The Journal of the International Society for Prosthetics and Orthotics

Prosthetics and Orthotics International

April 1994, Vol 18, No. 1

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Prosthetics and Orthotics International

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The Journal of the International Society for Prosthetics and Orthotics

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ISPO

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J. Vaucher (Vice President)	Switzerland
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T. Keokarn	Thailand
H. Shangali	Tanzania
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N. A. Jacobs (Hon. Secretary)	UK

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W. H. Eisma (Protocol and Nominations)	Netherlands
S. Sawamura (Congress)	Japan
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D. N. Condie (Standards)	UK
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A. Staros (1980-1982)	USA
E. Lyquist (1982-1983)	Denmark
E. G. Marquardt (1983-1986)	Germany
J. Hughes (1986-1989)	UK
W. H. Eisma (1989-1992)	Netherlands

Secretary

Aase Larsson	Denmark

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Editorial

The result for the financial year 1993 was a surplus of DKK 882,788, which was close to that budgeted and mainly derived from further income from the Chicago congress and a high capital yield. Neither of these will apply to the coming year.

Interest revenue on capital has dramatically dropped during the last quarter of 1993. The Society's investment policy has aimed at getting the highest possible outcome in the financial market without any undue risks. We have largely benefited from the turmoil with shifting exchange rates for vulnerable currencies, which led to high short term interest rates on cash. The effective interest was 9.3% on our total assets by the year end. However, we can not expect more than about 6% with the current low bank rate, which is expected to drop even further. Consequently we have invested the bulk of our assets in 6% bonds, giving an effective interest of above 7%.

We have been able to keep the income from the membership fees at a fairly even level since 1990 with only minor fluctuations around congress years.

The Society is grateful to the War Amputations of Canada for their continued support. However the income from sponsorship has decreased by the termination of financial support from SAHVA in Copenhagen. We will still enjoy cost free office facilities and the like at SAHVA, and together with the major secretarial and administrative contributions from staff associated with our President and other officers, we will also in the future be able to keep our office costs at a reasonable level. The Society greatly appreciates these contributions. The value of these services amounts to not less than DKK 400,000 on a yearly basis.

It is still possible to run the daily activities of our Society on the membership fees, i.e. Secretariat, Executive Board, Prosthetics and Orthotics International and publications. However, ISPO is a Society with aims of influencing education and other activities internationally. This is not possible without using our capital yield, which is also the base for our courses, conferences, and workshop activities. The capital should consequently be preserved as a foundation, if ISPO wishes to continue to influence activity outside its own membership.

Some cost items needs specific comments.

The court trial from the Bologna 1980 World Congress was closed with a settlement of DKK 160,000, which included fees to our Danish and Italian lawyers and experts of about DKK 35,000. INTERBOR has agreed from the start to refund half of the costs.

ISPO is currently preparing a series of consensus conferences on Appropriate Prosthetic Technology, Orthotics Management in Cerebral Palsy and Poliomyelitis. We have good reason to believe that USAID will support the Appropriate Prosthetic Technology programme financially, and we have therefore accrued rather considerable costs in preparatory meetings with USAID.

Our first course on Amputation Surgery and Related Prosthetics in the Developing World, in Tanzania, ended with a cost of only one third that budgeted due to contributions from collaborating governmental agencies including DANIDA (Danish International Development Agency), GTZ (German Technical Cooperation Agency) and DSE (German Foundation for International Development); non-governmental organisations including WOC (World Orthopaedic Concern) and ICRC (International Committee of the Red Cross); and a commercial company Otto Bock.

The journal, Prosthetics and Orthotics International, is still a cost issue, but an advertising campaign has been undertaken and further a promotional brochure has recently been released. Postage costs appears high and we are analysing possible reductions by not air mailing these Journals and the possible associated drawbacks for our subscribers.

Printing costs have been high because of un-budgeted costs for printing diplomas and payment of the services provided by the Recal Information Service in the University of Strathclyde for assistance with literature searches and copying for the Consensus Conference on Amputation Surgery, as was already agreed upon in the planning phase.

Membership is not as broadly spread to all the professions of the rehabilitation team as we would wish. We hope to improve through a promotional brochure, which is to be circulated shortly.

J. Steen Jensen
Honorary Treasurer

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ISPO Statement of Accounts, 1993

Auditors Report

We have audited the enclosed Financial Statements for the year 1993.

The audit has been performed in accordance with approved auditing standards and has included such procedures as I have considered necessary.

The Financial Statements have been prepared in accordance with statutory requirements, and the constitutions of the society and generally accepted accounting principles. In our opinion the Financial Statements give a true and fair view of the state of the association's affairs as of December 31, 1993 and of the result for the year then ended.

Copenhagen, March 1, 1994
Revisionsgruppen A/S

Søren Wonsild Glud
State Authorized Public Accountant

Securities

Bonds and shares have been valued at the lower of cost or market.

Office Equipment

Computer and office equipment have been stated at cost less depreciation computed straight line over 5 years.

Accrual Concept

The accrual concept of accounting has been used in these financial statements.

Income Statement for the Year 1993

SUMMARY		**1993**	**1992**
Society membership fees (note 1)		1.045.107	1.151.504
Sponsorship (note 2)		32.058	55.870
Meetings with other organisations (note 3)		(220.533)	(195.948)
Conferences, courses etc (note 4)		398.390	1.635.875
Prosthetics and Orthotics International (note 5)		(131.996)	(72.504)
Professional register		–	–
Publications (note 6)		(22.391)	18.748
Activity result		1.100.635	2.593.545
Administration expenses (note 7)		(832.601)	(912.793)
Primary result		268.034	1.680.752
Interest (note 8)		604.222	410.133
Dividend (note 8)		1.128	1.504
Maturity yield (note 8)		9.404	7.388
Change in value of securities (note 8)		–	(6.392)
Financial income		614.754	412.633
Net income	DKK	882.788	2.093.385

Balance sheet as of December 31, 1993

ASSETS		**1993**	**1992**
Cash		1.451.287	2.994.181
Accrued interest		124.435	85.925
Advertising receivable		104.190	66.778
Prepayment, World Congress		83.040	94.433
Receivables Chicago World Congress		181.215	–
Advance funding of World Congress 1980		–	87.437
Other		40.482	31.296
Receivables		533.362	365.869
Securities (note 9)		5.035.908	2.855.379
Office equipment (note 8)		8.571	–
Total assets	DKK	7.029.128	6.215.429
LIABILITIES AND EQUITY			
Accrued expenses		91.737	93.239
Accrued printing cost		178.000	160.000
Prepaid membership fees		9.951	3.350
Prepaid advertising income		–	9.387
Prepaid subscription income		77.100	72.464
Short-term liabilities		356.788	338.440
Provision World Congress 1980		–	87.437
Equity January 1		5.789.552	3.696.167
Net result		882.788	2.093.385
Equity December 31		6.672.340	5.789.552
Liabilities and capital	DKK	7.029.128	6.215.429

Notes to the Financial Statements

1. Society membership fees

Membership fees consist of payments from 2493 listed members, excluding 45 honorary members.

