulder edge and with this single pattern a one-piece inner lining is cut out of 1cm soft sorbo rubber. Velcro fasteners are then sewn on to the free shoulder edge of the sorbo rubber lining in order to hold it in place under the shoulder brace.

The anterior and posterior parts of the brace are moulded separately. First, the Plastazote is heated and moulded on the positive plaster cast followed by the Plexidur, which is moulded on top of the Plastazote. The Plexidur layers are glued on to the Plastazote layers and the edges are smoothed with the sander. The lower edge of the anterior part of the brace is bent outward slightly so as not to press painfully on the skin over the xiphoid when the patient is in a half-sitting position. The anterior and posterior components of the halo-shoulder brace are then trial fitted on the patient over the sorbo rubber lining and any necessary minor modifications carried out. The straps, buckles and leather tongues for holding the anterior and posterior elements of the brace together are next fitted to the brace. With the shoulder brace in place on the patient the positions for the attachment pieces of the halo connecting rods are marked. The halo connecting rods should be vertical and symmetrical. The anterior connecting rods should be as wide apart as possible so that the visual fields are not restricted. The anterior connecting rods are fixed to the Plexidur brace on a line approximately 3.5cm below the level of the suprasternal notch. The posterior connecting rods usually pass from the most posterior side holes on the halo and are screwed directly on to

the brace just under the level of the spines of the scapulae.

In order to simplify removal and reassembly the unused side screwholes in the halo are covered with sticking plaster. For the same reason there is only one fixation hole in the leather shoulder strap.

A complete halo-shoulder brace should appear as in Figure 2. With the brace in place X-rays are made to check whether the position of the cervical spine is satisfactory.



Fig. 2. The completed halo-shoulder brace.

The mandibular-shoulder brace

Figure 3 shows the materials necessary for the construction of the mandibular-shoulder brace. The paper patterns are made so that the resulting brace will support the ramus of the mandible whilst the thyroid cartilage remains free. The brace reaches down to just above the xipoid process and is bent outward similar to the halo-shoulder brace. The occipital part supports the head just behind the ears. The brace reaches from the occiput down to T4.

This brace is also made out of 3mm orthopaedic Plexidur and 6mm Plastazote, which are moulded on the plaster cast and glued together. A loose sorbo rubber lining has not been found to be necessary. For skin care elastic tubigrip seamed on one side can be used as a removable cover over the mandibular and occipital parts.

The anterior and posterior components of the mandibular-shoulder brace are then trial fitted on the patient and necessary minor modifications carried out. Fasteners (leather with Velcro) are fitted to the brace to hold the anterior and posterior elements together. If necessary, the

mandibular and occipital parts can be connected by leather straps for extra support.

Finally, in order to strengthen the attachments of the chin and occipital pieces to the shoulder part of the brace, two extra vertical strips of 3mm Plexidur are glued in position.

A completed mandibular-shoulder brace should appear as in Figure 4.

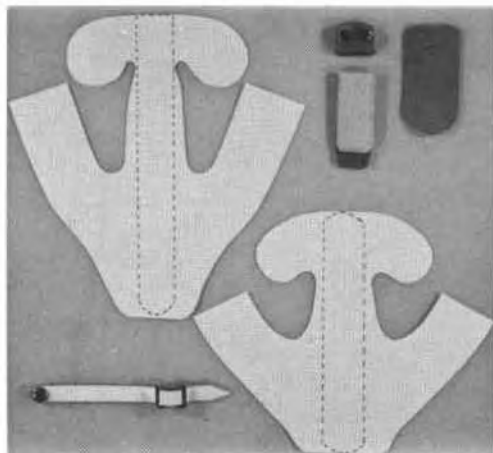


Fig. 3. The mandibular-shoulder brace. Top left, anterior paper pattern. Bottom right, posterior paper pattern. The dotted lines indicate the positions of the vertical Plexidur strips. The Velcro fasteners, leather tongue and chin-occipital strap are also shown.

Effectiveness of the mandibular-shoulder brace

The effectiveness of the mandibular-shoulder brace was assessed by fitting one to a 22 year old volunteer. X-rays of the cervical spine were taken in flexion and extension, before and after fitting the brace. The tube-film distance was 2.75m, to minimize distortion (Johnson et al, 1977).

Lines were drawn on the X-rays through corresponding points on each vertebra and the maximum range of motion at each level measured. The results are shown in Table 1. A negative sign indicates a local reversal of the general movement. During attempted extension of the neck, whilst wearing the brace, slight flexion occurred at the C1-2, C2-3 and C3-4 levels. During attempted flexion of the neck, slight extension occurred at these levels.

Measurements of lateral flexion and rotation were not made because of the possible danger of excessive irradiation for the young volunteer.



Fig. 4. The completed mandibular-shoulder brace.

Table 1

Level	Without brace	With brace
Occiput—C1	6	0
C1—C2	18	-2
C2—C3	10	-3
C3—C4	16	-3
C4—C5	19	0
C5—C6	22	3
C6—C7	16	3
C7—T1	12	3
Total		
Occiput—T1	119	1

Table 1. Motion of the cervical spine, measured in degrees from fully flexed to fully extended positions without and with the mandibular-shoulder brace. A negative sign indicates a local reversal of the general movement of the cervical spine.

Patient series

Up to now the halo-shoulder brace has been used on 12 patients, 9 of whom have subsequently required further support in a mandibular-shoulder brace; 1 patient needed support only in a mandibular-shoulder brace.

The details of these patients are shown in Table 2.

Discussion

The halo with a prefabricated plastic body vest has been shown to be a most effective manner of controlling the unstable cervical spine (Johnson et al, 1977).

The halo-thoracic brace (a halo connected to a prefabricated body vest) has proved successful in the treatment of fractures of the odontoid process (Schweigel, 1979).

Table 2. Patients treated with the halo-shoulder/mandibular-shoulder brace.

No.	Diagnosis	Age	Sex	Subdiagnosis	Operation	Postoperative			Remarks
						Traction	Halo-S-brace	Mandibular-S-brace	
1		61	m	Cervical spine instability subluxation C3-4 and C5-6 with a partial block and a posterior impression at C5, early cervical cord pressure symptoms.	C5 Laminectomy and C3-6 postero-lateral fusion.	3 kg for 2 weeks	2.5 months	3 months	Solid fusion, regression of symptoms.
2	Rheumatoid arthritis	68	m	Brainstem ischaemia, incipient quadriplegia C3	Enlargement of foramen magnum, C1 and C3 laminectomy, occiput to axis spondylosis.	5.5 kg for 6 weeks	2 months	3 months	Solid fusion, regression of symptoms.
3		60	f	Atlanto-axial dislocation of 15 mm with compression of the medulla oblongata.	Atlas laminectomy and removal of the posterior margin of the foramen magnum, occiput to axis spondylosis.	3 kg for 5 weeks	3 months	—	No chin and neck area, no mandibular-shoulder brace possible. Solid fusion, regression of symptoms.
4		60	f	Atlanto-axial instability with early long tract neurological signs.	Atlanto-axial arthrodesis.	36 kg for 48 hours	—	2.5 months	Solid fusion, regression of symptoms.
5	Rheumatoid arthritis + trauma	74	f	Fell and sustained a fracture of the dens and of the arch of the atlas on both sides, treated by immobilization in the halo-shoulder brace for 3 months; the atlas fracture united, but the dens fracture persisted as an unstable pseudarthrosis.	Atlanto-axial posterior fusion.	36 kg for 24 hours	7 weeks	2 months	Solid fusion.
6	Ankylosing spondylitis	41	m	Spontaneous onset of neck pain; fracture suspected but not confirmed. Treated in halo traction during which an extension fracture C4-5 became evident; traction continued to open the fracture and correct the flexion	Cloward anterior spinal fusion C4-5 to maintain the open wedge fracture.	3 kg for 3.5 weeks	2.5 months	3 months	Solid fusion.

7	Ankylosing spondylitis + trauma	66	m	Displaced fracture C6-7, almost complete quadriplegia, secondary instability following laminectomy at St. Elsewhere's.	Cloward anterior fusion C6-7.	3kg for 2 months	2 months	3 months	Solid fusion, sensation returned almost completely; power in legs partially returned, some return of power in arms.
8		48	f	Destruction of the bodies of C4-5-6. Severe pain in right shoulder and lateral side of arm (C5).	Laminectomy right C5 decompression C5 root and right posterior spondylosis C3-7.	8kg for 5 days 8kg for 4 weeks at night 5kg for 4 weeks at night 3kg for 4 weeks at night.	3 months in daytime with extra distraction right side.	3 months	Solid fusion, no pain.
9		50	f	Destruction of the right lateral mass of the atlas, severe pain due to involvement of the greater occipital nerve.	Posterior spondylosis occiput-C1-C2 following skull traction which relieved pain.	5.5kg for 5 weeks to allow fusion in painfree position.	3 months	3 months	Solid fusion, no pain.
10	Mamma metastasis	59	f	Destruction of the body of C3 and involvement of the lower half of the body C2, severe pain right shoulder and paraesthesiae right arm.	Posterior cervical fusion C1-5.	3kg for 48 hours	6 weeks	6 weeks	Preoperative immobilization in halo-s-brace during irradiation treatment; solid fusion, no pain, no paraesthesiae.
11		43	f	Metastases in the body and dens of C2 with fracture of the base of the dens and 8mm instability of the dens on flexion as compared with a normal position in extension; pain and stiffness in neck, disseminated metastases.	Posterior cervical fusion C1-3.	3kg for 24 hours	4 weeks	—	Preoperative immobilization in halo-s-brace during irradiation treatment, post-operative no pain, she died 4 weeks after operation.
12	Trauma	48	m	8 Months old unstable non-union of fracture of the dens.	Atlanto-axial posterior fusion.	3kg for 2 weeks	1 month	(2 months, wore previously made brace)	Solid fusion, anatomical reduction.
13		86	f	Dementia senilis + 10 days old unstable fracture of the odontoid process with 4mm anterior displacement of the atlas.	5kg skull traction for 3 days preoperative; posterior atlanto-axial spondylosis.	3kg for 24 hours	2 months	(2 months, wore a soft collar)	Anatomical reduction; solid fusion.

However, because of asymmetry, a tender bony or cutaneous swelling or tender skin, difficulties often arise in fitting a mass-produced brace and so we developed a carefully moulded made-to-measure halo-shoulder brace and also a mandibular-shoulder brace.

We appreciate that we have only studied the range of movement in one volunteer, but by comparison with the restriction of movement obtained by the Philadelphia collar, the four-poster brace, the cervico-thoracic brace, the Somi brace and the polyethylene Camp plastic collar as described by Johnson et al (1977) and Fisher et al (1977), it would appear that the mandibular-shoulder brace effectively stabilizes the cervical spine.

Postoperative stabilization by one or a combination of these orthoses has so far proved satisfactory in the 13 patients described. Furthermore the braces are comfortable as well as being simple to remove and refit. In the case of the halo-shoulder brace only two buckles on the shoulder and 4 Allen screws to connect the rods on the halo are involved. In the case of the mandibular-shoulder brace 2 Velcro fasteners are used on the shoulder combined if necessary with 2 leather straps to connect the mandibular and occipital parts for extra support. It is worth mentioning that some of the patients initially preferred to sleep in skull traction until they became used to wearing the halo-shoulder brace 24 hours per day and some of the patients wore their halo-shoulder brace rather longer than expected as they took some time getting used to the transition from the halo-shoulder brace and its associated free movement of the lower jaw to the somewhat more restrictive mandibular-shoulder brace.

Regarding the manufacture of the braces the important substance is the 3mm orthopaedic Plexidur, which during the past few years has been developed into an exceptionally strong material. So far none of the orthoses have

broken. The material is easy to mould and any minor corrections are simple to carry out with the aid of the heat gun, but these are seldom necessary when a good plaster cast is first made. The material is easy to clean and if necessary the patients can shower or wash their hair with the brace in place. Furthermore, the material is light and even with a halo and connecting rods the complete brace only weighs approximately 1,200 grammes.

The mandibular-shoulder brace only weighs approximately 360 grammes, is comfortable and well tolerated by the patient after removal of the halo-shoulder brace. Furthermore, this type of brace can be used on patients who for other reasons require a neck support, but who cannot tolerate a normal ready-made collar.

Acknowledgements

I wish to thank Mr. W. W. Fidler F.R.C.S. for his help and advice in the preparation of this article about patients under his care and also to thank Mr. D. van Doleweerd for the illustrations.

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Incidence of reamputation and death after gangrene of the lower extremity

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Abstract

Since 1972 the Danish Amputation Register (DAR) has recorded major amputations in Denmark. The register is based on voluntary detailed reports from surgical and orthopaedic departments. The present investigation is based upon 2029 amputations for arteriosclerotic and diabetic gangrene with an observation period up to 4 years.

The incidence of ipsilateral reamputation is high in the immediate postoperative period with 10.4% after one month, 16.5% after three months and 18.8% after six months. Later the incidence is quite low, reaching a total of 23.1% after four years.

The risk of contralateral amputation is ever present with an incidence of 11.9% within one year, 17.8% after two years, 27.2% after three years, and finally 44.3% after four years.

The mortality after three months is 16.3% and then tapers off to a total of 22.5% after four years. As compared with the normal population a significant over-mortality is seen during the first three months, and an equally significant under-mortality from six months onward during the observation period.

Introduction

Over the years many studies have attempted to clarify the fate of the arteriosclerotic and diabetic amputee, with respect to later ipsi- or contralateral amputation (Silbert 1952; Goldner 1960; Baddeley & Fulford 1965; Mazet 1967; Sarmiento 1968; Whitehouse et al. 1968; Persson & Sundén 1971; Kolind-Sørensen 1974); and also mortality (Smith 1956; Hansson 1964; Whitehouse et al. 1968; Ecker & Jacobs 1970; Persson & Sundén 1971; Kahn 1974; Kolind-Sørensen 1974).

A majority of the studies comprise rather few observations and the observation period is often rather short.

Method

The Danish Amputation Register was founded in 1972 for the purpose of continuous study of the amputation problem in the broadest sense. The register builds on voluntary reports from orthopaedic and surgical departments in Denmark and further reports from Danish prosthetic fitters.

Since 1973 the register has recorded data on c. 5,000 new amputations and an equal number of prostheses fitted. Data on amputee survival is brought up to date by a biannual comparison with the Danish Central Citizen Register (CPR). The present study was undertaken in order to establish survival of extremities and amputees and is based on detailed reports of 2,029 persons with amputations on the lower extremities, performed for arteriosclerotic or diabetic gangrene.

The input material was the date of birth, date of first lower extremity amputation and dates of any later ipsi- or contralateral lower extremity amputation performed during the observation period. In all instances of death the exact date is recorded.

The statistical analysis was performed in the department for medical statistics, Rigshospitalet, utilizing life table methods. All computations were carried out individually for the diabetic and non-diabetic groups, and as a compound as well. No significant differences were found between diabetics and non-diabetics.

Results

Ipsilateral reamputation

Ipsilateral reamputations are carried out on 10.4% of all amputees within one month of the initial amputation. The percentage after two months is 14.8 and after three months 16.5.

The percentage of reamputation after six months is 18.8, constituting the majority of all

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ipsilateral reamputations during the observation period (Fig. 1).

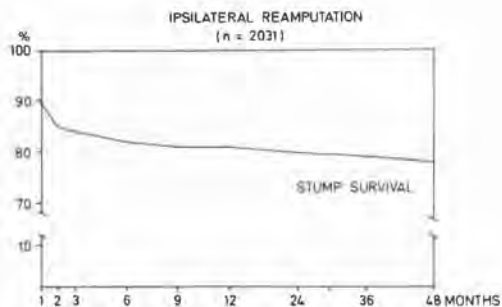


Fig. 1. Ipsilateral reamputation was performed after one month in 10.4% of patients, after three months in 16.5% and after six months in 18.8%. Thereafter, until four years from the initial operation, a further 4.3% were reamputated.

In fact, from the 7th and 48th postoperative month only a further 4.3% of the amputee population is reamputated. It seems most probable that by far the majority of ipsilateral reamputations is due to postoperative complications which could not be controlled by conservative means.

Later breakdown of a stump which has healed after the initial amputation seems to be a rather rare occurrence in the present material.

Contralateral amputation

The prognosis for "survival" of the other leg is less optimistic. Whereas the risk of ipsilateral amputation was almost eliminated 6 months after the primary amputation, the "other leg" is at risk as long as the tables are able to predict, with contralateral amputation hitting 11.9% within the first year, 17.8% within two years,

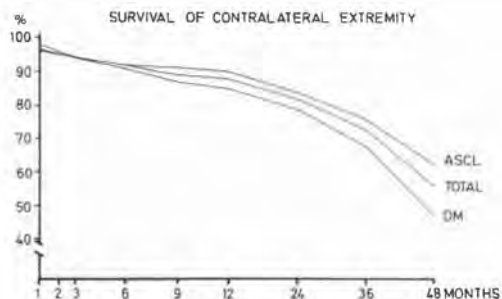


Fig. 2. One year after primary amputation, contralateral amputation in the compound group had been performed in 11.9% of patients, after two years in 17.8%, after three years in 27.2% and after four years in 44.3%. The incidence in diabetic amputees (DM) after four years was 52.6%, whereas in the non-diabetic group (ASCL) it was 38%.