		1993	**1992**
2. Sponsorship			
Contribution from:			
The War Amputations of Canada		32.058	30.870
SAHVA		–	25.000
	DKK	32.058	55.870

3. Meetings with other organisations			
Education Committee, INTERBOR		8.258	23.853
INTERBOR		9.834	5.906
WHO Geneva		17.120	9.211
World Orthopaedic Concern		14.346	10.229
ICRC		5.073	-
Amer Acad Orth-Prosth		-	53.578
ACOPPRA		5.508	-
USAID		80.228	-
Lisbon 1993		66.743	-
Other		13.423	93.171
	DKK	220.533	195.948
4. Conferences, courses etc			
Groningen		-	114.642
Chicago		546.577	1.521.233
Bologna		(80.222)	-
Amman		(12.983)	-
Tanzania		(54.982)	-
	DKK	398.390	1.635.875
5. Prosthetics and Orthotics International			
Advertising		287.477	246.559
Subscriptions		199.910	209.691
		487.387	456.250
Printing and mailing		(530.514)	(494.539)
Production editor		(32.129)	(29.086)
Journal promotion		(41.351)	-
Meeting expenses		(15.389)	(5.129)
		(619.383)	(528.754)
Net result (loss)	DKK	(131.996)	(72.504)
6. Publications			
Booksales		21.644	28.120
Amputation surgery consensus		(44.035)	(9.372)
Total cost	DKK	(22.391)	18.748
7. Administrative expenses			
Executive Board and Officers:			
Travel and hotel costs		307.621	304.512
Meeting expenses		-	6.480
Directory printing		-	58.500
	DKK	307.621	369.492

Secretariat, Copenhagen			
Staff salaries		291.530	272.783
Labour tax		12.747	12.360
Data service		1.152	5.522
Meeting expenses		12.836	13.436
Postage and Bank charges		60.250	88.269
Telephone		4.301	4.713
Stationery		21.208	16.174
Office supplies		10.172	2.481
Auditing		41.250	38.000
Bookkeeping		29.031	22.848
Sundries		26.925	15.872
Knud Jansen medals		–	50.843
Depreciation		4.285	–
Professional register		9.293	–
		524.980	543.301
Total	DKK	832.601	912.793

8. Office equipment

Computer equipment, at cost		108.203	95.347
Office equipment, at cost		26.220	26.220
Cost		134.423	121.567
Depreciation January 1		(121.567)	(121.567)
Depreciation December 31		(4.285)	–
Accumulated depreciation		(125.852)	(121.567)
Net book value	DKK	8.571	–

9. Securities

	Nominal value	Original cost	Year end value	Interest/ dividend
Bonds				
9% Kred. Danmark 2007	2.872.000	2.679.796	2.916.516	268.605
10% Kred. Danmark 2010	2.314.000	2.333.553	2.374.164	125.000
Matured				13.699
Shares				
Den Danske Bank	94	30.891	36.378	1.128
Total	5.186.094	5.044.240	5.327.058	408.432

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Executive Board Meeting

19-20 January 1994
Ballerup, Denmark

The following paragraphs summarise the major discussions and conclusions of the Executive Board Meeting held in Ballerup in January of this year. They are based on the draft minute of that meeting which has yet to be approved.

Standing Committee and Task Officers Reports

The Chairman of the Finance Committee, Bent Ebskov (Denmark), reported that although the Society's finances were generally in a sound position, there was some concern with regard the lowering of interest rates in Denmark and that income from capital investments would be reduced in the future. The Honorary Treasurer, J. Steen Jensen (Denmark), presented the accounts for 1993 which are subsequently published in this issue of *Prosthetics and Orthotics International*. The result for the year was a surplus of DKK 882,788 which was close to that budgeted. It derived from further income from the Chicago Congress and a high capital yield. The Honorary Treasurer presented the proposed budget for 1994. He estimated that the result for the year would be a deficit of approximately DKK 765,000. The major reasons for the deficit are the extraordinary amounts of activity proposed for the year, including Amputation Surgery and Related Prosthetics Courses in Thailand, Slovenia and Panama, as well as Consensus Conferences on Appropriate Prosthetic Technology in Developing Countries and the Orthotic Management of Cerebral Palsy. This, together with the reduced amount of sponsorship and investment income expected, resulted in the high deficit. The Executive Board discussed the budget for 1994 and approved it. The Executive Board discussed the fees for 1995 and agreed that they should remain at DKK 450 for industrial countries and DKK 225 for developing countries. The Executive Board voiced its concern with regard the proposed deficit for 1994 and the decreased income from sponsorship and investments and suggested that consideration may have to be given to increasing fees for the following triennium.

The Chairman of the Protocol and Nominations Committee, Willem H. Eisma (The Netherlands), reported that the Committee had discussed guidelines with regard the role of International Consultants. The Executive Board, after some amendments, approved of these guidelines. A proposed amendment to the Constitution recognising the role of International Consultants is published elsewhere in this issue of *Prosthetics and Orthotics International*.

The Chairman of the Education Committee, John Hughes (UK), presented a report of the Education Committee activities. He informed the Executive Board that the Course on Amputation Surgery and Related Prosthetics in China had to be cancelled due to local difficulties. However, it is hoped to arrange a new date for this course in the future. Plans for the courses in Thailand, 14-18 March 1994, Slovenia, 26-30 September 1994, and Panama, 14-18 November 1994, were well underway *(Secretary's Note: the course in Thailand was duly run with an attendance of 60 participants).* John Hughes went on to report on the activities of the ISPO/ INTERBOR Joint Education Committee. The Committee is involved with the problems of International Certification in prosthetics and orthotics. Plans are progressing to hold three further trials of the American Board for Certification (ABC) examinations in Australia, Tanzania and Germany. The Joint Education Committee will be looking at the wider aspects of International Certification with a view to establishing guidelines, standards and a plan of action John Hughes reported that the Joint Education Committee is hoping to seek funds from the ERASMUS programme of the European Community for a meeting of Heads of Schools and Associations to be organised late in 1994 at the University of Strathclyde, Scotland. This would focus on education in Europe but it was the intention that there would be a wider international representation. The German Agency for Technical Cooperation (GTZ) had invited the Society to inspect its school in Yerevan, Armenia which was carried out by Roy Bowers (UK) and Andries de Bont (Netherlands/Ireland). A number of questions had arisen from the report, mainly related to the

balance of the course between prosthetics and orthotics. It was agreed that the Chairman should contact GTZ and the inspectors with regard these matters and if they could be resolved, confirm recognition of the course for Category II Training and Education. The Society had received invitations to inspect the GTZ schools in Pakistan and China and the World Rehabilitation Fund (WRF) school, in Yerevan, Armenia and arrrangements for these inspections will be made in due course. The Society is collaborating with World Orthopaedic Concern (WOC) on an instructional course on Lower Limb Amputation Surgery to be offered at the British Orthopaedic Association meeting to be held on 15 April 1994 in London, UK. J. Steen Jensen (Denmark) presented a proposal for a course on Care and Rehabilitation of Amputees, primarily for nurses and therapists. He would, in the near future, be contacting National Member Societies seeking suggestions for the content and lecturers for the course.

The Honorary Secretary reported that at the end of 1993, the Society had a total of 2,493 members. This was a slight decrease over the total for the previous year which was extraordinarily high due to the numbers of new members joining the Society as a result of the Chicago Congress. The Executive Board endorsed the formation of the Panamanian National Member Society which would take effect as soon as the Constitution was translated into English in order to ensure that there was no contravention of the International Constitution. John Craig (USA) informed the board that the Colombian group were very close to forming a National Member Society. A number of other countries were considering establishing National Member Societies including, Chile, France, Mexico, Slovenia, and Taiwan.

Hans Arendzen (The Netherlands) reported on the publication of a promotional brochure for the Society. Some 5,000 copies had been printed and copies will be distributed to National Member Societies. He pointed out that it was printed in English, however, it would be possible to insert translations of the text or some other information to meet specific requirements. David N. Condie (UK) informed the Board that a flyer seeking new subscribers for *Prosthetics and Orthotics International* had been produced. Some 5,000 flyers had been printed and sent out to 1634 centres in 147 countries and attempts would be made to monitor the success of this exercise. The Executive Board agreed to re-constitute the Publications Committee as a result of the suggestion that, as an outcome of the Consensus Conference on Amputation Surgery, it would be useful if short, clearly illustrated booklets, specifically related to the techniques of different methods of amputation, could be produced for use by trainee surgeons and others. Such booklets should be fully coordinated with any video tapes on amputation surgery that the Society may produce. The Committee had met and its Chairman, Hans Arendzen, reported on suggestions for the establishment of a coordinated video tape and booklet project on amputations of the lower limbs. The Committee had listed the essentials to be covered in booklets and video tapes on ankle disarticulation, trans-tibial amputation, knee disarticulation and trans-femoral amputation. The Publications Committee would make a detailed proposal for the video tape and booklet programme for the next Executive Board meeting. The Committee had also viewed the video tape on trans-tibial amputation surgery produced by Amar Jain (UK) and John Guy (UK) and it was agreed that the Chairman should meet with them in order to discuss future plans for it.