27.2% within three years and 44.3% less than four years after the initial amputation (Fig. 2).

A certain difference is seen between the rate of contralateral amputation in arteriosclerotic patients (38%) and diabetic patients 52.6%.

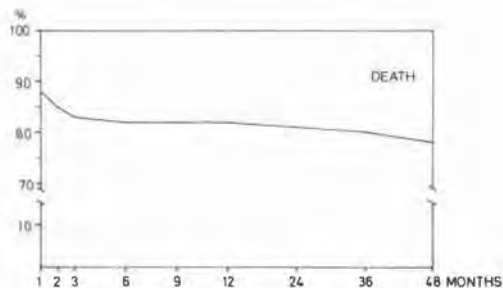


Fig. 3. Compound survival of diabetic and non-diabetic amputees.

Mortality

The rate of survival was stipulated for the arteriosclerotic and diabetic groups individually and no significant differences were encountered.

The compound survival curve (Fig. 3) demonstrates an initial "dip" but afterwards a rather linear and not very steep slope. By far the greatest risk of death is encountered within three months following amputation (16.6%), whereas the figures after 1 through 4 years are 18.4, 19.2, 20.3 and 22.5%. However further statistical study demonstrates an astounding difference in mortality, as compared to the "normal" population (Fig. 4). Within the first 3–6 months a markedly increased mortality is noted in the amputee group—the difference being significant ($p < 0.001$). At six months postoperatively the chance of survival is roughly the same as in the

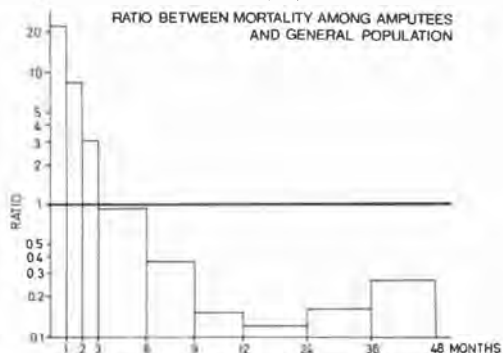


Fig. 4. A significantly increased mortality among amputees compared with a "normal" population is shown during the first three postoperative months. During the next three months the mortality is the same and after six months a significantly decreased mortality in the amputee group is demonstrated.

normal population, but at any later stage the chances of survival are significantly ($p < 0.001$) greater in the amputee group. The reasons for this unexpected observation are not known at present, but it is tempting to postulate that the frail and infirm are eliminated through the operative stress, leaving alive the fittest.

The compound fate of patients following the first lower extremity amputation is demonstrated in Fig. 5. After four years 36.6% of the patients are still alive without further ablative surgery. A further 40.9% have been subjected to ipsilateral reamputation (9.5%) or contralateral amputation (31.4%). After four years 22.5% are dead.

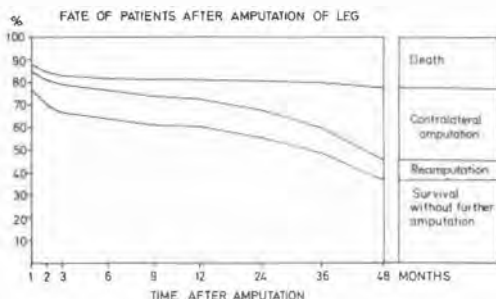


Fig. 5. Four years after the initial amputation three out of four patients were still alive. Almost half of these had no further amputation. The remainder had been ipsi- or contralaterally amputated at a later stage within the observation period.

Discussion

The incidence of ipsilateral reamputation has been described as ranging from 7.5% to 48% (Sarmiento 1968) and from 12.5% to 30% (Persson & Sundén 1971).

During the 48-months' observation period a total of 23.1% of our patients were reamputated.

In our series approximately half the total number of reamputations (10.4%) were performed within 1 month of the primary operation, three quarters (16.5%) after 3 months and almost all (18.8%) within 6 months following the initial amputation. From the 7th through the 48th month only a further 4.4% of the amputee population was reamputated.

No previous study details the exact time of ipsilateral reamputation over a prolonged period of time.

These findings suggest that the majority of ipsilateral reamputations were sequels to an unrealistic primary choice of amputation level and/or postoperative complications such as infection. If the amputation stump survives the

initial 6 postoperative months it stands a very good chance of permanency.

In a series of unilateral diabetic amputees Baddeley & Fulford (1965) recorded 20% contralateral amputations within three years. The corresponding findings of Silbert (1952) were 30% after three years and 51% after five years. Mazet (1967) in a group of unilateral diabetic amputees computed the risk of contralateral amputation at 10, 20 and 40% after 1, 2 and 5 years. Goldner (1960) followed 71 diabetic patients with amputation on one side of whom 66% eventually developed contralateral lesions; among these two thirds (68%) were amputated. The advent of the contralateral lesion was recorded within the 1st—4th years in 23, 61, 72 and 89% of all. With the stated amputation rate of 68% this would mean contralateral amputation in 15.6, 41.5, 49 and 60.5% of the originally unilateral amputees within the 1st through 4th years.

The above mentioned figures correspond fairly well to those of our series, in particular the general trend is identical, towards a relentlessly increasing risk of contralateral amputation. It should be stressed that whereas the studies referred to were all concerned with diabetic amputees, we found the same tendency in non-diabetics as well.

Many authors operate with the concept "in-hospital mortality" or "postoperative mortality" without clearly defining the average duration of the hospitalization.

In contemporary work it has become conventional to substitute "3-month mortality" i.e. the rate of death within 3 months following initial surgery. For this reason it is not possible to compare exactly the mortality in different series.

The in-hospital mortality ranges from 9% (Kahn 1974) over 11.9% (Persson & Sundén 1971) and 12% (Smith 1956), through 25% (Kolind-Sørensen 1974). In a nationwide survey of lower extremity amputations in Denmark during 1977 Ebskov (1979) found an average in-hospital mortality of 14%—varying between 8% and 21% in different parts of the country. The total number of amputees was 1725 and the average duration of hospitalization was 47 days. In the present series of 2,029 amputees 16.6% were dead within three months following surgery.

As will be seen there is no principal difference in this respect. This compatibility changes when

the mortality is followed over a longer span of time.

Hansson (1964) showed 45%, 58%, 71% and 76% mortality 1, 2, 3 and 4 years postoperatively.

Ecker & Jacobs (1970) found a 39% mortality after 3 years, Kolind-Sørensen (1974) demonstrated 50% after 5 years, Smith (1956) 60% after 5 years and Whitehouse et al. (1968) c. 80% after 7 years.

In our series the percentages after 1 through 4 years are 18.4, 19.2, 20.3 and 22.5. As far as can be judged there are no major differences in aetiology and age distribution, the sole difference in fact being the much more comprehensive material in our series.

Hanson (1964) flatly stated that the mortality in a group of 254 patient was four times that of a comparable "normal" population. This is in strong contrast to our findings that after 6 months the amputee group demonstrates a highly significant under-mortality as compared with the "normal" population. There is no known explanation for this discrepancy.

Whitehouse et al. (1968) stated that "a diabetic amputee will probably lose his life before he loses his second leg". This dictum is widely cited, but it is certainly not in correspondence with the findings in the present series, where very significant numbers of diabetics and non-diabetics live long enough to lose additional parts of the primarily amputated

leg and in particular to lose in ever increasing numbers "the second leg".

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Ischaemic wound complications in above-knee amputations in relation to the skin perfusion pressure*

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Abstract

Healing of the stumps in 59 above-knee amputations was correlated with the local skin perfusion pressure (SPP) measured preoperatively as the external pressure required to stop isotope washout using $^{131}\text{I}^-$ or $^{125}\text{I}^-$ antipyrine mixed with histamine. Out of the 11 cases with an SPP below 30 mmHg no fewer than 9 (82 per cent) suffered wound complications. Out of the 48 cases with an SPP above 30 mmHg severe wound complications occurred in only 4 cases (8 per cent). The difference in wound complication rate is highly significant ($P < 0.01$). It is concluded that the SPP can be used to predict ischaemic wound complications in above-knee amputations as has previously been shown to be the case in below-knee amputations.

Introduction

It may be surprising that, in spite of increasing knowledge about vascular diseases and in spite of all the modern progress in surgical techniques as well as in objective measurements of the circulation and in postoperative measures, an above-knee (AK) amputation must be considered the only possible treatment in regrettably many dysvascular patients.

Arterial reconstruction can be made only in a limited number of patients suffering from

occlusive arterial ischaemic disease. Among those patients who come to major amputation a considerable number suffer from ischaemia to such an extent that amputation below-knee (BK) cannot heal. And not even an AK-amputation is a guarantee against ischaemic wound complications.

In BK-amputations ischaemic wound complications can be predicted by preoperative measurement of the local skin perfusion pressure (SPP) (Holstein et al. 1979). The present study concerns the SPP in relation to wound complications in above-knee amputations.

Patients and methods

Patients:

Sixty-two above-knee amputations in 58 patients were performed after preoperative measurement of the skin perfusion pressure below and above the knee. The distribution according to age, sex and the presence of diabetes mellitus is shown in Table 1. Nine had previously had a contralateral major amputation and in 15 patients the above-knee amputation was secondary to a failed major amputation at a more distal level; in 14 cases below-knee and in one case through-knee (TK). Forty-nine of the patients undergoing AK-amputations were capable of independent walking up to the period of major amputation.

Table 1. Age distribution in 62 cases of above-knee amputation

	41-50	51-60	61-70	71-80	81-90	Total
Cases without diabetes mellitus		3	12	18	12	45
Cases with diabetes mellitus	1	1	4	6	5	17

Male/female ratio: 38/24 = 1.58. Arithmetic mean age: without diabetes mellitus (DM) 74.0 years. With DM: 72.6 years.

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The surgical technique used was simple amputation at midhigh or low midhigh level, the anterior flap often being longer than the posterior flap. Myoplasty was not used. Suction drainage was employed in most cases and the wound was dressed loosely (Tubegauze^R). Sutures were removed on the 14th to the 21st postoperative day. The patients were mobilized as soon as possible in a wheelchair or on walking appliances. Prosthetic fitting was undertaken when the stump was well healed.

Measurement of the SPP.

The SPP, which in normal subjects lies slightly above the systemic diastolic blood pressure, was determined as that external counterpressure which was just sufficient to stop the washout of an intradermal depot of radioactive isotopes (Holstein et al. 1977).

Approximately 0.1 ml of a sterile solution containing 10–20 μCi ^{131}I -antipyrine (or 30–40 μCi ^{125}I -antipyrine) and 50 mg histamine diphosphate was injected intradermally and a washout curve was recorded. The external pressure was applied by a blood pressure cuff and measured by a square air-filled plastic cushion (inflatable part, 11 by 11 cm) interposed between the labelled skin and the cuff and connected to an ordinary mercury manometer. (Fig. 1). When the washout rate, which

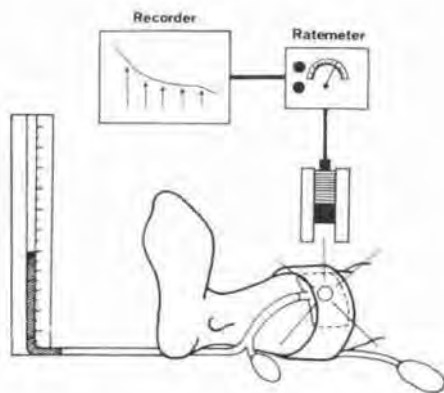


Fig. 1. Measurement of skin perfusion pressure on the calf. The washout from an intradermal depot of ^{131}I -antipyrine mixed with histamine is recorded by a conventional scintillation detector coupled to a ratemeter and written on a penwriter. External counter pressure to the labelled skin area is applied stepwise with an ordinary blood pressure cuff and measured with an airfilled plastic cushion interposed between the cuff and the depot and connected to a conventional mercury manometer.

accelerates during the first 2 to 15 minutes, had been constant for 3 to 5 minutes, the external pressure was raised in steps resulting in a stepwise decrease in washout rate until cessation. (Fig. 2). At each of the final steps the tracing was observed for about 5 minutes and after washout cessation the external pressure was released to zero in order to secure that the washout was re-established. The washout cessation pressure, viz. the SPP, was determined within an interval of 5 mmHg and was defined as the highest external pressure which allowed a minimal washout to be discerned, plus 3 mmHg.

The sites of measurements were approximately 10 cm distal to the knee joint on the anterolateral side of the calf just superficial to the anterior tibial muscle and 10 cm proximal to the upper margin of the patella on the anterolateral side of the thigh i.e. in most cases

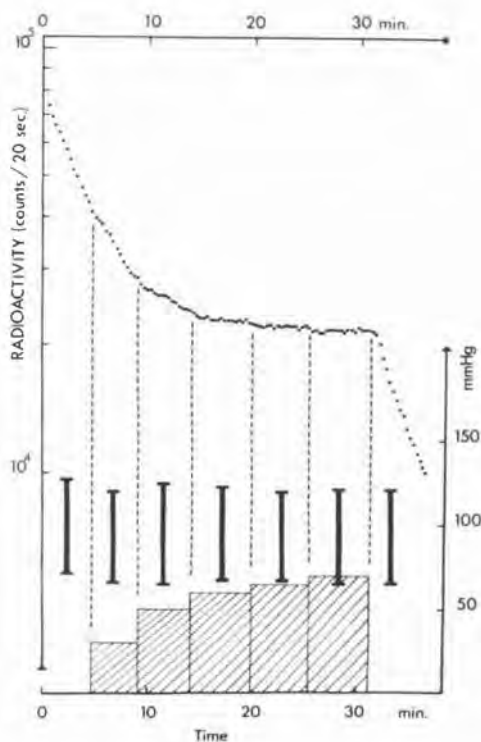


Fig. 2. Replotting of a washout curve. The washout stops at 70 mmHg (skin perfusion pressure = 68 mmHg). The hatched columns indicate the external counter pressure. The vertical bars indicate the auscultatory brachial blood pressure. Observe that the washout is re-established after releasing of the external pressure.

within a range of about 5 cm from the selected levels of amputation.

The patients were examined in the supine position with legs horizontal. Repeated i.v. doses of analgetics (demerol, 35 mg) sufficient to prevent involuntary movements from rest pains were given and, in addition, the legs were supported by sandbags. Conventional auscultatory arm blood pressure was repeatedly measured using a 12 by 26 cm cuff placed around the left arm. Before the examinations the thyroid gland was blocked with 0.5 mg potassium iodide given perorally in solution.

Results

Mortality

Fourteen patients (24 per cent) died postoperatively during hospitalization, six of these (10 per cent) died with severe wound complications of the stump. Two of these had bilateral AK amputations; one died with bilateral stump necrosis and the other died with necrosis of one stump and with the sutures still *in situ* on the other-intact-stump. Six patients died with well healed stumps and two patients died with the sutures not yet removed from an intact stump.

Thus analysis of wound complications in relation to the preoperatively measured SPP (see below) could be made in 59 AK amputations in 56 patients—excluding the three intact stumps with sutures *in situ* at the time of death.

Figure 3 shows the healing of the stump in relation to the SPP. The three cases with an SPP below 20 mmHg all had major wound complications. In one case the patient died with total rupture and severe necrosis of the wound. In two cases severe necrosis postponed the healing, which was not complete until after 4 and 5 months respectively.

Only one out of eight cases (12 per cent) with a preoperative SPP between 20 and 30 mmHg healed primarily. In one case healing of a minimal defect took place by second intention within 6 weeks. The remaining six patients all had major wound complications. In one case severe necrosis delayed the healing for 4 months, in two cases major surgical revisions because of necrosis and infection were necessary and in three cases the patients died with severe necrosis of the stumps. Thus, summarizing the cases with SPP below 30 mmHg, 9 out of 11 (82 per cent) suffered severe wound complications.

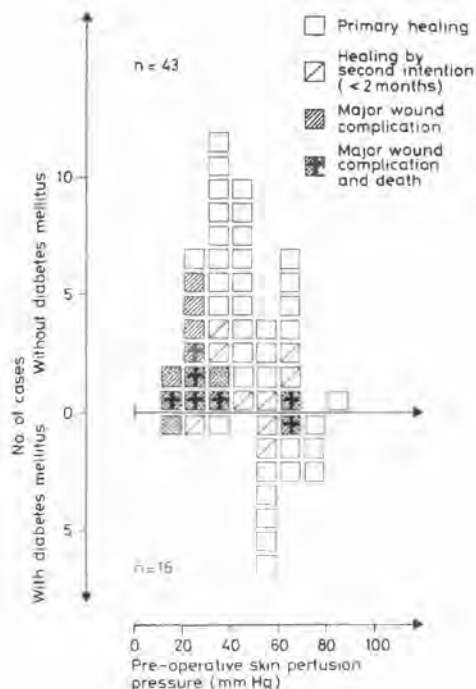


Fig. 3. Wound complications in 59 AK amputations in relation to the local skin perfusion pressure measured preoperatively.