David N. Condie (UK) reported on the Society's activities in relation to the International Standards Organisation (ISO) and the European Standards Organisation (CEN). The ISO Technical Committee 168 on Prosthetics and Orthotics and its three working groups on Terminology and Nomenclature, Medical Aspects and Physical Testing had met in Washington, USA, 19-21 November 1993. A number of drafts for standards had been completed and will be submitted to all countries participating in TC168 work for comment early in 1994. In addition, ISO 8548-2 Method of Describing Lower Limb Amputation Stumps and ISO 8548-3 Method of Describing Upper Limb Amputation Stumps have been accepted as International Standards. The Society is also active in TC173 – Technical Systems and Aids for Disabled Persons. The Society is represented on Sub-Committee 1 – Wheelchairs, by Geoff Bardsley (UK) and on Sub-Committee 2, Working Group 7 – Classification and Terminology by David N. Condie. David N. Condie also represents the Society on the ad hoc Working Group of CEN 293 on Prosthetics and Orthotics. The Group had met in Berlin, Germany 22 October 1993 when it was overwhelmingly agreed that there was a need for such CEN standards and that it was recommended that a Working Group of CEN Technical Committee 293 would be created

for this purpose. David N. Condie is in the process of preparing a paper outlining the current situation with regards the work on standards for publication in *Prosthetics and Orthotics International.*
Per Christiansen (Denmark) reported on the status of the Professional Register. He presented a proposal to combine the Society's Application Form with the Professional Register Questionnaire. The Executive Board discussed this proposal and made a number of suggestions and a definitive form would be produced for the next Executive Board meeting.

The President reported on developments with regard the proposal for a Consensus Conference for Appropriate Prosthetic Technology for developing countries. Representatives of the Board had met with officials of the US Agency for International Development (US AID) to discuss the programme and organisation of such a conference. It is hoped that US AID would co-sponsor the conference which would bring together all the major agencies involved in prosthetic technology in the developing world. HGB Day (UK) has been co-opted onto the organising committee for this conference. David N. Condie presented a report on the progress of the proposal to hold a Consensus Conference on the Orthotic Management of Cerebral Palsy. A planning team had been formed whose principal role is to finalise the programme structure and select reviewers and participants. It is expected that approximately 30 persons will be invited to attend representing appropriate medical specialties, bioengineering, orthotics and therapy. Requests for nominations for reviewers and/or participants have been sent to National Member Societies. The conference would last for 3 days and will be held in November 1994. George Murdoch, (UK) reported on the progress made with regards a proposal for a Consensus Conference on Poliomyelitis. It is anticipated that the total cost would be in the region of USD 170,000. The Executive Board expressed the view that it would be desirable to organise such a conference if it was possible to find a means to defray the costs. It was agreed that the committee reponsible should examine the funding in order to find sources of support and report back to the next Executive Board meeting.

International Consultants
Črt Marinček (Slovenia) reported that all attention in Central and Eastern Europe was focused on the course for Amputation Surgery and Related Prosthetics arranged for 12-16 September 1994 in Ljubljana, Slovenia. This will be the first time this year that professionals from this region will meet together and he hoped that this would provide useful contacts for ISPO within these countries.

Seishi Sawamura (Japan) reported on a proposal to establish a Prosthetic and Orthotic Centre for Asian developing countries. The proposal had been discussed at a meeting organised by the United Nations Economic and Social Commission for Asia and the Pacific as well as the Japanese Government in Okinawa, Japan on 19 October 1993. One of the outcomes of that meeting was a resolution calling for the establishment of a centre in Asia that would supply prostheses, orthoses and technical aids, calling for the support of Governments in that area. Such a centre in Asia would conduct an educational programme for prosthetists and orthotists as well as manufacturing inexpensive prosthetic and orthotic components for the region.

John Craig (USA) reported on activities in Central and South America. As well as trying to promote National Member Societies, he indicated that attempts are being made to increase the prosthetic and orthotic activities in this region, particularly in Colombia, Chile, Panama, Guatemala and Mexico.

International Organisations
Jacques van Rolleghem (INTERBOR) reported that the 12th International Congress of INTERBOR held in Lisbon, Portugal, 22-25 September 1993 had been very successful and, on behalf of the Board of INTERBOR, thanked ISPO for its collaboration. The venue for INTERBOR's next International Congress will be either Norway or Brazil.

The Honorary Secretary reported on a meeting called by the World Health Organisation (WHO) in Geneva on 4 November 1993, the purpose of which was for groups with an interest in prosthetics and orthotics in developing countries to exchange information about their activities and to identify actions which may require to be taken in the future. As well as ISPO, the meeting had been attended by representatives of the International Committee of the Red Cross (ICRC), Handicap International (HI), the German Agency for Technical Cooperation (GTZ) and Rehabilitation International (RI

Jan Bredie (The Netherlands) reported on the 11th International Congress of Internationaler Verband der Orthopädie-Schuhtechniker (IVO) held in Quebec, Canada 3-6 September 1993. Some 700 participants attended the conference, including 400 from Europe. This was the first time that the congress had been held outside of Europe. The next IVO congresses will be held in June 1995 in Berlin, Germany and in 1997 in Belgium. The possibility of ISPO holding a combined meeting with IVO on advances on orthopaedic footwear is being considered.

The President reported that he had been in communication with the President of World Orthopaedic Concern (WOC), Garry Hough III, and that it is hoped that he would attend the Executive Board Meeting regularly as the WOC observer.

The Honorary Secretary reported that the United Nations (UN) Economic and Social Council has re-classified ISPO to Category II Consultative Status at its meeting on 28 June-30 July 1993. The Executive Board agreed that the President and the Honorary Secretary should be the Society's representative to the New York Office of the UN and that Jean Vaucher (Switzerland) and the Honorary Secretary should be representatives to the Vienna and Geneva offices.

The Honorary Secretary reported that he had discussions with the International Committee of the Red Cross (ICRC) and Alain Garachon would attend future Executive Board meetings as its observer.

The President reported that in recent times he had established good contact with US Agency for International Development (US AID). In addition to the proposed Consensus Conference on Appropriate Technology, US AID were beginning to use ISPO members for advice. The President, together with Dan Ramsey (USA), Michael Schuch (USA) and Frank Gottschalk (USA) had inspected US AID projects in Vietnam. The President, together with John Hughes (UK), John Craig (USA), The Honorary Secretary and other ISPO members, had met in Dallas, 26-27 August 1993 to develop an evaluation form for US AID projects. In addition, American members of ISPO had been sent to visit projects in Sri Lanka and Mozambique.

Congresses

John Hughes (UK) reported that on the advice of the Society's lawyers in Bologna, it was decided to offer a settlement to Studio BC of LIT 30,000,000. This released ISPO and Hannes Schmidl (Italy) from any obligation towards Studio BC. This matter is now closed.

Valma Angliss (Australia) reported on progress for the arrangements for the 8th World Congress to be held in Melbourne, Australia, 2-7 April 1995. Arrangements were far advanced for the scientific programme, the commercial and scientific exhibit and the social programme. A full announcement and call for papers will be issued by the end of March 1994.

Hans Arendzen (The Netherlands) reported that arrangements were well underway to organise the 9th World Congress, 28 June-3 July 1998 in Amsterdam. A local committee had been set up, a foundation for the local organisation had been established, congress organisers had been appointed and a revised budget was being prepared. The Executive Board approved the design of a logo for the congress on condition it is shown in close association with the ISPO logo.

Conferences and Meetings

The Honorary Secretary reported that he had been asked to co-chair a session on International Education in Prosthetics and Orthotics ot Orthopädie+Reha Technique, Essen, Germany, 31 May-3 June 1994. John Hughes (UK), Sepp Heim (Germany) and William Neumann (USA) had been asked to make presentations during this session.

The Society is collaborating with the organisers of Dundee '94, Clinical Gait Analysis, 5-8 July 1994, Dundee, UK. Members of the Society will be offered reduced registration for this meeting.

Hans Arendzen (The Netherlands) reported that he had identified a number of individuals to make presentations on a session on prosthetics at the 6th European Regional Conference of Rehabilitation International, 4-9 September 1994, Budapest, Hungary. A request has been made to make a plenary session presentation at the meeting but no reply has been received to date.

Jean Vaucher (Switzerland) reported on the 2nd International Meeting of the Austrian, Swiss and

German National Member Societies, together with the Swiss Association for Prosthetics and Orthotics, 21-22 October 1994, Konstanz, Germany. The theme of the meeting will be electronics in prosthetics and orthotics. It was agreed that Jean Vaucher should represent the Board at this meeting.

Nominations for the Executive Board 1995-1998

The Executive Board prepared a slate of nominations for the coming triennium as follows –

President	Seishi Sawamura (Japan)	Orthopaedic Surgeon
President-Elect	Norman A. Jacobs	Bioengineer
Vice-Presidents	David N. Condie (UK)	Rehabilitation Engineer
	Harold G. Shangali (Tanzania)	Prosthetist/Orthotist
Members	Gerhard Fitzlaff (Germany)	Prosthetist/Orthotist
	Jean Halcrow (Australia)	Occupational Therapist
	Björn M. Persson (Sweden)	Orthopaedic Surgeon
	C. Michael Schuch (USA)	Prosthetist/Orthotist
Honorary Treasurer	J. Steen Jensen (Denmark)	Orthopaedic Surgeon
Honorary Secretary	Brendan McHugh (UK)	Bioengineer

This slate of nominations would be presented to the Interim Meeting of International Committee Representatives outlining the reasons for the slate and asking for comment.

Norman A. Jacobs
Honorary Secretary

Interim Meeting of International Committee Representatives

21-22 January 1994
Ballerup, Denmark

The meeting of International Committee Representatives which met directly after the Executive Board meeting was attended by representatives of 15 National Member Societies as well as members of the Executive Board.

Papers on ISPO policies and activities were presented to the meeting by members of the Executive Board. The Chairman of the Finance Committee, Bent Ebskov, and the Honorary Treasurer, J. Steen Jensen, reported on the finances of the Society. The Chairman of the Education Committee, John Hughes presented a report on the Society's activities on education. The Membership Task Officer, Hans Arendzen and the Honorary Secretary reported on membership and National Member Society development. Hans Arendzen, David N. Condie and the Honorary Secretary presented a report on publications which covered the publication of a promotional brochure, the publication of a subscription flyer for *Prosthetics and Orthotics International* and progress with the journal. David N. Condie informed the meeting of the Society's involvement in developing international standards in prosthetics and orthotics. Per Christiansen reported on the status of the professional register. Three Consensus Conferences are currently being planned. The President reported on progress with the development of a Consensus Conference on Appropriate Prosthetic Technology in Developing Countries, David N. Condie on the status of a Consensus Conference on Orthotic Management of Cerebral Palsy and George Murdoch on a proposal for a Consensus Conference on the Management of Poliomyelitis. The President presented a report on consumer interests on behalf of the Society's consumer consultant, Cliff Chadderton. The President-Elect, Seishi Sawamura, informed the meeting

of developments with regard the role of international consultants in the Society. John Craig, the International Consultant to Central and South America, gave a report of activities in that region. The Honorary Secretary outlined the relationships of the Society with other international organisations. The President presented a report on the World Congresses which covered the Congress in Bologna, Italy 1980, the 7th World Congress, Chicago, USA 1992, the 8th World Congress in Melbourne, Australia 1995 and the 9th World Congress in Amsterdam 1998. These reports were discussed and comments were made on these presentations for consideration by the Executive Board.

National Member Societies presented reports of the activities in their countries related to education and training for prosthetists and orthotists, research efforts in prosthetics and orthotics, governmental and non-governmental organisation activities in prosthetics and orthotics for developing countries and twinning. The reports were presented by Juan Martina (Caribbean), Lars Nummelin (Finland), Gerhard Fitzlaff (Germany), Yeun Tsz Kuen (Hong Kong), Jan Geertzen (The Netherlands), Robin Platts (UK), John Michael (USA), K. N. Niazi (Pakistan), Eiji Tazawa (Japan), Jean Halcrow (Australia), Guy Martel (Canada), Martin Goplen (Norway), R. K. Srivastava (India), Wyn Beasley (New Zealand) and E. Deschoolmeester (Belgium). The meeting had a full discussion of these reports. In particular, it discussed the principle of whether the International Society should make a financial contribution to the twinning arrangements entered into by individual National Member Societies. The consensus of the meeting was that the International Society should not do so.

The meeting discussed the composition of the International Committee and representation at the Interim Meeting. It was suggested that it may be better if the Interim Meeting was a full International Committee meeting that had full Constitutional rights. It was pointed out that the Interim Meeting of International Committee Representatives came about at the request of the joint International Committee and Executive Board working group. The numbers had been limited to one representative from each National Member Society in order to keep the costs of such a meeting at a reasonable level. No conclusion was reached on this issue.

The meeting discussed the matter of therapy representation on the Executive Board. It was generally felt that there is a need to make sure that the Executive Board has as wide a representation from the different professions as possible. It would be possible for the Executive Board to appoint consultants if the elected Board did not represent all the major professions.

The President presented the slate of nominations for the Executive Board for the next triennium *(please see report on Executive Board meeting)*. The President explained that the slate conformed with the Constitution in as much that it reflects, as far as possible, the various professional disciplines and interests and the appropriate cultural and geographical distribution of the Society. The slate was discussed by the meeting and it would be sent out to the National Member Societies to seek either agreement or further nominations.

The meeting looked at the proposed amendments to the Constitution and suggested that the Executive Board look at the wording of the proposed amendment 2.5.1 previously published in the Journal with the suggestion that it should be re-worded.

The meeting proved to be a successful event which provided a good forum for exchange of information between the Executive Board and representatives of the International Committee.

Norman A. Jacobs
Honorary Secretary

Prosthetics and Orthotics International, 1994, 18, 12-17

The biomechanics of trans-femoral amputation

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Abstract

The biomechanics of trans-femoral amputations has not been previously described. Little attention has been paid to the importance of adductor magnus in holding the femur in its normal anatomical axis. Loss of function of adductor magnus leads to abduction of the residual femur, in a trans-femoral amputation. A cadaver study of the adductor group of thigh muscles has been done and the biomechanical importance of these muscles is documented. The moment arms of the three adductor muscles have been determined, based on muscle attachments and muscle size, relative to each other. Adductor magnus has a major mechanical advantage in holding the thigh in its normal anatomical position. Loss of the distal third of its attachment results in a 70% loss of the effective moment arm of the muscle, which contributes to the abducted femur in standard trans-femoral amputations. A muscle preserving trans-femoral amputation, which keeps adductor magnus intact, prevents abduction of the residual femur and may allow for easier walking with a prosthesis. The conflicting reports about adductor magnus activity during the gait cycle can be explained by this muscle's dual innervation by the sciatic and obturator nerves and its dual function as a hip adductor and extensor.