Thirty-six out of the 48 cases (75.0 per cent) with a preoperative SPP of above 30 mmHg healed primarily. In eight cases small defects healed rapidly, i.e. within 2 months. In four cases (8 per cent) major wound complications developed. In two of these cases—both with a preoperative SPP of 30–40 mmHg—i.e. on the borderline of the risk group with an SPP below 30 mmHg—surgical revision because of severe necrosis was carried out. In one of these cases the patient died with necrosis of the revised stump. In two cases with normal SPP, i.e. 60 to 70 mmHg, the patients died with severe wound complications; one with infection of the wound and sepsis and the other with rupture of the infected wound. The clinical picture, a swelling, warm, red stump in these two cases with normal SPP and infection was very different from the necrotic appearance of the low pressure stumps.

These differences in primary healing rate and in major wound complication rate in the various SPP groups are highly significant for the total number of cases and for the 43 non-diabetic cases (Fig. 3). In the 16 diabetic cases there were only 2

major wound complications (12 per cent) compared with 11 major complications (26 per cent) in the non-diabetic group ($0.5 < P < 0.10$). The SPP in the diabetic group, which averaged 58.1 mmHg, was however, significantly higher than in the non-diabetic group where the average was 42.9 mmHg ($P < 0.01$) and only 2 of the diabetic cases had an SPP below 30 mmHg.

Among the 14 cases with AK amputations secondary to failed BK amputations the wound healed primarily in 12 cases. In one case the wound healed slowly (in 6 months) and in one case the patient died from wound infection. The average SPP at the BK level before the BK amputations in these 14 cases was 31.0 mmHg (range 8–63 mmHg), as against 54.3 mmHg (range 23–68 mmHg) at the AK level before the AK amputations ($P < 0.01$).

The TK amputation which failed had preoperatively an SPP of 28 mmHg below the knee. The revision to AK amputation healed primarily after measurements of the SPP above the knee, which was 38 mmHg.

Among the 44 cases where an AK amputation was the primary operation, the SPP below the knee was less than 30 mmHg in 32 cases i.e. with great risk of ischaemic complications at that low level. In 12 cases the SPP below the knee was

greater than 30 mmHg. The general condition of these patients, however, was so poor that a primary AK amputation was considered the safest treatment and the AK amputation healed primarily in 10 cases and secondarily, caused by very small defects, in 2 cases.

Rehabilitation

The patients returned to their own homes in 28 out of 48 cases (58 per cent). Of the 49 patients who could walk prior to major amputation, rehabilitation as regards walking with a prosthesis was obtained in 20 cases (41 per cent). The walking ability was not regained in the remaining 29 cases due to death in 9 cases, to poor mental and physical condition in 15 cases and to bilateral major amputation in 5 cases.

The average time spent in hospital per AK amputation was 15.8 weeks. Table 2 shows that the *preoperative* period was about nine times longer in patients with failed major amputation at a lower level. Rehabilitation or an attempt at rehabilitation as regards walking increased the *postoperative* time about three to five times. Wound complications did not on average increase the period of hospitalization, but some of these patients died in the early postoperative period.

Table 2 Number of weeks spent in hospital in relation to primary or secondary AK amputation and to rehabilitation

No. of AK amputations	No. of patients	Type of AK amputation	Weeks in hospital			
			preoperatively mean*	range	postoperatively mean*	range
47	43	Primary	1.8	(0.1–8.0)	10.2	(0.5–52.0)
15	15	Secondary to failed BK or TK amputation	16.9	(4.0–39.0)	12.1	(0.5–48.0)
No. of AK amputations	No. of patients	Rehabilitation	preoperatively mean*	range	postoperatively mean*	range
20	20	Discharged walking	6.8	(0.1–38.5)	15.3	(3.0–31.0)
8	8	Failed attempt at walking	8.8	(0.5–24.0)	24.1	(6.0–56.0)
34	30	No attempt at walking	3.5	(0.5–9.0)	4.7	(0.5–40.0)

* Arithmetic mean per AK amputation.

Discussion

The healing of the AK amputations correlated significantly with the preoperative SPP. The poor results in patients with an SPP below 30 mmHg agree with previous findings in BK amputations (Holstein et al. 1979).

Apart from a preliminary report on this series (Holstein 1973) no studies of wound healing in above-knee stumps in relation to objective measurements of the arterial supply have previously been published. Our rate of primary healing (62.7 per cent) is, however, of the same order as that reported in larger series in the literature (Dale & Capps 1959, Schlitt & Serlin 1960, Warren & Kihn 1968, Hall & Schucksmith 1971, Kihn et al. 1972).

The high mortality (24 per cent during hospitalization) reflects the often poor condition of the patients undergoing AK amputations. Our figure falls within the range of mortality rates of about 10–40 per cent in larger series in the literature (Dale & Capps 1959, Lempke et al. 1963, Warren & Kihn 1968, Hansson 1964, Ottewill & Stahlgren 1965, Hall & Schucksmith 1971).

In discussing the importance of the SPP in relation to AK amputations one must distinguish between two different groups of patients. The first group consists of patients who have lost the ability to walk for reasons other than the peripheral ischaemia and in these patients the aim of the amputation is to relieve a painful useless extremity with a minimum of discomfort. In 13 cases in our series the patients belonged to this category. In six cases the patients suffered wound complications which in four cases were related to an SPP below 30 mmHg. These findings point towards the selection of a short stump in cases of inadequate blood supply in a weak patient. Only if the blood supply is adequate should a long stump, which is more comfortable during sitting and when moving in bed, be chosen.

The level selection is more difficult in the second group where the patients have been able to walk up to the time of amputation. In these cases the result of the treatment should be considered satisfactory only if the ability to walk is regained by means of a prosthesis; 41 per cent achieved this in the series. In principle a long stump facilitates walking with a prosthesis and when this advantage is added to the previously mentioned comfort during sitting and moving in

bed it seems justified to take the risk of ischaemic wound complications in order to obtain a long stump. Slow healing may be obtained even when the SPP is of the order of 20 to 30 mmHg. But this must be balanced against the risk of loss of ambulation in the event of a long period with a painful, slowly healing ulcer prohibiting prosthetic training—and early surgical revision should be considered in case of ulcers in order to shorten the healing time.

Compared with our figures for BK amputations (Holstein et al. 1979) the average duration of hospitalization for AK amputations was less. This finding agrees with Weaver & Marshall's observations (1973). A high mortality, a number of patients discharged to nursing homes soon after surgery and only a few reamputations, reduced the average period of hospitalization in patients undergoing AK amputations.

To summarize, the SPP is a very reliable means of predicting ischaemic wound complications in AK amputations. The implications of wound complications are, however, very variable, ranging from healing by second intention with preservation of the stump length to a life-threatening complication. If ischaemic wound complications are to be avoided meticulous surgery is required and in non-mobile weak patients a short stump length is advocated in the case of a low SPP.

Acknowledgements

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Major amputations of the lower extremity for vascular disease

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Introduction

Despite continuing progress in vascular surgery, some 90% of all amputations of the lower limb are still being performed for vascular occlusive disease. Gangrene too can be extensive. A patient can be inoperable for vascular surgery and arterial reconstruction or lumbar sympathectomy does not always give the desired effect.

Amputations of the lower limb will therefore continue to be part of the armamentarium of the vascular surgeon. An amputation is a semi-elective operation. The degree and progression or regression of the ischemia are often difficult to judge and predict. It is generally advisable to observe an ischemic leg for at least a few days and to take conservative measures, both local and by means of 10% Dextran by intravenous drip. Then there is time for further evaluation of the general condition of the patient and for angiography. Physiotherapy is required as well. Moreover, the level of amputation, below-knee or above-knee, can be determined more reliably.

Below-knee amputation is done with the formation of a long posterior musculocutaneous flap with myoplasty, and an above-knee amputation is performed by means of a fishmouth incision and myoplasty. Only a soft dressing, without plaster of Paris or bandage, is used on the stump.

Patient series

A series of 151 patients with 171 primary amputations, performed over a period of six years (1972-1977), is reviewed. Re-amputations are not included in this number. More than one-third of the patients were in the seventh decade of life (Fig. 1); 89 of the 151 patients were male and 62 female. A record of previous surgery to achieve improvement of the circulation of the leg

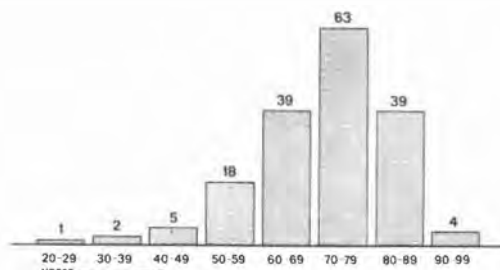


Fig. 1. Age distribution in 171 amputations.

was not uncommon as Table 1 shows. Nearly one-third of the patients had undergone lumbar sympathectomy, sometimes several years ago.

Table 1. Previous surgical treatment
171 Amputations

Arterial reconstruction	
—in 20 patients	26 (15%)
Lumbar sympathectomy	55 (32%)
Local intervention	15 (9%)

Most patients, suffering from generalized atherosclerosis, had a number of concomitant diseases, usually two or three (Table 2).

Table 2. Concomitant diseases
in 171 Amputations

Cardiac	79%
Diabetes mellitus	61%
Hypertension	33%
Pulmonary	30%
Renal	25%
Cerebrovascular	19%

Amputation level

The indication for amputation was gangrene with or without rest pains in 92% of cases. In only 13 cases were intractable rest pains the sole indication. As Table 3 demonstrates, the ratio of below-knee versus above-knee amputations was about 2:1. A below-knee amputation was always the primary choice, unless there was severe cyanosis and oedema or tissue necrosis and

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infection of the lower leg. Series functional disorders of the knee existed in a few cases and made an above-knee amputation desirable. Two patients even showed tissue necrosis of the upper leg, which made a hip disarticulation necessary.

Table 3. Level of amputation

Below-knee	109	(64%)
Above-knee	60	(35%)
Hip disarticulation	2	(1%)
	171	

Wound healing

Wound healing of the stump is of paramount importance. Primary healing occurred in two-thirds of the 109 below-knee and in over two-thirds of the 60 above-knee amputations as Table 4 shows. The risk of failure in healing after above-knee amputation is not all that much smaller than after below-knee amputation!

Table 4. Wound healing of 171 amputations

	Below-knee	Above-knee
Primary healing	71 (65%)	43 (72%)
Death before primary healing	9 (8%)	6 (10%)
Failure	29 (27%)	11 (18%)
	109	60

(Death before primary healing 2 hip disarticulation)

Failures of wound healing are presented in Table 5. Secondary wound healing usually took one or two months. Reamputation above the knee was necessary in 9 of the 109 below-knee amputations (8%); usually after a few weeks.

Table 5. Failures of wound healing

	Below-knee	Above-knee
Secondary healing	14	3
Death before secondary healing	5	4
Operative stump revision	1	4
Reamputation	9	0
	29	11

Operative mortality

Another important aspect is the operative mortality within 30 days of the operation. The

total operative mortality in this group of atherosclerotic patients was fairly high—19%—and that after above-knee amputation proved to be higher than that after below-knee amputation, as Table 6 demonstrates. In some 50% of cases the cause of death was cardiac and in some 30% sepsis (urosepsis or sepsis from decubitus). More than 50% of the patients died before primary wound healing could occur.

Table 6. Operative mortality in 171 amputations

		Causes	
Below-knee	16 (15%)	Cardiac	15
Above-knee	14 (23%)	Sepsis	9
Hip disarticulation	2 (100%)	Pulmonary	3
	32 (19%)	CVA	3
		Other	2
			32

Postoperative complications

Table 7 lists the non-fatal postoperative complications, except failures of wound healing. They occurred in some 20% of below-knee amputations and in an equal percentage of above-knee amputations. In nearly 50% of these cases the complications were pulmonary or cardiac disorders. Gas gangrene developed in two of the earlier cases; this complication no longer occurred after introduction of a policy in which the skin of the leg was painted with an aqueous solution of Betadine 10%, a couple of hours before operation.

Table 7. Non-fatal postoperative complications in 171 amputations

		Pulmonary	10
		Cardiac	8
Below-knee	21/109 (19%)	Pressure sores	6
Above-knee	12/60 (20%)	Cerebral	4
Hip disarticulation	1/2 (50%)	Urinary tract	4
		Sepsis	3
	34/171 (20%)	Gas gangrene	2
		Other	5
	42 complications		42

Contralateral amputations

There are many factors which prevent rehabilitation, such as cardiopulmonary or cerebrovascular insufficiency, dementia or blindness. But the further destiny and possibility

of rehabilitation of the amputee is also largely influenced by circulatory disorders in the other leg. Table 8 shows that six patients had previously undergone amputation of the other leg. Forty seven patients had ischemia of the other leg (intermittent claudication, rest pains or tissue necrosis) at the time of the primary amputation. In 20 patients, the other leg had to be amputated as well during the period

Table 8. Ischemia of the other limb
151 patients—1972–1977

Previous amputation	6 (4%)
Ischemia	47 (31%)
Amputation other limb	20 (13%)

considered; from 1972 to 1977. Bilateral amputations are therefore not uncommon. In this series the ultimate percentage was 17. Table 9 gives the distribution of the levels of amputation. In 20 of the 26 patients, amputation

Table 9. Bilateral amputations
26 of 151 patients (17%)

Bilateral below-knee	11
Below-knee and above-knee	13
Bilateral above-knee	1
Above-knee and hip disarticulation	1

of the second leg was performed within two years of the first amputation.

Conclusions

Of the 151 amputees, 120 remained (after deducting the operative deaths) for whom rehabilitation could in principle be considered.

The results of rehabilitation will be presented in this Journal in the future.

It can be stated in the meantime, that in spite of a considerable mortality and a fair percentage of failures in wound healing, a significant number of amputees can be rehabilitated with a prosthesis and enabled to have a reasonable life for years.

Case note—fitting of an artificial limb after 43 years

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The patient, a 48 year old Indian with a right above knee amputation, first attended Wolverhampton Artificial Limb and Appliance Centre in 1978. As a 5 year old child in India he had fallen from a camel, sustaining a compound fracture of the tibia and fibula which had become severely infected necessitating amputation. Within a few weeks the amputation was healed and the first prosthesis he tried out was a bamboo pole with a sling to support the stump as shown in the accompanying photograph (Fig. 1, left). This prosthesis was designed and built by his father. He grew up using the bamboo pole which gave him excellent mobility whilst working as a farmer and shopkeeper in his village.



Fig. 1 Left, bamboo pole with supporting sling. Right, the patient fitted with a modular assembly above-knee prosthesis.

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He came to England in April 1978 to join relatives already here. In May he suffered a simple influenza-like illness for which he was seen by his doctor, who suggested to him in passing that he could have a proper artificial limb. He attended Wolverhampton ALAC on 7th September 1978 when he was observed to be extremely mobile on his bamboo pole. He stated that he could walk as far as any normal person; this statement was found to be true.

On examination he had a good right above-knee stump of 13 cm, as measured from the tip of the greater trochanter, with a full range of movement of that hip joint. A modular assembly prosthesis was ordered on the same day and this was delivered to him on 12th December 1978 (Fig. 1, right).

Immediately after receiving the artificial limb he walked extremely well despite the fact that the prosthesis incorporated a "free" (i.e. not locked) stabilised knee unit and within a few months he was able to walk without the use of any other aid.

He was seen again on 25th January, 1979 and he was very pleased with his leg. He could walk well and had no problems; he had by this time discarded his bamboo pole.

Acknowledgements

I wish to thank Mr. K. B. Allcock LBIST, prosthetist, who attended the case, Dr. Arora, General Practitioner, Wolverhampton, and Mr. Alan English FRCS, Principal Medical Officer, Artificial Limb and Appliance Service of DHSS, for giving me permission to publish this case and also advice regarding the writing of this article.

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Clinical decision making with the aid of ambulatory monitoring of heart rate

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Abstract

Routine assessment of heavily handicapped patients by means of speed and heart rate has been carried out in ORLAU over the past four years. The methodology and the apparatus have been described by Davies (1977) and Stallard et al (1978), who also indicated its value in terms of research. Gradually the technique has been assimilated as a routine clinical assessment procedure, and a number of cases in which it has positively influenced treatment are described in order to illustrate its benefits.

The simplicity of the methodology and portable nature of the equipment enable physiotherapists to carry out many assessments in schools, greatly minimising disruption for the patient and maximising the effectiveness of the procedure.

Analysis of the types of assessment which had been conducted showed that they could be divided into six categories:

- Learning time for a new orthosis
- Relative value of a new orthosis
- The need for operative procedures
- The value of operative procedures
- Indication of areas requiring further investigation
- Confirmation of clinical opinion

When used in conjunction with the other assessment techniques available in ORLAU, monitoring speed and heart rate become a powerful tool for routine clinical evaluation of patients.

Introduction

The Orthotic Research and Locomotor Assessment Unit have been carrying out

assessments of heavily handicapped children for the last four years. For three and a half of those years clinical comparisons of physical effort pre and post treatment have been made on the basis of heart rate and speed of ambulation.

Justification for embarking on a research programme to evolve clinical assessment procedures came from the work of various physiologists who had shown that heart rate was related to oxygen uptake, and this work is exemplified by Astrand and Rhodahl (1970). In order to further confirm the validity of the approach an M.Sc. study of the technique applied to heavily handicapped subjects was commissioned from the Department of Physiology at Birmingham University. The results of this scientific study, Hill (1978), showed that heart rate response could, with certain limitations, be used as an indicator of performance in handicapped subjects using walking aids. The methodology of the technique has been described in papers by Davies (1977) and Stallard et al (1978) and in one presented at the ISPO World Congress in New York (Stallard et al. 1977).