Introduction

The introduction of new socket shapes and designs for trans-femoral amputation has led to a resurgence of interest in trans-femoral amputees. Originally it was thought that by changing socket shape and alignment the residual femur of a trans-femoral amputation could be better controlled within the socket and thus improve the patients gait and functional activity (Long, 1985; Sabolich, 1985.) Several publications have documented that patients with trans-femoral amputations have an increased energy expenditure for walking and that the older patient with little or no physical reserve may lose the ability to walk again (Gonzalez *et al.*, 1974; James 1973; Volpicelli *et al.*, 1985; Waters *et al.*, 1976). Long (1985) noted that the trans-femoral amputee wearing a quadrilateral type socket had an abducted residual femur. The development of the normal shape normal alignment type socket was thought to improve the position of the femoral shaft from an abducted position to a more neutral position. Sabolich (1985) developed the concept of an ischial containment socket with a narrow medial lateral configuration in an attempt to bring the femur back towards adduction and improve the patient's gait and activity. No objective results were provided to show that mechanically this was achieved. A subsequent study comparing patients who used quadrilateral sockets and those that used ischial containment sockets showed that socket shape and design was not able to influence or control the position of the femur within the socket itself (Gottschalk *et al.*, 1989[2]). Alignment of the prosthesis did not appear to influence the position of the residual femoral shaft either.

Little consideration has been given to improving the surgical technique and most of

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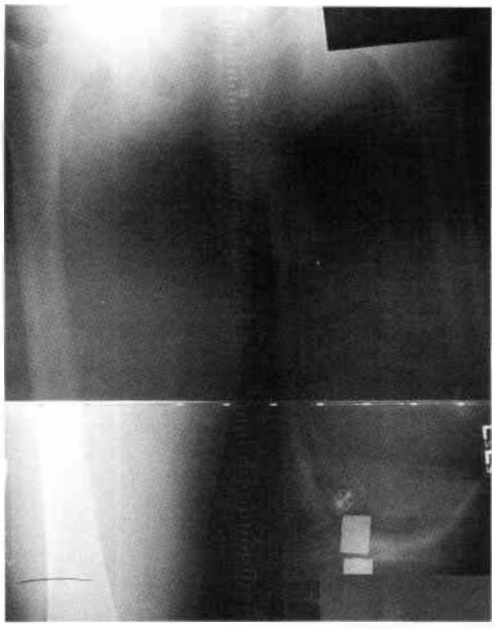

Fig 1. Radiograph of residual femur in prosthetic socket, with femur in abducted position. Increased soft tissue is noted medially.

the surgical literature related to trans-femoral amputations highlights patient function and longevity rather than the surgical technique itself. The standard texts on the technique of trans-femoral amputation make no mention of the adductor muscles and their importance in controlling the position of the femur (Bohne, 1987; Harris, 1981; Burgess, 1989). With a conventional trans-femoral amputation it has been noted that the femur comes to lie in abduction, with a large medial soft tissue mass (Fig. 1). The deviation from the normal mechanical axis of the limb results from the surgery and loss of muscle tissue and muscle attachment as well as the position of the thigh at the time of wound closure (Murdoch *et al.*, 1992).

The paper presents the biomechanics of the adductor muscles of the thigh and the importance of a muscle preserving surgical technique to hold the femur in its normal mechanical alignment.

Materials and methods

A biomechanical model of the adductors of the thigh was developed from the anatomical descriptions in standard texts and cadaver dissections. Four cadavers were dissected and the attachments and volume of each of the adductor muscles was noted. The femur and thigh were divided into thirds to correspond to the attachments of the three major adductor muscles and diagrams based on those used by Brash (1955) were developed to project lines of action of the muscles and the vertical and horizontal resultant forces

A muscle preserving trans-femoral amputation, with myodesis of the adductor magnus and quadriceps has been done on 30 patients. The adductor muscle is preserved intact with its blood and nerve supply and reattached to the distal lateral aspect of the residual femur by a myodesis (Gottschalk, 1992) (Fig. 2). The femur is transected at the appropriate level prior to anchoring of the adductor magnus. At the time of suturing the muscle to the bone, the femur is held in maximum adduction. The quadriceps is also anchored to the femur via anterior and posterior drill holes. Standing radiographs of the residual

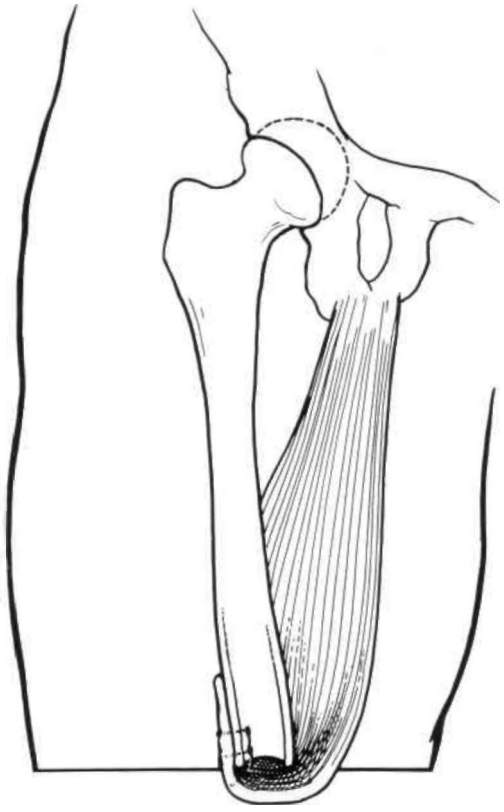

Fig 2. Diagrammatic representation of muscle preserving adductor myodesis for trans-femoral amputation. (Reprinted with permission. Gottschalk, Mosby, 1992.)

femur are taken with and without the socket.

Results

The adductor magnus because of the greater length of its lever arm is best placed to hold the femur in a normal adducted position. Figure 3 shows the normal mechanical and anatomical alignment of the lower limb. The directions of the forces exerted by the adductor muscles are show in Figure 4. The directions of the components of force normal to the lines joining the points of attachment of the muscles and the centre of rotation of the hip joint are also shown. These are the components producing adduction. Adductor magnus is an important adductor because of its bulk and consequent capacity for force development. The cadaver study showed that adductor magnus is three to four times larger in physiological cross-sectional area and volume than the adductor longus and brevis. The point of application of

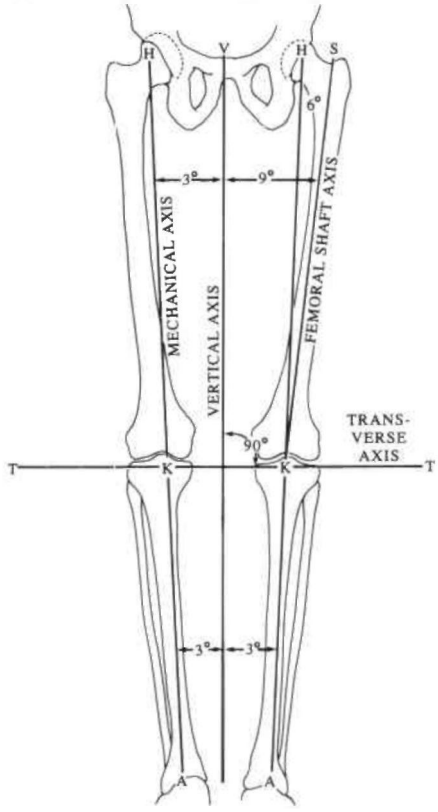

Fig 3. Normal mechanical and anatomical alignment of the lower limb. (Reprinted with permission. Gottschalk *et al.*, J Prosthet Orthot, 1989.)