The virtue of the technique in assessing the merit of a particular apparatus has been demonstrated in the development of the Salop Skate (Davies & Lucas, 1977, and Stallard & Rose, 1978) and also in research into various types of crutch (Stallard et al, 1978). Whilst all these publications have indicated that the method is valid, and useful in particular areas of research, they have not adequately shown its value in routine clinical assessment of patients. The routine clinical assessments of patients using heart rate monitoring to compare relative effort carried out in the last three and a half years, both at the Unit, and in various schools attended by severely handicapped patients, have been very successful and have had a positive effect on the treatment of many patients.

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Clinical assessments

Two standard test procedures have been devised for assessment of handicapped patients. The heavily handicapped are asked to walk 5 runs of 20 ft and are given one minute standing rest between each run. Heart rate is monitored throughout the trial and the rate at the end of each timed run noted. This enables the speed and heart rate of the series to be plotted against run numbers. Comparison of different trials gives a clear visual and quantitative indication of the change in both speed and heart rate, so that the effect of treatment is immediately apparent.

Less handicapped patients are asked to walk 80 ft runs continuously until they are tired or uncomfortable. The speed and heart rate are plotted against run number, and comparisons of different trials give an indication of the changes in speed, heart rate and endurance which have occurred.

Assessment in schools is made possible by the portable nature of the apparatus (Fig. 1).



Fig. 1. Portable heart rate telemetry equipment.

Physiotherapists can visit the schools, taking with them a small transmitter, receiver and pen recorder, and this has the twin advantage of minimising emotional disturbance and loss of academic activity. This is particularly important when a series of trials is necessary to establish that a patient has completed his "learning curve" and established a steady performance. An example of this was a patient (G.L.) for whom a hip guidance orthosis (hgo) (Farmer et al, 1976, and Rose, G. K. 1979) had been prescribed as an interim learning device, after which it was considered that he would graduate to KAFO's only. The change to KAFO's was monitored

carefully over a series of weekly assessments (Fig. 2), starting with an initial assessment in hgo. When the patient's performance had reached a plateau, it could clearly be seen that he not only walked slower by 20% but that this slower speed was costing 10 bpm more heart rate. On this basis a clinical decision was taken to return him to hgo.

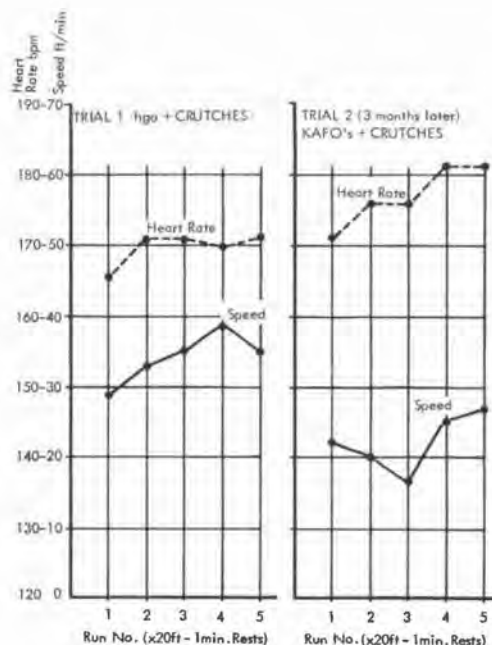


Fig. 2. Change from hgo to KAFO, (patient G.L.).

Most patients using hgo start by using a rollator as a walking aid. This is a cumbersome apparatus, but it does give patients a feeling of security. Whenever possible, patients are encouraged to use crutches and in cases where there is doubt as to their ability to cope, the learning process is regularly monitored in the school environment. A typical result of such an assessment is shown in Fig. 3. Initially an assessment with the patient using a rollator was taken. For comparison with this the "plateau" result at the end of the series is shown. From this it can be seen that speed had dropped, but that this was accompanied by a drop in heart rate. Although this was not a clear cut result in favour of one or the other, it did give sufficient

indication that crutches were not significantly less efficient so that the convenience of crutches was worthwhile.

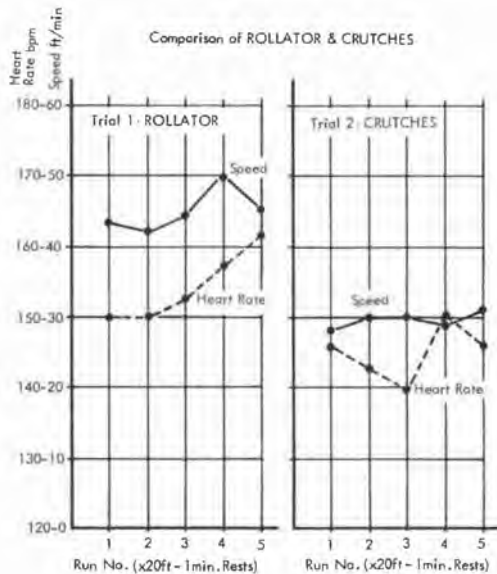


Fig. 3. Change from rollator to crutches (patient K.E.P.)

A replacement apparatus is monitored in schools whenever facilities for this are available, and the data is entered in patients' notes. This has benefits which cannot always be foreseen. A patient with excessive lordosis who used hgo was provided with a replacement hgo which ostensibly had the same specification. An eagle-eyed physiotherapist spotted from her own routine assessment (encouraged by ORLAU Education Programmes) that the number of steps the patient was taking for 20 ft had increased, even though the times were virtually identical. Examination of the records showed that this was not detrimental since the patient's heart rate was also virtually identical. It transpired that a slightly smaller flexion angle on the hip range stop had been provided on the new device. The patient preferred the more upright posture provided by this flexion angle, and since it was seen not to be detrimental it was left as it was. Without proper assessment technique, the temptation would have been to adjust the apparatus to the original setting.

Although many routine assessments do take place in schools, it is also frequently necessary to carry out more searching investigations in the ORLAU gait laboratory at Oswestry, where a greater range of facilities and tests are available. Since this is situated within the hospital complex, pre-operative investigations are undertaken as are problems encountered within routine clinics. The improved facilities for function testing of patients include automatic timing, digital read-out of heart rate and video recording in three orthogonal planes. In addition there is instrumentation available to monitor ground reaction forces, ambulatory EMG, foot-ground contact, under-sole pressure development and step pattern and timings. This range of instrumentation has enabled many clinical decisions affecting patient treatment, both operative and orthotic, to be taken on a much sounder basis. Heart rate monitoring is playing an increasingly important role in this sphere of activities.

Results from such assessments often have the effect of convincing not only the clinician, but also the patient and their guardians of the wisdom of a particular treatment. Just one example of this was a patient with spastic diplegia giving bilateral ankle instability. The girl (T.W.) had a low level of handicap and could walk with no orthoses or other apparatus. Her main problem appeared to be an inability to stand still. The patient was assessed using video recording of her gait pattern and monitoring of speed and heart rate over continuous 80 ft runs until she wished to stop because she was tired. Bilateral plastic below-knee fixed ankle orthoses (AFO's) were prescribed and a re-assessment carried out after she had used these for 6 months. From the visual record by video, no significant change in the gait pattern could be observed, other than an improvement in the patients ability to stand still. On that basis alone, there would have been a temptation for the patient to discard the apparatus. However, the assessment of ambulation by means of speed and heart rate (Fig. 4) showed that the orthoses gave a very considerable advantage in terms of function. Not only did the speed rise by 30 ft/min (15%) for a concurrent drop in heart rate of 20 bpm, but the patient walked more than twice as far before she gave up because she was tired. With this information available, there was no question of the orthoses being discarded.

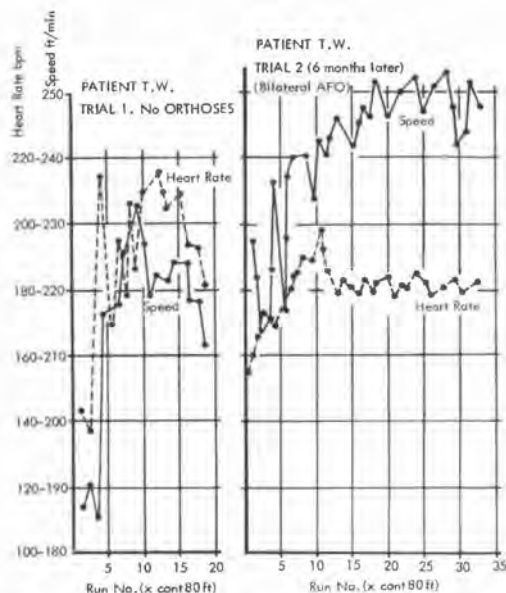


Fig. 4. Adoption of AFO's (patient T.W.).

The results of assessments sometimes lead, in addition to influencing clinical decisions, to more searching investigations of a fundamental problem. Patients with progressive deterioration of motor power in the lower limbs, coupled with flexion deformities in knees and hips, present problems of treatment philosophy with regard to the orthotic treatment which should be used, and the timing of surgical intervention. One such patient (DB) refused surgery for straightening of the knees and hips, despite the increasing difficulty in maintaining her ambulatory status. She had been using plastic fixed ankle AFO's and the treatment adopted after refusal of surgery was bilateral long leg calipers (KAFO's) to stabilise the knees. These do have disadvantages in terms of increasing vertical movement of C of G, which ostensibly should lead to greater energy expenditure. In the case of this particular patient, greater instability also required the use of a walking stick. The advantage of KAFO's was clearly demonstrated by an assessment using 5x20 ft runs with one minute rests (Fig. 5). Using AFO's the patients heart rate rose gradually throughout the trial to 152 bpm, with greater increases often occurring during the standing rest periods. However, when using

KAFO's the heart rate was contained at a steady level of 128 bpm for each 20 ft run and returned to approximately 110 bpm for each rest period. AFO's were clearly costing the patient an ever increasing effort merely to stand still, as indicated by the high heart rates during the standing rest period. Apart from confirming the wisdom of KAFO's for this patient, the assessment led to more fundamental research into the problems of such patients. A programme was undertaken to establish EMG activity in the lower limbs of such patients compared to normal and also a comparison of their C of G movements.

One of the most important functions of these assessment procedures is to monitor the effect of surgical treatment. It is particularly useful with C.P. patients, and the two following cases are typical examples of many such assessments.

A patient with good function, but with a bilateral internally rotated equinus deformity (L.M.) was anxious for a cosmetic improvement due to the considerable number of taunts suffered at the hands of his peers. Bilateral derotation osteotomy with elongation of the tendo Achilles was carried out. The effect of this was to markedly diminish the patients speed coupled with a lower heart rate when monitored on continuous 80 ft runs. There was no significant

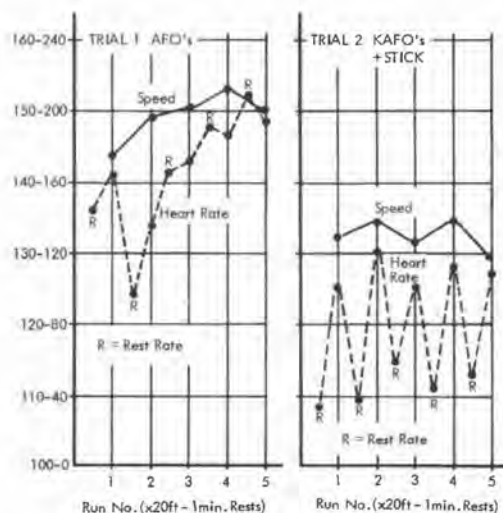


Fig. 5. Comparison of AFO's to KAFO's (patient D.B.).

change in endurance, the patient managing a high number with no significant difference pre and post operatively. The improvement in the appearance of his gait was greatly appreciated by the patient, and in his view this more than outweighed the disadvantage of the lower speed, particularly in view of the reduced heart rate which indicated that efficiency had not been markedly affected.

A patient (D.J.) was referred to the unit for assessment prior to bilateral elongation of the tendo Achilles. This showed that he had very good ambulation function (high speeds for low heart rates) suggesting that little more than a cosmetic improvement could be expected. The treatment was undertaken on that basis and post operative assessment showed that function had not been impaired in any way, with speeds and heart rates for the continuous 80 ft runs assessment being virtually identical some 6 months after the completion of operative procedures. Visual recording by video did show that a significant change in gait had been achieved, the equinus deformities which had previously given a bilateral toe strike being transformed to the extent that heel strike was achieved on one side with a foot flat strike on the opposite side.

A further advantage of heart rate monitoring which has shown up during the assessment of heavily handicapped patients using a new device has been the indication of a lack of effort from the patient. This has been valuable in determining the course of treatment. An example of this occurred with an adolescent patient (L.H.) for whom the Salop Skate, (Davies & Lucas, 1977, and Stallard & Rose, 1978) a device which eases 'drag-to' gait, was prescribed. Initially trials had indicated that speed was increased by 50% with a reduction in heart rate of 10-15 bpm. At a 3 month follow-up assessment during a holiday from the patient's residential school, the device had ostensibly become much less effective. Speeds compared to 'drag-to' gait were lower with an apparently greater effort for the patient. However, when heart rate results were analysed (at that time they had to be calculated from ECG recordings) it could be seen that they were comparatively low. Further questioning of the patient showed that an antipathy to the device had developed, due probably to its strange appearance arousing comment from peers at school. Without the

information from the heart rate results this would probably not have been discovered, because the patient was clearly worried about the reaction her antipathy was likely to arouse in the therapists. Naturally, the device was immediately discarded without further trials which would have caused unnecessary distress to the patient.

Confirmation of an impression gained from clinical examination is a further valuable asset of function assessment using heart rate. A spina bifida patient with diminished motor power in the lower limbs (I.P.) was routinely examined, when it was considered that deterioration had occurred during the 12 months since her previous full examination and functional assessment. Because a routine assessment had been carried out, this opinion could be tested. When this was done the clinical opinion was confirmed (Fig. 6). Speed had dropped by approximately 70% for the same heart rate, and only three quarters of the original distance was covered.

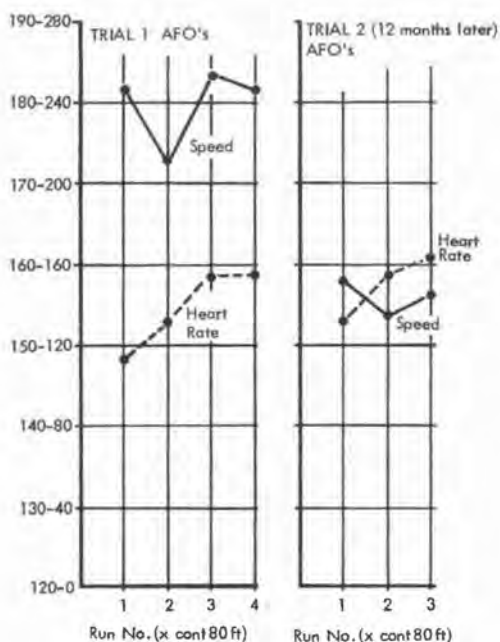


Fig. 6. (I.P.) Confirmation of clinical opinion (patient I.P.)

Conclusion

The experience gained by ORLAU in routinely assessing ambulation function of handicapped patients using radio telemetered heart rate to gauge relative effort, has strengthened the view that this is a valuable procedure. From the cases quoted, who form a small proportion of the number of positive contributions from such procedures, it can be seen that the various ways in which it is of value can be categorised:

Assessing the learning time for a new orthosis

Assessing the value of a new orthosis

Assessing the need for operative procedures

Assessing the value of operative procedures

Indicating areas requiring further investigation

Confirmation of clinical opinion

With a comparatively small amount of apparatus physiotherapists can carry out routine assessments of children in schools. The amount of time taken up by such procedures is of the order of half an hour and they can therefore be repeated at frequent intervals with minimal interference to the child's schooling. This has proven particularly valuable when new orthotic devices have been prescribed to which the adjustment of the patient needs to be carefully monitored.

Continuous digital readout of rate in the gait laboratory is a great asset. It permits interpretation of various activities without the need to specify the activity prior to the event. This has led to a better understanding of some patients problems and enabled more effective treatment to be prescribed.

Although post-operative assessment cannot alter the result of a procedure, it does give confidence that treatment for patients is proceeding along the correct path.

The experience gained in moving out of the research programme into routine clinical assessment indicates that the simple procedures adopted could be used to great advantage in physiotherapy departments coping with severely handicapped patients. Not only does it improve the assessment of patients, but it also gives a greater insight of the prescribed treatment to the therapists involved.

Centres where searching investigations of more difficult cases can be undertaken are fully justified by the experience of ORLAU. In such centres heart rate assessment of relative effort would be but one of a whole range of techniques, but nevertheless fundamental to the operation of such a centre.

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Amputee stump radiology

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Abstract

In patients with stump problems, radiological examination of the stump is desirable. To get a maximum of information, the X-ray technique has to be adapted to the qualities of the stump which are different from the corresponding part of a normal limb. Special techniques permit further diagnosis.