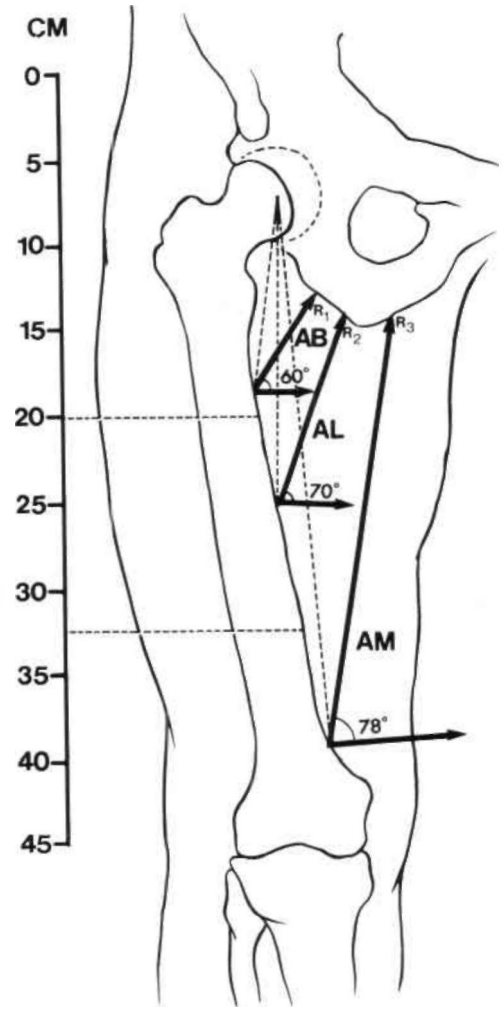

Fig 4. The resultant forces of the adductor group of muscles showing the components producing adduction. The moment arms are depicted by the interrupted line. (AM=adductor magnus, AL=adductor longus, AB=adductor brevis.) (Reprinted with permission. Gottschalk *et al.*, J Prosthet Orthot, 1989.)

the force of the muscles was taken as the middle of the attachment to the femur of each muscle. The unique anatomy of adductor magnus provides the muscle with 2 nerve innervations and 2 separate functions. The most medial portion of adductor magnus makes the greatest contributions to the adduction moment (rotational moment) which is 4 to 5 times that of adductor longus and adductor brevis. Adductor longus and brevis contribute in smaller amounts to normal thigh adduction as noted from the resultant forces. Based on the

Fig 5. Position of the femur after trans-femoral amputation and muscle preserving adductor myodesis.

contribution of each adductor moment, if the distal third of the femur is amputated and an inadequate myodesis of adductor magnus is done, then 70% of the adduction moment is lost. Thus the intact adductor longus and brevis would provide the only mechanism for holding the femur in adduction.

The full surgical procedure has been described in a previous publication (Gottschalk, 1992). The surgical technique to preserve the adductor magnus and re-anchor it adequately to the residual femur by suturing to the lateral distal femur maintains the normal femoral anatomical alignment (Fig. 5). The radiographs show that the anatomical axis and the overall mechanical alignment of the limb can be maintained (Fig. 6). The femur is contained in the middle of the muscle envelope of the thigh, which is a normal adducted position.

Discussion

It is well accepted that the patients with trans-femoral amputations have a higher level of energy expenditure for normal walking, because of loss of the knee joint. One of the contributing factors to abnormal gait in trans-femoral amputees is the mechanical disadvantage of an abducted position of the residual femur, which forces the patient to walk with an increased energy expenditure, despite satisfactory fitting with a prosthesis. Many patients who are good prosthetic users develop pain and discomfort at the distal lateral end of the femur, in the socket, as a direct result of the abducted position. The adductor roll that is commonly noted in trans-femoral amputees is another cause of the patient walking with the leg abducted. The muscle preserving adductor myodesis appears to prevent the formation of an adductor roll, and thereby allow for a more comfortable fitting socket. By applying the biomechanics of the adductor muscles of the thigh and improving the surgical technique to hold the femur in adduction, a patient who may have been a marginal prosthetic user could become a

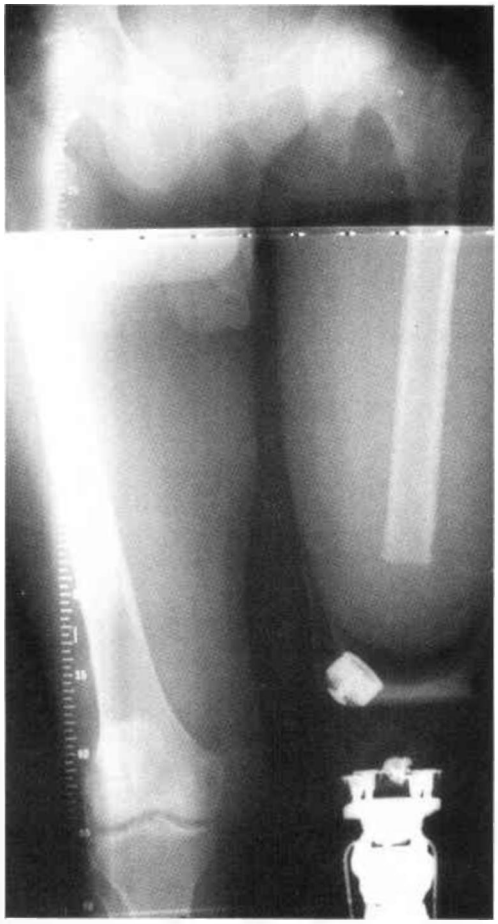

Fig 6. Radiographs of trans-femoral amputation with muscle preserving adductor myodesis in prosthetic socket, with residual femur in normal anatomical alignment.

definitive prosthetic user. James (1973) noted that patients with a standard trans-femoral amputation had decreased muscle strength as a result of reduced muscle mass, inadequate fixation and atrophy of the thigh muscles. This was confirmed in a study on the neurophysiology of muscle function in the stump (Thiele *et al.*, 1973). It is possible to preserve a large amount of the adductor power by preserving muscle bulk and attaching the distal end of the muscle to the distal end of the residual femur, with the stump held in an over corrected position. This helps maintain the length and tension of the muscle and keeps enough muscle power to overcome the shorter horizontal moment arm. In addition, the femur is no longer in an abducted position and this allows the abductor mechanism to function normally.

The hip abductor mechanism remains intact at the time of a trans-femoral amputation. Gluteus medius, minimus and parts of maximus are abductors of the hip. However tensor fasciae latae plays the most important role in hip abduction during the stance phase of gait (Gottschalk *et al.*, 1989[1]). Although the very distal attachment of tensor fasciae latae is lost in a trans-femoral amputation, the muscle can still function as a thigh abductor because of its indirect attachment from the fascia lata to the linea aspera via the lateral intermuscular septum. However, at the time of surgery the tensor fasciae latae should be sutured to the medial fascia of the thigh to provide additional stabilisation. Failure to re-anchor the tensor fasciae latae may contribute to some weakness of the hip abductor mechanism. Interference with the action of adductor magnus leads to an imbalance of the mostly intact abductor mechanism with subsequent abduction of the femur. Keeping adductor magnus intact and adequately re-anchoring it to the residual femur will maintain the balance between the hip abductors and adductors. It is not possible to hold the residual femur adducted with a prosthetic socket irrespective of its shape or design, as has previously been reported (Gottschalk *et al.*, 1989[2]), since the femur cannot be displaced in its soft tissue envelope.

Electromyographic studies of adductor magnus provide conflicting information. Review of the literature reveals that most likely the muscle is active at the beginning of stance phase and again at the end of stance and into early swing phase (Green and Morris, 1970; Inman *et al.*, 1981). Because of the muscle's dual innervation by the sciatic and obturator nerves, most likely different parts of the muscle are active at different times during the gait cycle. Inman et al., (1981) note that adductor magnus is active only at the beginning and termination of swing phase. Green and Morris (1970) describe activity of adductor magnus and lognus and noted that activity occurred in stance phase. The disparity in the results is most likely due to the dual innervation of adductor magnus and its dual function of hip extensor and thigh adductor.

In a distal third femur amputation the tendon of the adductor magnus should be preserved and swung around the distal end of the femur and anchored by drill holes to the lateral femur, with the femur maximally adducted. This preserves maximum muscle force by having an intact adductor system, and provides a mechanical advantage for the adductors and abductors of the thigh. In a middle third amputation, instead of transecting adductor magnus, it should be detached from the bone and swung around the distal end of the adducted femur. The myodesis can then be performed and redundant tissue excised.

Those patients who have had the amputation as described above have the residual femur in a normal, or near normal anatomical alignment. (Fig. 6). The position of the femur is not influenced by a prosthetic socket. In a standard trans-femoral amputation the position of the femur may vary from 6° of adduction to 14° of abduction irrespective of the type of prosthetic socket that is used (Gottschalk *et al.*, 1989[2]). The normal anatomical position of the femur is 7-10° of adduction. The mechanical axis of the lower limb is a line from the centre of the hip through the middle of the knee and ankle. This was first described by Duchenne in 1867 (Duchenne, 1949) and has been well established in orthopaedic surgery, especially total knee replacement (Freeman, 1980; Hungerford *et al.*, 1984; Maquet, 1980). Thus, a trans-femoral amputation which maintains the anatomical alignment of the residual femur will have a mechanical alignment when a prosthesis is fitted similar to that of a normal intact limb. The combination of a normal mechanical alignment and maintenance of the muscle moment arm should improve the patient's ability to walk.

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Functional outcome of rehabilitated bilateral lower limb amputees

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Abstract

The functional outcome of rehabilitated bilateral lower limb amputees was studied. The study included 31 amputees who were admitted during 1980–1990 to a rehabilitation centre in the north of the Netherlands. The clinical notes made during the patients' admission were studied to obtain information about their characteristics, while mobility and prosthetic use were studied at discharge. The patients who were alive and willing to participate in the study were interviewed by a physician at their residence in November 1992, using among other things, the Sickness Impact Profile (SIP) and the Life Satisfaction questionnaire.

Some 25 of the 31 patients were amputated for vascular reasons, 1 patient primarily for traumatic reasons and secondarily for vascular reasons, 5 patients for traumatic reasons. Eight patients had a bilateral trans-femoral amputation, 18 patients a bilateral trans-tibial amputation, 2 patients a combination of trans-tibial and knee-disarticulation amputation, 3 patients a trans-femoral/trans-tibial amputation.

Mean age at second amputation was 66.3 years. Of the 31 amputees 21 were men and 10 women, 25 amputees were prosthetically rehabilitated during admission, 3 of them died during admission and 5 did not achieve mobility at discharge. In their activities of daily life 22 of the 28 patients alive at discharge were almost independent.

At the time of the follow-up evaluation 17 of the 31 patients had died. For several reasons only 8 patients could be included in the follow-up, 6 vascular amputees and 2 traumatic amputees. Six of the 8 patients were prosthetically rehabilitated at discharge, but only 2 of them used their prosthesis at the time of follow-up, 1 vascular and 1 traumatic amputee. The SIP showed high levels of impairment for ambulation, mobility, body care/movement, work and home management. In the Life Satisfaction questionnaire all patients reported to be rather satisfied to very satisfied with life.

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Introduction

The rehabilitation of bilateral lower limb amputees is generally more intensive than that of unilateral amputees and poses a great challenge to both the rehabilitation team and the amputees themselves.

The major cause of bilateral amputation of the lower limb is an obstructive arterial disease. Other causes mentioned in the literature are trauma, infections, tumours and frostbite (Evans *et al.*, 1987; Kerstein *et al.*, 1975; McCollough *et al.*, 1972).

The clinical situation of the amputee is often complicated by associated problems due to arteriosclerosis, such as hypertension, coronary heart disease and stroke. Diabetes mellitus often contributes to the amputation and may also cause other diseases, such as kidney failure and poor vision, which determine the functional level after amputation (Kerstein *et al.*, 1975; Volpicelli *et al.*, 1983).

Since the 1960s, the amputation has been performed at more distal levels for several

reasons. At the moment, 20 to 40% of the bilateral amputees have two trans-tibial amputations, while 25 to 35% have a combined trans-tibial/trans-femoral amputation (Sakuma *et al.*, 1974; Couch *et al.*, 1977; Hunter and Holliday, 1978; Evans *et al.*, 1987; Datta *et al.*, 1992).

After intensive inpatient physiotherapy the success rate in using the prosthesis is 60-90% for trans-tibial amputees (McCollough *et al.*, 1972; Sakuma *et al.*, 1974; Couch *et al.*, 1977; Hunter and Holliday, 1978; Thornhill *et al.*, 1986; Volpicelli *et al.*, 1983; Brodzka *et al.*, 1990; Datta *et al.*, 1992). For trans-femoral amputees the percentage of success is much lower: 0-40% (Sakuma *et al.*, 1974; Couch *et al.*, 1977; Hunter *et al.*, 1978; Volpicelli *et al.*, 1983; Datta *et al.*, 1992).

Some amputees use their prosthesis only occasionally, for cosmetic reasons (Brodzka *et al.*, 1990; Wolf *et al.*, 1989). The success rate of knee disarticulation amputees is unknown. Bilateral hip disarticulation is rare. Some young amputees with bilateral hip disarticulation learn to walk with prostheses (Brown, 1970).

Most amputees, especially the bilateral trans-femoral amputees, walk with crutches or canes (Brown, 1970; Hunter and Holliday, 1978; Sakuma *et al.*, 1974).

The clinical material presented in this study was derived from *Beatrixoord* a rehabilitation hospital in Haren in the north of the Netherlands. This hospital is a sub-regional referral centre for rehabilitation, covering a population of approximately 1.3 million people.

Bilateral lower limb amputees who were admitted in the period 1980-1990 were included in the study.

The clinical notes made during the patients' admission were studied to obtain information about their characteristics, while their mobility and prosthetic use were studied at discharge. The patients who were alive and willing to participate in the study were visited by a physician at their place of residence in November 1992.

A literature search failed to yield an acceptable questionnaire for the impairments, disability and handicaps. The authors therefore compiled a comprehensive questionnaire including a self-constructed questionnaire, the Sickness Impact Profile (SIP) and the Life Satisfaction questionnaire. The self-constructed questionnaire measured the disabilities and has been tested for reliability. The SIP is a behaviourally-based measure of health status containing 136 statements about health-related dysfunction in 12 areas of activity. The score on each area of activity is between zero (no impact) and one hundred percent (maximal impact). The reasons to use the SIP are its validity and reliability and the possibility of comparison with other patients. The Life Satisfaction questionnaire is a "Quality of Life" measure. This questionnaire, used by Viitanen *et al.* (1988) in stroke patients is simple to use. Patients are asked to rate life satisfaction on one global and six specific areas. using the response categories *1: very dissatisfied, 2: dissatisfied, 3: rather dissatisfied, 4: rather satisfied, 5: satisfied, 6: very satisfied.* The Life Satisfaction questionnaire has been validated. The compiled questionnaire was administered by one interviewer.

Results

Retrospective study

The study included 31 patients, 21 men (67.7%) and 10 women (32.3%). The characteristics of the patients are summarised in Table 1.

The average age at the second amputation was 66.3 years (women 60.5 and men 69.0 years) with a range of 22-96 years. The average age of the 26 patients with a vascular disease was 72.1. The average age of the 5 patients with a traumatic amputation was 33.8. One patient had a combined vascular and traumatic amputation at the age of 84. He was included in the vascular group.

Of the 31 patients, 8 patients (25.8%) had a bilateral trans-femoral (TF/TF) amputation, while 18 patients (58.1%) had a bilateral trans-tibial (TT/TT) amputation, 2 patients had a combination of trans-tibial and knee-disarticulation amputation, while 3 patients had a TF/TT amputation.