Introduction

In many respects, radiology of the amputation stump is different in technique, indication and interpretation compared with X-ray examination of a corresponding part of the intact extremity. Thus, in standard and other X-rays made with the same criteria usually applied to a normal limb, results are often very disappointing. The purpose of this paper is to present the particular aspects of the amputation stump from the point of view of X-ray examination to obtain a maximum of diagnostic information with a minimum of exposure to radiation.

Tissue qualities

The tissues of the stump differ from the normal limb in two respects. Firstly the general diameter is usually less than normal. If not, there might be swelling caused by oedema or haematoma, both presenting rather a slight obstacle to X-rays compared to muscles and bones. Secondly, the density of the bony tissues is always less compared with the normal limb. There is normally presence of osteoporosis in some degree, usually due to old age, inactivity or both. The only exception is the bone immediately after amputation on a young, otherwise healthy patient. Finally, the radiological density of the stump considerably decreases from proximal to distal direction.

For diagnostic evaluation, the interpretation of the soft tissues in a stump is just as important

as bone and joints. In addition to that, we are interested in the proximal and the distal part of the stump as well (Fig. 1). A peculiarity of stump radiology is examination with the patient wearing his prosthesis. On these pictures, the inner wall of the sockets should become visible, the densities of the prosthetic components (wood, laminated plastics, metal) are different; if possible, metal parts of the prosthesis should not overlap stump tissues important for diagnosis.

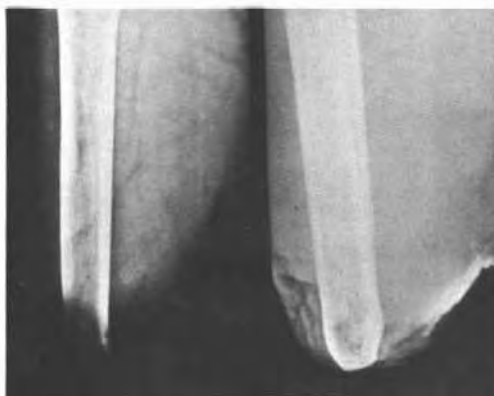


Fig. 1. Two X-rays of the same above-knee stump. Left, standard exposure for the femur, over-exposed tip of the femur. Soft tissues only partially visible. Right, low contrast technique shows the whole of the femur and also the soft tissues. The quality of the soft tissues covering the bone and a skin ulceration on the medial side become visible.

Technology

Since soft tissues, bones and even prosthetic components should be visible on the X-ray film, low contrast techniques, even in standard exposures, are necessary using a system of films and screens with low gradation, high kilovoltage and a wedge shaped aluminium filter.

If one is interested only in details, direct magnification technique with a focus less than 0.3mm controlled by television gives an optimum of sharpness and contrast. If emphasis is put on the soft tissues, we recommend the exposure with low kilovolts as used in mammography.

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Fig. 2. Three examples of fistulography. Left, bursa on a short above-knee stump filled with contrast liquid. Middle, lateral fistula on a below-knee stump. The cone marks the orifice of the fistula which unexpectedly does not reach the tip of the fibula but the end of the tibia. Right, fistula on an above-elbow stump caused by electric burns. Fistula following the stump of the radial and ulnar nerve filling a cavity in the axilla.

For further diagnosis, special techniques such as xeroradiography (Otto & Wellauer, 1977), tomography, arteriography and fistulography might be indicated.

In arteriography, we recommend the Seldinger technique which inserts the catheter into the femoral artery of the opposite side to prevent any damage to the stump arteries which are usually already impaired.

In fistulography, we inject a water soluble contrast liquid under pressure using a cone shaped bulb instead of a needle (Fig. 2). This technique is simple and does not require other than standard X-ray equipment.

Diagnostics

At the time of amputation, most patients already present a marked osteoporosis of the cortical and cancellous bone. After amputation, all patients present some degree of osteoporosis even if they are regularly wearing a prosthesis. If the stump presents and bearing qualities and the patient is adequately fitted with a prosthesis, the degree of osteoporosis is less important. Since osteoporosis in stumps is often very marked and irregular, it might be confused with Sudeck dystrophy. This diagnosis can never be based on X-ray examination only.

Every amputation stump also shows a certain muscle atrophy. In unilateral amputation, this

atrophy is exaggerated since there is regularly a compensatory hypertrophy of the opposite side. Stump atrophy is more important if the patient is unable to activate his stump or if the prosthetic fitting immobilizes more muscles than necessary. Thus, stump atrophy of the thigh in below-knee amputees is much more important in patients wearing a prosthesis with thigh cuff than in those fitted with a total contact below-knee prosthesis.

In patients amputated before the end of growth, differences in size of bones and joints are present. Depending on the epiphyseal growth lines which had to be sacrificed at amputation, the stump will also present bony over- or undergrowth. The younger the age of the patient at the time of amputation the more important these growth effects will be in some cases and might necessitate stump corrections (Baumgartner 1979).

Atrophy not only occurs in bone and muscles of the stump, but also in the arteries and veins. As for instance in leg paralysis following poliomyelitis, less cells are to be provided with blood and for the remaining tissues there is less activity and thus less energy consumption. Consequently nature automatically diminishes the diameter of the blood vessels (Fig. 3). With the patient getting old, arteriosclerotic changes and external pressures from prostheses often cause early arterial obliteration. In patients with

peripheral vascular disease, calcium deposits even in smaller arteries are visible on standard X-rays.



Fig. 3. Arteriogram of a 60 years old patient who underwent an above-knee amputation 30 years ago. The contrast liquid is injected by a femoral catheter at the opposite side. Considerable narrowing of the diameter of the left iliac arteries. Obliteration of the femoral artery. Osteoporosis of left femur and left half of the pelvis.

Radiological examination is particularly important in diagnosis of the problems which frequently occur at the stump end. The bony stump has to be carefully rounded at the operation. If the stump has two or more bones such as in below-knee or midfoot amputations the relation in length between these bones is very important. Overlength of one bone might cause troubles. Secondary changes of bone configuration at the end of the stump are very frequent and often cause problems. Growth or chronic external pressure by the prosthesis can result in the bone becoming slim like a pencil and thus perforate the soft tissues and give rise to chronic infection. Often there is a large bursa filled with calcium deposit between the soft tissues and the bone.

More often, the standard X-ray shows evidence of bony overgrowth from a minimal spur to a huge exostosis.

If there is acute or chronic osteomyelitis, erosions and sequestrations may be present. In addition to standard radiograms, fistulography and tomograms might be indicated (Figs. 2 & 4).



Fig. 4. Traumatic above-knee amputation with chronic osteomyelitis. The tomogram (right) provides better evidence of the size and site of sequestrations.

On standard X-rays, the contours of the stump, the position of the muscles and of the major vessels and nerves as well should be visible. We are looking for the degree of muscle atrophy and eventual retraction of muscles. On the radiogram in the sagittal plane, the stump of the major nerves might become visible, particularly if a neuroma is present (Fig. 5). Foreign bodies must be identified even if they are not as opaque as metal. Sutures in stumps more often cause granuloma and fistulae as in current orthopaedic surgery.

Trauma of the stump might cause fractures and more frequently a large haematoma at its end. In amputations for malignancies, we must look for metastases (Fig. 6). If they are not visible on standard x-rays, arteriography and scintigraphy give further information.

Radiological examination of the stump within the prosthesis should not be a routine procedure. In difficult stump conditions, however it can be helpful in achieving a prosthetic fitting with a total contact socket. In leg amputees, radiograms with and without load provide evidence of the sometimes surprising differences in the position of the stump in the prosthesis.

Conclusions

In stump problems, radiological examination is of great help in diagnosis. To evaluate the



Fig. 5. Lateral view of an above-knee stump. The dorsal side (left) shows poor soft tissue covering. The sciatic nerve is clearly visible forming a bulb-shaped neuroma at 3cm from the tip of the femur.

evolution of a stump, a standard examination in the frontal and sagittal plane should be



Fig. 6. Below-knee amputation due to malignant tumour of the calcaneus and talus (left). One year after amputation, the patient complained of increasing stump pains. The X-ray gives evidence of two metastases in the fibula.

performed immediately after surgery to document the result of the operation and for comparison in case stump problems might occur later on. More sophisticated X-ray techniques are indicated in particular conditions where stump corrections have to be discussed. Radiological examination also can be helpful in improving prosthetic fitting of difficult stumps.

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The mobile arm support

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Abstract

The Mobile Arm Support, conceived and researched by Dr. Radulovic, is intended for the use of patients whose arm is afflicted. The support consists of a supporting harness, an articulated splint on which the arm is fixed and a pneumatic system of elevation that counterbalances the weight of the arm. Its originality lies in the use of a splint as a simple lever, supported by a spherical articulation, located as close as possible to the centre of the scapulohumeral joint and linking shoulder and arm movements.

A clinical study involving 18 patients has shown that the support reduces pain, increases ranges of movement of the shoulder and elbow, and increases functional possibilities.

Function

The principle of the Mobile Arm Support (Radulovic 1978) is to support the afflicted member with a movable splint attached to the arm and held in balance by a pneumatic system.

The Mobile Arm Support was not conceived as a passive crutch. On the contrary, its role is to assist whatever active movements the arm is still capable of, without fighting the arm's weight. In order for this to be possible, the muscles of the upper arm must be rated about 2 on the international rating scale; that is when the muscles cannot raise the arm, but can act upon it if its weight is counterbalanced. In this way, if the hand is uninjured but the arm muscles deficient, the hand can be directed in space and thus rendered usable due to the movable support.

Description of the apparatus

The Mobile Arm Support (Fig. 1) consists of three parts, a harness, an articulated splint that

supports the arm and a pneumatic system which raises the arm and counterbalances it.

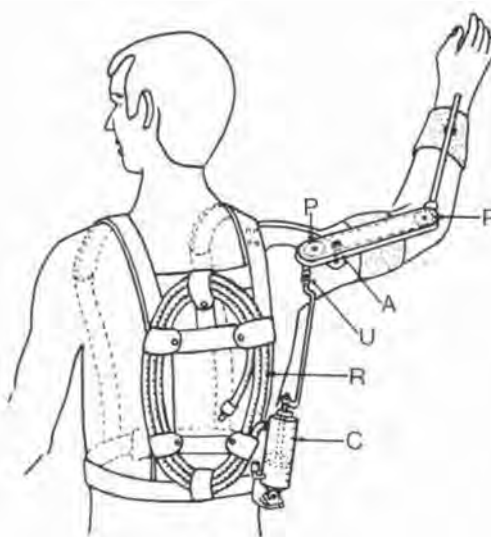


Fig. 1. The splint rests on a supporting spherical articulation (A) attached to the harness. The pneumatic system is composed of a cylinder (C) connected to a reservoir of compressed air (R) made from a simple reinforced pipe. Force is transmitted from the splint by a rod and a universal joint (U). Two pulleys (P) connected by a cable, coordinate the movements of the elbow and shoulder.

1. The harness

The harness is fitted to the trunk and the splint is mounted on it. The framework of the harness is formed from aluminium, the two main parts of which are attached over the shoulders. It is held in position by an adjustable belt and straps.

A spherical articulation is attached to the harness at the level of the shoulders. It is made of hard steel and serves as a support for the arm splint. The support articulation must be located as close as possible to the articular centre of the scapulohumeral joint.

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2. The supporting splint

The splint is composed of two metal parts, one for the forearm and the other for the upper arm. The two segments are articulated at the elbow by a uniaxial joint.

The forearm and upper arm of the patient are held in the splint by large self-adhesive straps.

The segment attached to the forearm is made from a cylindrical rod which can turn on its axis, thus permitting pronation and supination of the forearm.

As already mentioned the supporting arm splint is fastened to the harness by a spherical articulation which allows the splint to pivot in any direction.

3. The pneumatic lifting system

The principal part of the pneumatic system is a cylinder fixed vertically to the harness at the waist. The cylinder is attached to the harness by a robust universal joint which allows for variations in the orientation of the cylinder.

Inside the cylinder is a movable piston attached to a vertical rod. The rod acts on the posterior part of the supporting arm splint and is attached to the splint by means of a universal joint. This joint plays the role of the origin of force in the lever system that activates the splint (Fig. 2). The pneumatic system is completed by a reservoir of compressed air which is made from a reinforced, coiled pipe 1.5m in length fixed to the back of the harness. The reservoir is connected to the upper part of the cylinder.

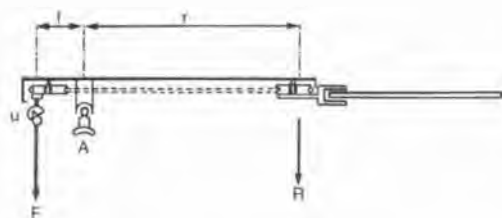


Fig. 2. The splint functions as a simple lever. (A) is the supporting spherical articulation attached to the harness; (R) is the force produced by the weight of the arm and (F) is the force transmitted by the universal joint. The point where the force (F) is applied is fixed eccentrically on the pulley located at the level of the shoulder and is dependent on the movements of the forearm.

Fitting and operation

The harness is fitted to the patient, making sure that the spherical support articulation is

placed as close as possible to the articular axis of the scapulohumeral joint. The affected arm is then attached to the splint by the straps.

Air is then pumped into the reservoir by a simple hand pump. When the air pressure in the cylinder is sufficient, it acts on the piston which is forced downwards and draws down the posterior part of the splint. As the posterior part of the splint goes down the anterior part of the splint goes up along with the arm fixed to it as a result of the positioning of the spherical joint.

The pressure in the reservoir must be adapted to each patient so as to equalize the pressure between the piston and the weight of the arm and splint. The pressure required for this purpose usually varies between 1.5 and 3.5 bars.

The reservoir of compressed air and the upper part of the cylinder is a closed system. Once the correct pressure is arrived at, it cannot escape during arm movements. Thus the weight of the arm is balanced.

The one problem that remains to be resolved is how to maintain a correct balance while the arm is stretched or bent. If the elbow is stretched out, the arm's centre of gravity moves away from the shoulder thus adding to the lever arm of the resistance (R). The opposite result is produced if the elbow is bent, the lever arm of the resistance diminishes. Under these conditions it is necessary to vary the piston force, making it proportional to the resistance, proportional, that is, to the extension or flexion of the elbow. This can be obtained by varying the length of the lever arms according to the position of the elbow, a process which is described below.

A pulley is situated at the level of the elbow which rotates by the flexion/extension movements of the forearm. At the level of the shoulder is a second pulley. These two pulleys are secured and linked together by a metal cable in such a way that the rotation of one leads to the rotation of the other. It is at the shoulder pulley that one finds the universal joint which transmits the pneumatic force. The joint is positioned in an offset fashion (like a cam) so that when the elbow is flexed the distance between the universal joint and the spherical support articulation is reduced. On the other hand, when the elbow is extended, the distance between the universal joint and the spherical support articulation is maximal, about twice as much as when the elbow is flexed. This arrangement ensures that the arm is in constant balance whether it is extended or flexed.

The system of connection by cable also has the advantage of harmonizing the movements of the shoulder and elbow. Thus abduction of the arm, alters the position of the universal joint and turns the shoulder-level pulley which leads to passive flexion of the elbow. Indeed, in everyday life abduction of the arm and flexion of the elbow are generally performed together.

Range of movement

Arm movements with the apparatus are made possible by the strength of the patient's muscles and the arrangement of the mechanical parts.

During numerous clinical tests, the passive ranges of movement permitted by the apparatus have been measured. They are as follows;

- shoulder abduction: 90°
- shoulder flexion: 135° (Fig. 3)
- shoulder adduction combined with flexion: 20°
- shoulder adduction combined with extension: 35°
- shoulder extension: 45°
- internal rotation of the arm: 90°
- external rotation of the arm: 80°
- flexion of the elbow: 120°
- extension of the elbow: 0° (complete)
- supination and pronation of the forearm: 90° (complete)

This great mobility on all levels is made possible by the use of the spherical support articulation, its location very near the centre of the scapulohumeral articulation, its connection with the universal joint and, finally, by the long movement of the cylinder piston.

Clinical tests

Clinical tests were carried out with 18 patients. Each patient had to;

- have a local deficiency of the arm, predominantly at the shoulder or throughout the arm, related to paralysis, muscular or rheumatic ailments, etc.
- have a muscular rating at the shoulder of around 2
- be alert and if possible co-operative.

The 18 patients suffered from various conditions;

- myopathy of the shoulder girdle
- paralysis of the brachial plexus with the major damage at C5 and C6
- hemiplegia
- tetraplegia
- reflex sympathetic dystrophy of the arm.



Fig. 3. During clinical tests shoulder flexion reached 135°.

The apparatus used for these tests was a prototype for the right side only and not perfectly adapted to each subject, a fact which led to some difficulties.

For each patient a dossier containing the following was compiled;

- evaluation of the handicapped patient
- evaluation of active mobility and the muscular force for all movements of the shoulder and elbow, first without and then with the Mobile Arm Support
- evaluation of usual movements, with and without the Mobile Arm Support.

Results

1 Tolerance

Tolerance to the support was excellent. Use of the apparatus caused no pain and did not aggravate the patient's condition.

The apparatus was well accepted; after fitting, the patient required no training in its use. The splint was immediately put into action by the force left in the arm and the subjects tested made use of it in the most natural way.

2 Gains in range of movements

a Shoulder movements.

Important gains were noted for nearly all movements of the arm, but especially for abduction and flexion (Fig. 4). Axial rotational movements were not affected by the apparatus which was not designed for this purpose.

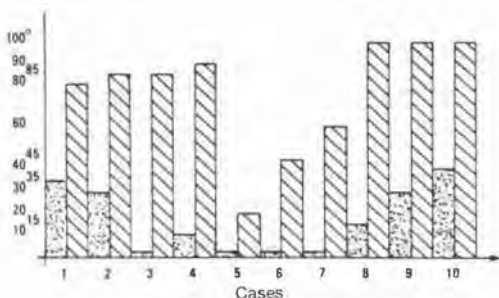


Fig. 4. Abduction of the shoulder in 10 cases of peripheral affliction. The grey area represents abduction without the support, the striped area shows the improvement produced by using the support.

b Flexion of the elbow.

Flexion of the elbow was improved in all cases except one (a hemiplegic) where no progress was made with or without the apparatus. The gain in elbow flexion is explained by two facts. Firstly, as the shoulder and elbow movements are linked by the apparatus, abduction of the arm favours flexion of the elbow. Secondly, when the arm is abducted and becomes horizontal, flexion of the elbow is accomplished more easily.

c Pronation-supination movements of the forearm.

They were not affected by use of the apparatus.

3 Gains in muscular strength

It was noted with some surprise that muscular strength was improved in one third of the cases, from about $\frac{1}{2}$ to 1 point on the international rating scale. It is believed that the positioning of the arm and the effects of rest brought about by the supporting splint are responsible for this improvement; once the subject no longer has to fight the weight of his own arm, the arm muscles are more relaxed and can thus work better.

4 Lessening of pain

In cases of rheumatism of the shoulder in which functional inability is due largely to pain, the support provided by the splint permitted an immediate and painless resumption of movement. In these cases the Mobile Arm Support promises to be a useful instrument of rehabilitation.

5 Functional improvements

Improvement has been noted especially in cases of peripheral neurological conditions. These patients can write better, eat unaided, dress themselves, clean themselves and urinate normally.

The Mobile Arm Support improves functional movements in the greater part for all the patients fitted. In particular it permits patients to carry out activities more easily and with less fatigue (Fig. 5).



Fig. 5. Top, without the Mobile Arm Support a patient suffering from myopathy has to lean forward to don his spectacles. Bottom, normal action possible when using the support.

6 Negative effects

Negative effects have been very rare and are due largely to unsatisfactory adaptation of the prototype. The weight of the apparatus (4 kg) has been judged too high and must be reduced. Aesthetically the apparatus has been found acceptable.

The limitation of certain articular movements caused by the apparatus has not provided problems since the patients, due to their handicaps, were not able to reach the limits of the apparatus.

Application of the support

The type of apparatus and the results obtained offer hope for a large area of application. It is possible to use the support in a great number of illnesses and a variety of pathological states. It must be remembered, however, that the apparatus is only useful for weaknesses involving the shoulder joint.

Generally speaking, the apparatus can be used under two circumstances;

—temporarily; during the first stage of rehabilitation

—for prolonged and more definitive use during the last stage of rehabilitation.

As a result of experience with the apparatus it can be used temporarily in traumatic or painful rheumatic afflictions of the shoulder and in regressive neurological conditions, thereby allowing early movements and avoiding trophic problems.

The support is suitable for prolonged use in cases of marked brachial plexus, other myopathic scapulohumeral conditions, the aftermath of poliomyelitis, etc., especially if the other arm is also affected.

It can also be used in conjunction with another apparatus, for example, to cancel out the weight of a myo-electrical device or an apparatus needed to work the hand. The weight of a hand apparatus can be counterbalanced by the Mobile Arm Support.

Conclusions

1 The Mobile Arm Support is a simple, technically advanced apparatus which completely supports the arm thus allowing it to make use of its residual strength for functional

activity. Its originality comes from the following;

- the splint is placed in contact with the arm
- it is supported by a harness and moves with the patient

- it functions on an elementary lever principle supported by a spherical articulation placed as close as possible to the scapulohumeral articulation

- it uses a pneumatic system that is both strong and supple

- the movements of the shoulder and elbow are linked.

2 The splint and handicapped arm form a hybrid system which functions as a single unit while using the patient's normal senses as well as his own strength. The apparatus is part and parcel of the handicapped patient, a point which favours its acceptance. Its utilization necessitates no long term learning.

3 Clinical tests have shown that the Mobile Arm Support has improved the active range in most shoulder and elbow movements as well as functional possibilities. Functional improvement was less marked than improvement in articular movements because most of the patients, although very handicapped, use, as best they can, the motor functions which are left to them.

4 The apparatus must be lightened, the harness must be individually fitted and its general aesthetics improved.

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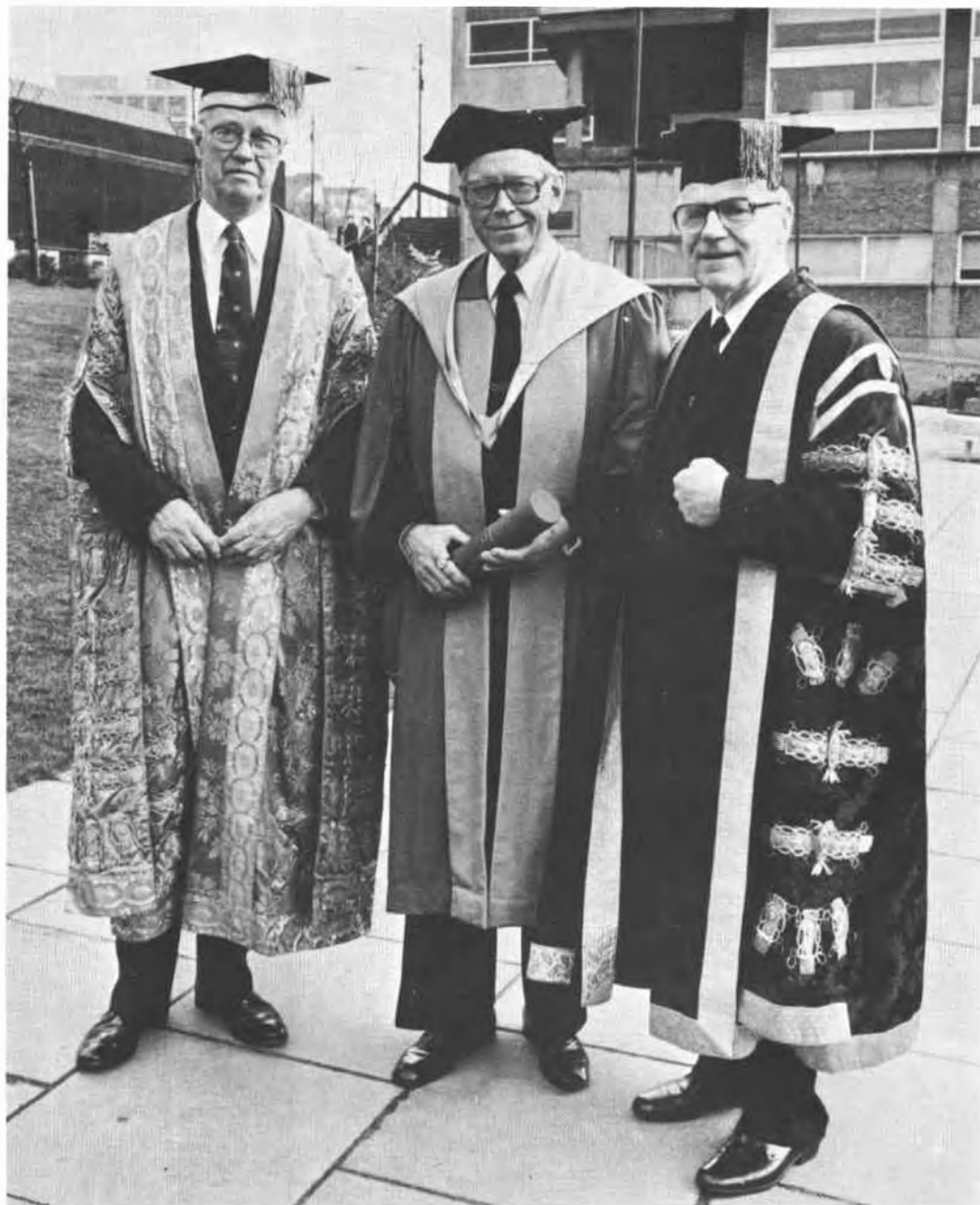
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Honorary Degree for I.S.P.O. Past-President



In the last issue of the journal we referred to the conferment of the Honorary Degree of Doctor of Science of the University of Strathclyde on the Past-President, Dr. Knud Jansen. The photograph shows Dr. Jansen following his graduation and standing between—on his right, the Rt. Hon. Lord Todd of Trumpington, Chancellor of the University, and on his left, Sir Samuel Curran, the Principal and Vice-Chancellor.

Letter to the Editor

Dear Editors,

On the 7th March the Norwegian National Member Society of ISPO held a Symposium in Oslo on problems regarding geriatric amputees. The meeting created such interest that I am convinced the subject would be a very useful gathering theme for an ISPO meeting in other countries as well. The handling of the geriatric amputee involves the engagement of many disciplines, and the development of multi-disciplinary team-work is one of the main aims of ISPO.

The programme was divided into sessions following the natural progress of treatment and rehabilitation. Each session was arranged as a panel debate with participation of the audience.

The first panel stressed how adequate care of a diseased lower extremity might, in many cases, prevent deterioration leading to amputation. The surgical panel was concerned with the different surgical aspects of amputation, such as levels, techniques, etc., in particular, vascular problems of geriatric amputees were debated. The next panel discussed the pre-, per-, and post operative treatment of the amputees. The following panel discussed guidelines for the selection of the prosthesis and its adaptation from the point of view of the orthopaedic surgeon, prosthetist, different therapists, etc., together with nursing problems during hospitalization. The closing panel discussed the psycho-social aspects of the elderly patient, such as mental reaction to the amputation and the problems of total social rehabilitation for the future.

The panel papers were given by physicians, nurses, social workers, prosthetists, physiotherapists, occupational therapists and foot therapists. The audience had the same structure. We had 190 participants at our one-day seminar. It is believed that the symposium covered a real need and was so successful that many participants proposed to hold similar meetings in the future. The general feeling was that some of the topics touched upon in this meeting should be discussed in the future in greater detail by special interest groups (workshops).

The symposium very effectively strengthened the rapport between ISPO members and demonstrated the usefulness of this kind of ISPO activity.

George Veres,
Chairman,
Norwegian National Member Society,
Sophies Minde Orthopaedic Hospital,
Trondheimsveien 132,
Oslo.

Obituaries

Captain Thomas Canty, M.D., U.S. Navy

Captain Thomas Canty, M.D., U.S. Navy passed away on July 15, 1979.

To most of the younger ISPO members, Tom Canty may have been unknown; he was however one of the professional pioneers since 1951 in the forerunner of our society, the committee on Prostheses, Braces and Technical Aids. He was head of the orthopaedic rehabilitation centre of the U.S. Navy in Oakland, California.

By some groups Canty was considered a controversial person. Within ISPO however he was one of the dedicated, active and fighting members, who possessed long range vision. To the committee members he became a close friend and a dynamic promoter. Others saw him as a vigorous lecturer and discussor.

The old timers will cherish the memory of good old Tom—several of the youngsters will recall him, when they prescribe a Canty-brace.

Verne Thompson Inman

The passing of Verne Inman is learned with deep sadness by the world of orthopaedic surgeons.

His range of research was wide and his contributions in several areas remain of great significance. His studies within nerve- and muscle physiology are recognized in all countries. His activity within the scope of our society was his research in locomotion and in prosthetics and orthotics.

As professor in the University of California he accepted the challenge arising after the second world war. In team work with the engineer Prof. Howard Eberhart, Dr. Henry Ralston and others the laboratory of biomechanics and bioengineering was developed. The pooled intelligence under gifted and dedicated leadership offered results of immense clinical importance.

Verne Inman with his experience, noble sense of humour and unique talent for teaching was a beloved member of the faculty on our international courses. By the participants he was given the nickname "Charlie Charming", due to his slight resemblance to Charlie Chaplin.

Our thoughts go to his wonderful wife, Irene and his sons and family. His memory will be treasured by his patients and his many friends all over the world.

KNUD JANSEN.

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Deutsch

Toilettenhygiene für Patienten mit doppelseitiger hoher Armamputation

L. Friedmann

Pros. Orth. Int. 4:1, 29–36

Zusammenfassung

Eines der grössten Probleme für die Patienten mit hoher doppelseitiger Armamputation ist die Unselbständigkeit bei den hygienischen Verrichtungen. Diese Abhängigkeit vermag Ausbildung und Erwerbsfähigkeit zu verunmöglichen. Die Arbeit beschreibt die verschiedenen, im Handel erhältlichen geeigneten Bekleidungsstücke und Hilfsmittel zum An- und Ausziehen sowie zur Toiletten- und Menstruationshygiene. Die verschiedenen Hilfsmittel werden auf ihre Eignung geprüft in bezug auf die verschiedenen Amputationshöhen. Der Patient muss aber zur Unabhängigkeit besonders stark motiviert sein. Eine zu intensive Betreuung durch die Angehörigen wirkt sich negativ aus.

Hautprobleme bei Beinamputierten

S. William Levy

Pros. Orth. Int. 4:1, 37–44

Zusammenfassung

Die Arbeit befasst sich mit häufigen Hautproblemen bei Trägern von Ober- und Unterschenkelprothesen. Sie beschreibt die Möglichkeiten der Stumpfpflege und bringt dann eine Einteilung der verschiedenen Hauterkrankungen und deren Behandlung. Behandelt wird die Kontaktdermatitis, das Elezern, Epidermoid-Zysten, bakterielle und mykose Infektionen, das chronische Ulcus und die verruköse Hyperplasie.

Ein einfaches und vielseitiges Hilfsmittel zum Steuern von Kraftfahrzeugen durch Arm-amputierte

T. E. Sensky

Pros. Orth. Int. 4:1, 47–49.

Zusammenfassung

Beschreibung eines einfachen Hilfsmittels zum Bedienen des Steuerrades für Oberarm-amputierte. Es besteht aus einem einfachen, sicheren und preisgünstigen Greifhaken und hat Vorteile im Vergleich zu den üblichen Hilfsmitteln mit Kugelgelenk. Ein weiteres Hilfsmittel lässt sich am Schalthebel befestigen und gestattet so dem Patienten das Bedienen eines Getriebes mit Handschaltung.

Richtlinien für Rohrskelettprothesen

A. Staros

Pros. Orth. Int. 4:1, 45–46.

Zusammenfassung

Die Arbeit berichtet über die von der Amerikanischen Kriegsofopferfürsorge verfolgten Richtlinien und Anforderungen für Rohrskelettprothesen.

Behandlung mit der klimakammer

I. M. Troup

Pros. Orth. Int. 4:1, 15–28.

Zusammenfassung

Eine neue Methode wird vorgestellt, mit der sich gewisse physikalische Umweltsbedingungen an einer operierten Extremität sich verbessern lassen. Die Methode wurde in der Amputationschirurgie und in anderen bestimmten Fällen auf breiter Basis in verschiedenen Zentren in Grossbritannien und den USA geprüft.

Die Untersuchung folgt nicht einem bestimmten Schema, sondern beruht auf Beobachtung und klinischem Verlauf. Den Autoren ging es vor allem darum, den Indikationsbereich der Behandlung in der Klimakammer möglichst weit zu fassen.

Die Statistik umfasst 100 Patienten mit 128 Behandlungen aus einem möglichst weiten Indikationsbereich. Registriert wurde das Vorhandensein oder das Fehlen von Oedem,

Infektion, Ischämie, Schmerz und weiteren wichtigen Gesichtspunkten. Darauf ergaben sich einige Schlussfolgerungen, die von den Beteiligten allgemein akzeptiert wurden.

Für bestimmte sorgfältig ausgewählte Fälle ist die Behandlung mit der Klimakammer von Vorteil. Notwendig sind jedoch weitere objektive Kriterien, insbesondere zur Beurteilung der Durchblutungsverhältnisse, um die Methode allgemein zur Einführung zu empfehlen.

Español

Metodos auto-higienico para amputados bilaterales a alto nivel de miembro superior

L. Friedmann

Pros. Orth. Int. 4:1, 29-36

Resumen

Uno de los problemas más importantes para el paciente bilateral de miembro superior, es su incapacidad para realizar sus actividades higiénicas. La dependencia en este área, imposibilita su asistencia a la escuela o al trabajo. Este estudio investiga los diferentes tipos de ropa disponibles y su adaptación para facilitar la muda, limpieza genital y dispositivos para el cuidado menstrual. Los dispositivos se analizan con el fin de adaptarlos a las necesidades de los diferentes tipos y niveles de deficiencias y fines. La independencia requiere una intensa motivación del paciente y la eliminación del exceso de protección por parte de los padres.

Problemas de la piel en los amputados de miembro inferior

S. William Levy

Pros. Orth. Int. 4:1, 37-44

Resumen

Este artículo trata de los problemas comunes de la piel, asociados al uso de las prótesis en los amputados por encima y debajo de la rodilla. Después de una breve exposición sobre los métodos para la higiene del muñón, se clasifican las alteraciones cutáneas específicas de los amputados de extremidad inferior y se hace un pequeño resumen de los avances en los métodos para su tratamiento. Las alteraciones que se tratan son: dermatitis de contacto, eczema,

quistes epidérmicos, infecciones de hongos y bacterias, úlceras orónicas y verrugas hiperplásicas.

Dispositivo sencillo y versátil para amputados de extremidad inferior

T. E. Sensky

Pros. Orth. Int. 4:1, 47-49

Resumen

Se describe un dispositivo para conducir. Es un sencillo gancho fijo para amputados de extremidad superior, y su función, en comparación con los dispositivos de bola y copa. El gancho es seguro y barato. Se describe también un accesorio que se adapta a la palanca de la marcha, permitiendo cambiar al marcha manualmente, utilizando el dispositivo de conducción.

Normas para prótesis modulares

A. Staros

Pros. Orth. Int. 4:1, 45-46

Resumen

Este estudio subraya las actitudes de la Administración de Veteranos de los Estados Unidos, respecto a las normas y especificaciones de las prótesis modulares.

Tratamiento controlado del medio ambiente (CET)

I. M. Troup

Pros. Orth. Int. 4:1, 15-28

Resumen

Se discute un nuevo método para mejorar ciertos aspectos físicos ambientales sobre la extremidad. Este método describe el tratamiento controlado del medio ambiente en la amputación quirúrgica y otras condiciones específicas, efectuado en pruebas controladas en varios Centros del Reino Unido y Estados Unidos de América.

El protocolo no intentaba establecer ningún sistema de control, basando los resultados en la observación e impresión clínica. En otras palabras, se trata de una prolongación del uso del método CET, en un intento de conseguir una más amplia experiencia de su aplicación.

Se detallan 100 casos con 128 tratamientos, que cubren una extensa variedad de ponencias clínicas. Entre otros datos importantes se

registraron aquellos sobre la presencia o ausencia de edema, infección, isquemia y dolor.

Algunas conclusiones se consideraron posibles y se obtuvo la aceptación del personal pertinente.

La evidencia sugiere que el uso continuado del método CET, está justificado en ciertos casos clínicos cuidadosamente seleccionados. Es más, parece necesario establecer valoraciones científicas controladas del sistema, especialmente en los laboratorios vasculares, donde se realizan importantes programas de investigación de forma rutinaria.

Français

Toilette intime chez des patients avec amputation haute des deux bras.

L. Friedmann

Pros. Orth. Int. 4:1, 29-36

Résumé

La dépendance lors des besoins intimes représente un gros problème pour les patients qui ont subi une amputation haute des 2 bras. Cette dépendance peut rendre une formation professionnelle et une activité lucrative impossible. Ce travail décrit les pièces de vêtements adéquats obtenables dans le commerce et les moyens auxilliaires pour s'habiller et se déshabiller ainsi que ceux pour l'hygiène de la toilette et de la menstruation. La convenance, de ces objets par rapport à la hauteur de l'amputation est étudiée. Cependant il faut que le patient soit très motivé à son indépendance. Un maternage trop intensif des proches du patient a un effet néfaste.

Problèmes cutanés chez les amputés du Membre inférieur

S. William Levy

Pros. Orth. Int. 4:1, 37-44

Résumé

Ce travail concerne les problèmes fréquents qu'ont les porteurs de prothèse amputés en-dessus ou en-dessous du genou. Il décrit les soins possibles au moignon et présente une classification des différentes maladies de la peau et leurs traitements. La dermatite de contact

l'exzéma, les kystes épidermoïdes, les infections bactériennes et mycotiques, l'ulcère chronique et l'hyperplasie verruqueuse sont discutées.

Un moyen auxilliaire simple et très utile pour la conduite d'un véhicule par un amputé du membre supérieur

T. E. Sensky

Pros. Orth. Int. 4:1, 47-49

Résumé

Description d'un moyen auxilliaire simple pour un amputé du membre supérieur pour se servir du volant. Il consiste en un crochet de préhension simple, sûr et bon marché et présentant des avantages en comparaison des moyens auxilliaires habituels avec articulation sphérique. On peut fixer un autre moyen auxilliaire sur le manche des vitesses, permettant ainsi au patient de conduire un véhicule à changement de vitesse manuel.

Lignes directrices concernant les prothèses tubulaires

A. Staros

Pros. Orth. Int. 4:1, 45-46

Résumé

Ce travail donne un compte-rendu des lignes directrices et des exigences concernant les prothèse tubulaires qui sont admises par le service Américain d'assistance aux victimes de guerre.

Traitement à la chambre climatique

I. M. Troup

Pros. Orth. Int. 4:1, 15-28

Résumé

Le travail présente une nouvelle méthode par laquelle certaines conditions physiques de l'environnement d'un membre opéré sont améliorées. Cette méthode a été testée en chirurgie des amputations et dans d'autres cas bien précis, sur une vaste échelle dans différents centres en Grande-Bretagne et aux Etats-Unis. L'étude ne suit pas de schéma précis mais se base sur les observations et décours cliniques. Les auteurs voulaient avant tout saisir un champ le plus vaste possible d'indications de traitement à la chambre climatique.

La statistique comprend 100 patients avec 128 traitements d'un champ d'indication le plus vaste possible. Il a été noté la présence ou l'absence de: oedème, infection, ischémie, douleurs et d'autres points importants. Il en est résulté quelques conclusions acceptées par les intéressés.

Pour certains cas précis choisis avec soins, le traitement à la chambre climatique présente des avantages. Cependant, d'autres critères objectifs, en particulier concernant l'état circulatoire, sont nécessaires avant de recommander l'introduction généralisée de la méthode.

Italiano

I Methodi per l'Igiene personale Autonoma per gli Amputati Bilaterali di Arto superiore ad alto livello

L. Friedmann

Pros. Orth. Int. 4:1, 29-36

Riassunto

Uno dei problemi più importanti per il paziente al quale mancano tutti e due gli arti superiori è l'impossibilità di svolgere le attività di igiene personale. La dipendenza di questa sfera di attività non consente né di andare a scuola né di lavorare. Questa relazione prende in esame i tipi di articoli di abbigliamento disponibili e gli adattamenti per facilitare lo svestirsi e il vestirsi e i dispositivi per la pulizia dei genitali e la cura mestruale.

I dispositivi vengono esaminati per la loro adeguatezza ai diversi tipi e livelli di amputazione e i loro scopi. L'autonomia richiede una motivazione intensa da parte del paziente e l'eliminazione di eccessive protezioni da parte dei familiari.

Disturbi cutanei negli amputati di Arto Inferiore

S. William Levy

Pros. Orth. Int. 4:1, 37-44

Riassunto

Questo articolo tratta dei problemi comuni della pelle, associati all'uso delle protesi che affliggono amputati di arto inferiore, sopra e sotto il ginocchio. Dopo una breve discussione dei metodi per effettuare l'igiene del moncone, si

classificano i disturbi cutanei propri degli amputati di arto inferiore e si riassumono i metodi migliorativi di cura. I disturbi presi in esame comprendono: dermatiti a contatto, eczema, cisti epidermoidi infezioni da batteri e funghi, ulcere croniche e iperplasia verrucosa.

Un Congegno semplice e Vessatile per la Guida all'uso degli Amputati di Arto Superiore

T. E. Sensky

Pros. Orth. Int. 4:1, 47-49

Riassunto

Sir descrive un congegno semplice, a gancio per la guida, adatto agli amputati di arto superiore, nonché la sua funzione in confronto di quello a giunto a sfera, comunemente disponibile. Il gancio è funzionale sicuro e economico. Si descrive anche un accessorio che può essere adattato alle leve del cambio, permettendo che il congegno venga utilizzato per il cambio manuale delle marce.

Gli Standard per le Protesi Modulari

A. Staros

Pros. Orth. Int. 4:1, 45-46

Riassunto

Questa relazione evidenzia la posizione dell'Amministrazione dei Veterani degli Stati Uniti nei confronti dei tipi e delle norme per le protesi modulari.

Il Trattamento Ambientale Controllato (CET)

I. M. Troup

Pros. Orth. Int. 4:1, 15-28

Riassunto

Si espone l'utilizzazione di un nuovo metodo per migliorare gli aspetti dell'ambiente che circonda le estremità. Ciò segue l'uso del CET nella chirurgia di amputazione ed altre condizioni specifiche in una prova controllata condotta in diversi Centri nel Regno Unito e negli Stati Uniti.

Il protocollo non tentava di stabilire qualsiasi sistema di controllo, essendo i risultati basati sull'osservazione e sull'impressione clinica. In altre parole è una estensione dell'uso del CET in un tentativo di ottenere una più ampia esperienza sua applicazione.

Cento casi interessando 128 cure sono elencati per un'ampia varietà di presentazioni cliniche. E'

stata registrata la presenza p l'assenza dell'edema, dell'infezione, dell'ischemia e del dolore fra altri dati pertinenti. Certe conclusioni risultavano possibili e l'accettazione del sistema da parte del personale è stata ottentua.

L'evidenza suggerisce che l'utilizzazione del CET sia giustificata in certe condizioni cliniche accuratamente selezionale. Inoltre, sembra necessario impostare delle valutazioni scientifiche del sistema specialmente nel laboratori vascolari dove molte procedure investigative pertinenti vengono eseguite come prassi normale.

Medizinisch-Orthopädische-Technik, 3/80

A. W. Gentner publishers, Stuttgart

The above volume was dedicated to foot orthotics and edited by G. Grosch.

Contents

- Imhäuser, G.: Club foot orthotics.
 Baumann, J. U.: The pes plano-valgus.
 Tillmann, K.: The genesis of rheumatic foot deformities and their orthotic treatment.
 Kristen, H.: The prescription of insoles depending on the form of the foot.
 Marquardt, W.: Indications for orthopaedic shoes.
 Wolf, D.: Is there still a need for foot gymnastics?
 Grosch, G.: The role of the human foot in standing.
 Heuse, D. and Stumpf J.: The inside shoe, its indication and technology.
 Pschirrer, M.: A new technique for negative foot moulds.

SATURDAY SEPTEMBER 27	SUNDAY SEPTEMBER 28	MONDAY SEPTEMBER 29	TUESDAY SEPTEMBER 30
07.30-17.00 REGISTRATION	08.00-16.00 REGISTRATION	08.00-16.00 REGISTRATION	08.00-16.00 REGISTRATION
		09.00-18.00 EXHIBITS OPEN	09.00-18.00 EXHIBITS OPEN
MORNING	MORNING	MORNING	MORNING
08.00-12.00 Course BK Below-Knee & Syme Prosthetics Course ULO Upper-Limb Orthotics Course SE Seating for the Severely Disabled Course CH Management of Congenital Limb Deformities	08.00-10.00 Course SU Amputation Surgery 08.00-12.00 Course BK Below-Knee & Syme Prosthetics Course ST Management of Stroke Patients Course FB Fracture Bracing Course ULO Upper-Limb Orthotics Course SE Seating for the Severely Disabled 10.00-12.00 Course CH Management of Congenital Limb Deformities	08.00-10.00 Film & Video Tape Programme 08.00-10.00 Course AK Above-Knee & Knee Disarticulation Prosthetics Course SU Amputation Surgery Course GA Gait Analysis Techniques Course LLO Lower-Limb Orthotics Course ULP Upper-Limb Prosthetics Course FB Fracture Bracing	08.00-10.00 Film & Video Tape Programme 08.00-10.00 Course AK Above-Knee & Knee Disarticulation Prosthetics Course SU Amputation Surgery Course GA Gait Analysis Techniques Course LLO Lower-Limb Orthotics
	AFTERNOON	AFTERNOON	AFTERNOON
	15.00-16.00 Opening Ceremony 16.00 Opening of Exhibition Exhibition open till 18.00	14.00-17.00 Discussion Panel and Open Papers Film & Video Tape Programme Symposium S-1 Management of Low Back Pain Symposium S-2 Hip and Knee Orthoses Symposium S-3 Point of view of the Disabled	14.00-17.00 Discussion Panel and Open Papers Film & Video Tape Programme Symposium S-4 Conventional vs Plastic Orthoses Symposium S-5 Stump Management & Classification Symposium S-6 Orthotics in Cerebral Palsy
	EVENING		
	20.00 Welcoming Reception		
VISIT THE EXHIBITS Open 09.00-18.00 Monday through Friday			

Programme

WEDNESDAY OCTOBER 1	THURSDAY OCTOBER 2	FRIDAY OCTOBER 3	SATURDAY OCTOBER 4
08.00-16.00 REGISTRATION	08.00-16.00 REGISTRATION	08.00-16.00 REGISTRATION	
09.00-18.00 EXHIBITS OPEN	09.00-18.00 EXHIBITS OPEN	09.00-18.00 EXHIBITS OPEN	
MORNING	MORNING	MORNING	MORNING
08.00-10.00 Film & Video Tape Programme 08.00-10.00 Course AK Above-Knee & Knee Disarticulation Prosthetics Course LLO Lower-Limb Orthotics Course ULP Upper-Limb Prosthetics Course SC Orthotic Management in Scoliosis Course WP Wheelchair Prescription	08.00-10.00 Film & Video Tape Programme 08.00-10.00 Course AK Above-Knee & Knee Disarticulation Prosthetics Course LLO Lower-Limb Orthotics Course ULP Upper-Limb Prosthetics Course SC Orthotic Management in Scoliosis Course WP Wheelchair Prescription	08.00-10.00 Film & Video Tape Programme 08.00-10.00 Course HD Hip-Disarticulation Prosthetics Course GT Gait Training Course ULP Upper-Limb Prosthetics Course SC Orthotic Management in Scoliosis Course WP Wheelchair Prescription	08.30-11.45 Plenary Session Prosthetics and Orthotics in the Developing Countries Promise of Rehabilitation Engineering 11.45-12.30 Closing Ceremony
10.30-12.30 Plenary Session Congenital Limb Deficiencies	10.30-12.30 Plenary Session Lower Limb Disorders	10.30-12.30 Plenary Session Orthopaedic Problems-Foot	
AFTERNOON	AFTERNOON	AFTERNOON	
	14.00-17.00 Discussion Panel and Open Papers Film & Video Tape Programme Symposium S-7 Above Knee Fitting & Alignment Symposium S-8 Prostheses for Amputation Through the Foot Symposium S-9 Prosthetics/Orthotics Ed.	14.00-17.00 Discussion Panel and Open Papers Film & Video Tape Programme Symposium S-10 Prosthetics & Orthotics in Developing Countries Symposium S-11 Evaluation, Philosophy and Practices	
	EVENING		
	20.00 Congress Dinner		

Pre-Congress Instructional Courses
September 25–September 27, 1980.

Code	Subject	Total Hours	Thursday September 25	Friday September 26	Saturday September 27
OS	Construction Techniques for Orthopaedic Shoes Location: Officine Ortopediche dell'Istituto Ortopedico Rizzoli, Bologna	16		9.00–18.00	9.00–18.00
MY	Construction Techniques for Myoelectric and Electronic Prostheses for Amputations and Congenital Deformities Location: Centro Protesi I.N.A.I.L., Budrio (Bo.)	24	9.00–18.00	9.00–18.00	9.00–18.00

Congress Instructional Courses
September 27–October 3, 1980

Code	Subject & Organizer	Total Hours	Sat. Sept. 27	Sun. Sept. 28	Mon. Sept. 29	Tues. Sept. 30	Wed. Oct. 1	Thurs. Oct. 2	Fri. Oct. 3
BK	Below-Knee & Syme Prosthetics J. Hughes (Scotland)	8	8–12	8–12					
AK	Above-Knee & Knee Disarticulation Prosthetics E. Lyquist (Denmark)	8			8–10	8–10	8–10	8–10	
HD	Hip-Disarticulation Prosthetics G. Holmgren (Sweden)	2							8–10
SU	Amputation Surgery (*Monday and Tuesday only) B. Persson (Sweden)	6		8–10	8–10	8–10			
GA	Gait Analysis Techniques S. Simon (U.S.A.)	4			8–10	8–10			
GT	Gait Training J. Van Rolleghe (Belgium)	2							8–10
CH	Management of Congenital Limb Deformities L. Kruger (U.S.A.)	6	8–12	10–12					
ST	Management of Stroke Patients R. Waters (U.S.A.)	4		8–12					
LLO	Lower-Limb Orthotics D. Condie (Scotland)	8			8–10	8–10	8–10	8–10	
FB	Fracture Bracing V. Mooney (U.S.A.)	6		8–12	8–10				
SC	Orthotic Management of Scoliosis A. Bähler (Switzerland)	6					8–10	8–10	8–10
ULO	Upper-Limb Orthotics J. Edelstein (U.S.A.)	8	8–12	8–12					
SE	Seating for the Severely Disabled* N. Ring (England)	8	8–12	8–12					
WP	Wheelchair Prescription* L. Simon (Germ. Fed. Rep.)	6					8–10	8–10	8–10
ULP	Upper-Limb Prosthetics D. Childress (U.S.A.)	8				8–10	8–10	8–10	8–10

*English only, at present.

Calendar of events

National Centre for Training and Education in Prosthetics and Orthotics

Short Term Courses 1980-1981 Courses for Physicians and Surgeons

- NC 103 Introductory Biomechanics, Prosthetics and Orthotics; 3-7 November, 1980.
NC 101 Lower Limb Prosthetics, 8-12 December, 1980.
NC 102 Lower Limb Orthotics, 9-13 February, 1981.

Courses for Prosthetists

- NC 204 A Patellar-Tendon-Bearing Prosthetics; 13-24 October, 1980.
NC 205 A Above-Knee Prosthetics; 10-21 November, 1980.
NC 204 B Patellar-Tendon-Bearing Prosthetics; 12-23 January, 1981.
NC 205 B Above-Knee Prosthetics; 16-27 February, 1981.
NC 209 Below-Knee Modular Prosthetics; 16-20 March, 1981.
NC 210 Above-Knee Modular Prosthetics; 23-27 March, 1981.

Courses for Orthotists

- NC 203 Knee-Ankle-Foot and Hip-Knee-Ankle-Foot Orthotics; 24 November-5 December, 1980.
NC 206 Upper Limb Orthotics; 26-30 January, 1981.
NC 208 Spinal Orthotics; 2-13 March, 1981.

Courses for Occupational and Physiotherapists

- NC 301 Lower Limb Orthotics; 15-19 December, 1980.
NC 302 Lower Limb Prosthetics; 2-6 February, 1981.

Courses for Prosthetic and Orthotic Technicians Enquiries should be made to the Centre

Further information may be obtained by contacting Prof. J. Hughes, Director, National Centre for Training and Education in Prosthetics and Orthotics, University of Strathclyde, 73 Rottenrow East, Glasgow G4 0NG, Scotland Tel. 041-552 4400, extension 3298.

New York University Medical School Short Term Courses 1980-1981 Courses for Physicians and Surgeons

- 741 A Lower Limb Prosthetics, 6-10 October, 1980.
751 A Lower Limb and Spinal Orthotics, 27 October-1 November, 1980.
744 A Upper Limb Prosthetics and Orthotics, 1-5 December, 1980.
741 B Lower Limb Prosthetics, 15-19 December, 1980.
741 C Lower Limb Prosthetics, 16-20 March, 1981.

- 751 B Lower Limb and Spinal Orthotics, 23–28 March, 1981.
741 D Lower Limb Prosthetics 20–24 April, 1981.
751 C Lower Limb and Spinal Orthotics, 27 April–2 May, 1981.
744 B Upper Limb Prosthetics and Orthotics 15–19 June, 1981.

Courses for Therapists

- 752 A Lower Limb and Spinal Orthotics, 27 October–1 November, 1980.
742 A Lower Limb Prosthetics, 3–14 November, 1980.
742 B Lower Limb Prosthetics, 2–13 March, 1981.
752 B Lower Limb and Spinal Orthotics, 23–28 March, 1981.
742 C Lower Limb Prosthetics, 6–17 April, 1981.
752 C Lower Limb and Spinal Orthotics, 27 April–2 May, 1981.
757 Upper Limb Orthotics, 1–5 June, 1981.
745 Upper Limb Prosthetics, 8–12 June, 1981.

Courses for Orthotists

- 756 Spinal Orthotics, 5–16 January, 1981.
753 Lower Limb Orthotics, 15 June–3 July, 1981.

Courses for Prosthetists

- 743 Above-Knee Prosthetics, 26 May–12 June, 1981.

Courses for Rehabilitation Counsellors

- 750 A Prosthetics and Orthotics, 13–17 October, 1980.
750 B Prosthetics and Orthotics, 22–26 June, 1981.
Requests for further information should be addressed to Ms. Sandy Kern, Registrar, Prosthetics and Orthotics, New York University Post-Graduate Medical School, 317 East 34th Street, New York, N.Y. 10016.

Oxford Study Days 1980

22–23 October, 1980

Joint Replacement and Medical Management in Rheumatoid Arthritis.

3–4 November

Rehabilitation after Stroke.

19–20 November

Principles of Research for the Remedial Professions.

Information: Secretary, Demonstration Centre, Mary Malborough Lodge, Nuffield Orthopaedic Centre, Headington, Oxford.

Closing date for applications: two months before the date of each course.

Mid-September, 1980

American Orthotic and Prosthetic Association Meeting, New Orleans, U.S.A.

Information: M/s S. I. McCamley, American Orthotic and Prosthetic Association, 1444 N. Street NW, Washington, DC 20005, U.S.A.

25 September and 4 December 1980

"Coping with Disabilities"—an elementary course for all those concerned with rehabilitation of the disabled.

Information: Mrs. S. Bracchi, Withington Hospital, West Didsbury, Manchester M20 8LR. Tel. 061-445 8111 ext. 2387.

27 September-1 October, 1980

33rd Annual Conference on Engineering in Medicine and Biology, Washington DC, U.S.A.

Information: M/s P. I. Horner, Administrator Director, Alliance for Engineering in Medicine and Biology, 4405 East-West Highway, Suite 404, Bethesda, Maryland 20014, U.S.A.

28 September-4 October, 1980

ISPO 3rd World Congress, Bologna, Italy.

Information: Studio B.C., via Ugo Bassi 10, 40123 Bologna, Italy.

1-4 October, 1980

European Regional Seminar on "The Years Ahead in Physical Therapy", Geneva, Switzerland.

Information: World Confederation for Physical Therapy, 16/19 East Castle Street, London W1N 7PA, England.

17 October, 1980

B.E.S. Scientific Meeting and A.G.M.

Information: K. Copeland, Royal College of Surgeons, Lincolns Inn Fields, London W.C.2.

November, 1980

2nd West Africa Regional Seminar to create a regional association of vocational rehabilitation centres, West Africa.

Information: International Council of Goodwill Industries, 9200 Wisconsin Ave., Washington, D.C. 20014, U.S.A.

16-21 November, 1980

First International Convention on Medico-Legal Aspects of Disability, Tel Aviv, Israel.

Information: Convention Secretariat, P.O. Box 3059, Tel Aviv, Israel.

21-23 November, 1980

Fundamentals of Gait, Orthotics and Prosthetics, The Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry, Salop.

Information: Mr. G. K. Rose, F.R.C.S., Orthotic Research and Locomotor Assessment Unit, The Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry, Salop, SY10 7AG, U.K.

16-18 February, 1981

10th Annual Congress of the Society for Rehabilitation in the German Democratic Republic, with international participation.

Information: Society for Rehabilitation in the German Democratic Republic, Harz 42-44, 402 Halle (Saale), German Democratic Republic.

6-10 April, 1981

3rd European Regional Conference of Rehabilitation International "The Handicapped Person in Society" Vienna.

Information: Eva M. Schaup, Secretariat, Hofburg-Heldenplatz. Postfach 105 A-1014 Wien.

11-13 June, 1981

5th Nordic Meeting on Medical and Biological Engineering, Linköping, Sweden.

Information: Prof. Ake Öberg, Dept. of Biomedical Engineering, Regional Hospital, S-58185 Linköping, Sweden.

18-24 June, 1981

International Technical Aids Exhibition and Forum, Düsseldorf, Federal Republic of Germany.

Information: Deutsche Vereinigung für die Rehabilitation Behinderteter, 6900 Heidelberg 1, Friedrich-Ebert-Anlage 9, Federal Republic of Germany.

1-3 July, 1981

Conference on Design in Medicine. A three day scientific meeting organised by the Institution of Engineering Design to be held at the University of Strathclyde, Glasgow, Scotland.

Information: Mr. R. D. Cullum, Publication Services, 33 Foxley Lane, High Salvington, Worthing, West Sussex BN13 3AD, U.K.

August, 1981

5th International Conference on Electrical Bio-Impedance, Tokyo, Japan.

Information: Prof. K. Nakayama, Dept. of Electrical Engineering, Sophia University, Kioi-cho 7, Chiyoda-ku, Tokyo 102, Japan.

9-11 September, 1981

1st Annual Advanced Course in Lower Limb Prosthetics, New York.

Information: Dr. L. W. Friedmann, Chairman, Department of Physical Medicine and Rehabilitation, Nassau County Medical Centre, 2201 Hempstead Turnpike, East Meadow, New York 11554, U.S.A.

15-20 November, 1981

International Symposium on Design for the Disabled, in co-operation with Israel Design Centre and International Council of Industrial Design. Tel Aviv, Israel.

Information: Israel Society for Rehabilitation of the Disabled, 10 Ibn Gvirol St., Tel Aviv, Israel.

Modular Artificial Limbs

Above-knee Systems

Second Report on a Programme of Clinical and Laboratory Evaluation

Edited by S. E. Solomonidis
HMSO Publication (1980)

The Bioengineering Unit of the University of Strathclyde has been carrying out a programme of clinical and laboratory evaluation of modular artificial limbs. The objectives of the project fell into two categories. Firstly, the assessment of clinical suitability which aimed to compare the prostheses both from the patients' point of view and that of the service, and secondly to produce design information relating to the clinical and constructional requirements of the modular assembly prostheses. The work was authorised and funded by the Scottish Home and Health Department.

The first stage dealt with six below-knee systems and a report was published in 1975 (*Modular Artificial Limbs—Below-knee Systems*—HMSO ISBN 011 491182 7). The work was continued to above-knee level and a report describing the philosophy and methodology employed and discussing the findings is now available.

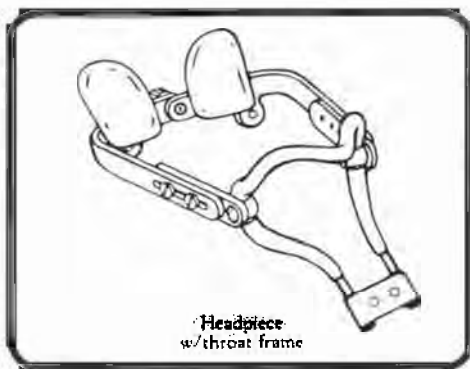
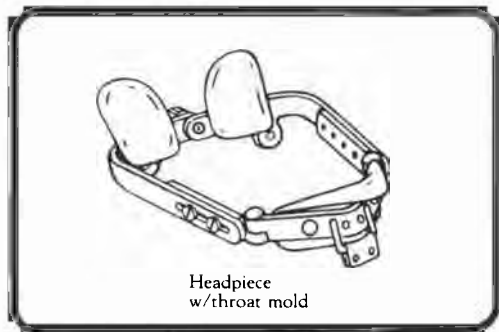
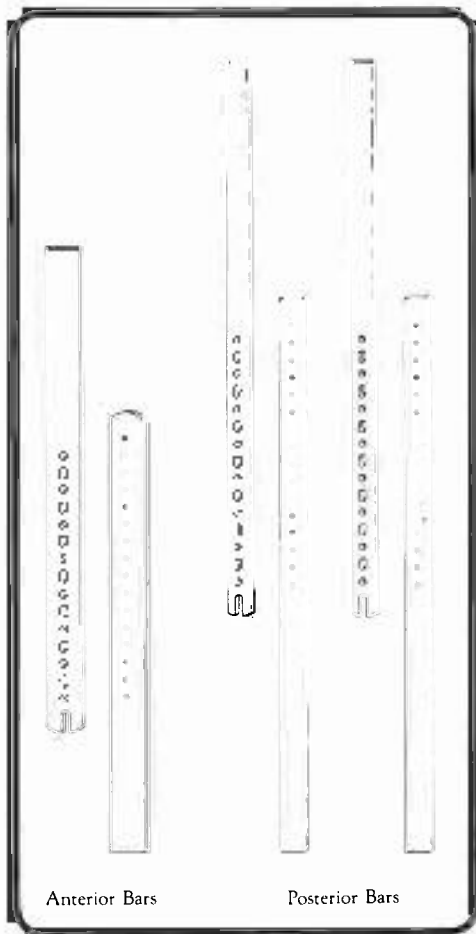
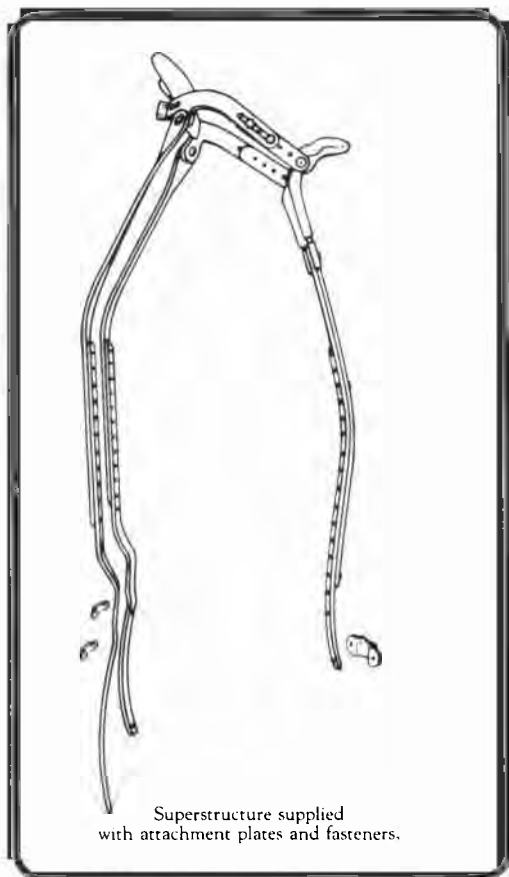
Four systems were investigated on 12 patients: the Blatchford Above-knee Modular System; the Otto Bock Above-knee System Leg; the U.S. Manufacturing Co. Universal Multiplex Above-knee Modular System; and the Hosmer/Dorrance Modular Prosthetic System. Each patient was fitted and issued with each of the systems to wear continuously for a sufficient time to allow valid opinions to be formed. The following information was collected:

- (a) Physical Properties: mass, position of centre of gravity, mass moment of inertia and alignment configuration.
- (b) Time taken for fitting, assembly and construction.
- (c) Critical analysis of design features.
- (d) Subjective assessment by the patient and the other members of the clinic team.
- (e) Load analysis: by means of a transducer, fitted into the shank of the prosthesis, the load actions during amputee activity were determined.

Although all four systems were found to be clinically usable, the evaluation indicated preferred systems for the limb fitting service in Britain. All systems had several disadvantages and require further development. The report gives information which should be useful for the design of new generation modular limbs and highlights areas for further research.

Further information and copies of the evaluation report are obtainable from Miss A. Spears, Chief Scientists Office, Scottish Home and Health Department, 218 St. Andrews House, Edinburgh EH1 3DE (Tel: 031-556 8501 ext. 2760).

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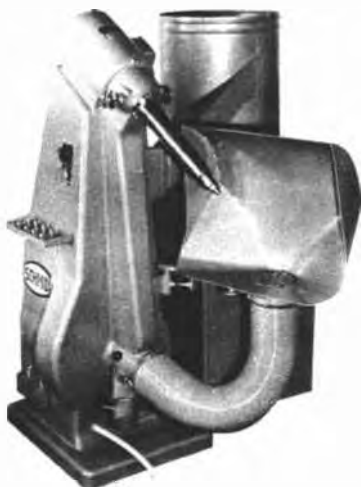


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Content of Volume 2, 1979

Main contributions

Issue no. 1: R. Schindele: Communication and cooperation between professionals in the field of rehabilitation. P.J.R. Nichols: Training in rehabilitation. M.R. Bury: Disablement in society. J. Kiwerski, M. Weiss, & R. Pasniczek: Electrostimulation of the median nerve by means of implanted stimulators. S. Dillner, & G. Georgiev: Technical and clinical function testing of hand orthoses. H.P. Houter, & P.M. Smeets: Teaching toothbrushing behaviour in severely retarded adults. A.H. Hanninen: The blind: Education and vocational preparation in Finland.

Issue no. 2: W. Rutz: Interdisciplinary cooperation in an integrated psychiatric rehabilitation program. J.J. Woodward et al.: The application of Kelly's Repertory Grid technique. E. Funke, & T. Herold: Antisociality and school failure. W.B. Kinney: The relationship of body image and perceptual-motor performance of trainable mental retardates. D. Kirtley, & B. Sabat: Symbolism in the dreams of the blind.

Issue no. 3: G. Saenger et al.: Delivery of care for severely retarded children. R. Goldfarb, & E. Bader: Espousing melodic intonation therapy in aphasia rehabilitation. T. Spurgeon, & C. Underhill: Horticultural therapy. H. Paul: Ecological aspects concerning the rehabilitation of handicapped persons. E. Hischer: Styles of personal approach.

Issue no. 4: L. McCaul, & P. Cooper: Techniques to increase response rate in follow-up studies. W. Meister: Rehabilitation of chronic obstructive pulmonary diseases. A.E. Philip et al.: Personal traits and physical, psychiatric and social state of patients with myocardial infarction. H. Frank, & B. Buttgeriet: Classroom behavior of special school teachers. S. Segal, & U. Aviram: Reintegrating the mentally ill in the community.

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References to articles in books should include author, year of publication, article title, book title edition, editor (if different from author) first and last pages, publisher and place of publication. For example, Hughes, J. (1975). Recent developments in prosthetics and orthotics. *Recent Advances in Orthopaedics* (2) Ed. McKibbin, B., 196–216, Churchill Livingstone, Edinburgh.

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