Of the 31 patients 25 (80.6%) were prosthetically rehabilitated during their hospital stay. Three of them died during their stay. For several reasons, such as stroke and depression during admission, 5 patients did not achieve mobility at discharge. All 6 patients without prostheses attained functional independence at wheelchair level though 2 of them used the prosthesis for cosmetic reasons.

Table 1: Characteristics of the amputee (n=31)

age at amputation of second limb (Yr)	mean range	66.3 22-96
sex	male female	21 10
level of amputation	trans-femoral/trans-femoral trans-tibial/trans-tibial trans-tibial/knee disarticulation trans-femoral/trans-tibial	8 18 2 3
aetiology	peripheral vascular disease (with diabetes mellitus) peripheral vascular disease and trauma trauma	25 (13) 1 5

Of the 17 patients who had been prosthetically rehabilitated at discharge, 16 required additional upper limb gait aids. There was one bilateral trans-tibial amputee who could walk without any assistive devices.

In their activities of daily life (ADL) 22 of the 28 patients alive at discharge became almost independent, while 6 remained dependent.

The mean rehabilitation period in the clinic was 8.9 months, with a range of 1-25 months.

Follow-up

The average period between discharge from the centre and follow-up was 3.8 years (range 0.5-8.5 years).

At the time of evaluation in November 1992, 17 of the 31 patients (54.8%) had died, 4 had moved to a different address and 2 patients were too ill to be interviewed. so 8 patients were included. The characteristics of these patients are summarised in Table 2. This group included 6 vascular and 2 traumatic amputees, 5 men and 3 women. The average age at the second amputation was 61.4 years (range 22-83 years). the amputation levels were one TF/TF and 7 TT/TT. Of the 8 patients 6 were prosthetically rehabilitated and were able to walk with assistive devices at discharge. The patients without prostheses became mobile with a wheelchair.

Table 2: Characteristics of the patients at follow-up (n=8)

age at amputation of second limb (Yr)	mean range	61.4 22-83
sex	male female	5 3
level of amputation	trans-femoral/trans-femoral trans-tibial/trans-tibial	1 7
aetiology	peripheral vascular disease trauma	6 2

Table 3: Mobility and prosthetic use of the 2 prosthesis users at follow-up

	traumatic amputee	vascular amputee
maximum period of standing	5-15 min	< 5 min
to sit and to rise from a chair	possible but difficult	possible but difficult
walking distance	500-2000 m	< 50 m
stump pain during walking	once a day	never
climb and descend stairs with handrail	possible but difficult	not possible
falling	never	sometimes
bicycling	not possible	not possible
gait aid	always	always
mean period of wearing	> 5 hours a day	a whole day
donning and doffing	possible without help	possible without help

At the time of the interview 5 lived in their own home with their spouses, one lived alone, one lived in a private residents home and one in a nursing home.

After discharge 3 of the 6 prosthesis users became non-users. Three years after the initial discharge and after several further admissions one patient still had not been fitted with adequate prostheses, and she was not using prostheses at the time of the interview.

The 2 prostheses users, one traumatic and one vascular amputee, were men with a TT/TT amputation. Their ambulation and mobility with the prostheses is shown in Table 3. The scores of the SIP (means and ranges) are presented for the vascular amputees and the traumatic amputees in Table 4. Table 5 also presents data on the SIP, for the purpose of comparison with other patient groups. Examining the means for the individual category scores high levels of impairments for work and home management can be seen. As was to be expected, relatively high levels of impairment were scored in ambulation, mobility and body care/movement. The high level of impairments in work and home management, combined with sleep/rest, recreation/pastime and eating makes the independent dimension the highest of the 3 dimensions. Low levels of impairments were reported in alertness, behaviour and eating. Relatively low levels of impairment were reported in social interaction, emotional behaviour and communication.

The scores of the Life Satisfaction questionnaire (mean and ranges) are presented in Table 6. Almost all patients reported to be rather satisfied to very satisfied with life.

Discussion

The average age of all or patients at the time of the second amputation was 66.3 years. The average age at the time of the second amputation for the vascular amputees was 72.1. Both were comparable with that in similar studies (Volpicelli *et al.*, 1983; O'Toole *et al.*, 1985; Steinberg *et al.*, 1985; Thornhill *et al.*, 1986; Datta *et al.*, 1992).

As in most other surveys a predominance of men (67.7%) were among the patients. Of the prosthetically rehabilitated vascular amputees (n=6) interviewed after discharge, only one was still walking with prostheses. The percentage prosthetically rehabilitated patients dropped from 83% to 17%. This is comparable with the results of Wolf (1989) but significantly lower than those of others, who reported success rates of 83.3% (Hunter and Holliday, 1978), 71.0% (Volpicelli *et al.*, 1983) and 56.7% (Datta *et al.*, 1992). However, the populations in these studies included more traumatic amputees. The mean inpatient rehabilitation time was 8.9 months, which is much longer than in the study

Table 4: SICKNESS IMPACT PROFILE of the patients at follow-up (n=8)

		vascular bilateral amputees n=6		traumatic bilateral amputees n=2	
Dimension	Category	Mean	Range	Mean	Range
Independent	Sleep and rest	24	22-34	5	0-10
	Eating	9	0-31	0	0
	Work	70	0	9	0-18
	Home management	50	31-54	3	0-7
	Recreation and pastime	23	0-50	24	0-47
total		35	26-45	8	0-16
Physical	Ambulation	33	0-66	9	0-17
	Mobility	32	13-40	24	13-34
	Body care/movement	19	8-49	11	10-11
total		25	15-51	13	12-14
Psychosocial	Social interaction	14	0-41	6	0-11
	Alertness behaviour	5	0-27	0	0
	Emotional behaviour	15	0-40	6	0-11
	Communication	16	0-86	0	0
total		13	4-40	3	0-7
SIP total		23	14-45	8	5-11

Table 5: Comparison of the SICKNESS IMPACT PROFILE of bilateral amputees with other patient groups

Dimension	Category	Mean (S.D.) score for patients with vasc. bilat. amp (N=6)	Mean (S.D.) score for patients with CLBP (*) (N=107)	Mean (S.D.) score for patients with RA (**) (N=79)	Mean (S.D.) score for patients with a stroke (***) (N=111)	Mean (S.D.) score for controls >65 yrs (***) (N=232)
Independent	Sleep and Rest	24.3 (4.7)	28.4 (17.7)	17.6 (14.9)	17.6 (17.7)	7.5 (11.6)
	Eating	8.9 (11.5)	2.7 (4.5)	3.5 (5.5)	6.7 (10.4)	1.4 (3.8)
	Work	70.1 (0)	57.6 (24.7)	46.5 (31.4)	—	—
	Home Management	49.7 (20.1)	33.7 (18.9)	26.3 (21.0)	43.4 (27.1)	15.3 (20.4)
	Recreation and Pastime	22.6 (21.8)	35.9 (19.3)	26.7 (19.3)	38.6 (25.2)	8.9 (18.5)
total		35.1 (8.8)	30.2 (11.4)	22.8 (****)	—	—
Physical	Ambulation	32.8 (21.0)	20.5 (13.2)	21.0 (13.8)	22.9 (17.6)	8.0 (12.6)
	Mobility	32.3 (10.6)	20.2 (16.4)	10.4 (12.1)	26.0 (20.5)	10.5 (15.2)
	Bodycare/ Movement	19.4 (15.3)	15.8 (11.6)	12.7 (10.1)	19.9 (21.1)	5.4 (10.9)
total		25.2 (13.0)	17.7 (11.3)	14.0 (10.0)	21.8 (18.3)	7.0 (10.8)
Psychosocial	Social Interaction	14.4 (15.3)	31.0 (23.5)	11.7 (11.6)	12.0 (11.4)	4.4 (8.8)
	Alertness Behaviour	4.5 (11.1)	24.2 (28.2)	13.0 (17.8)	16.5 (24.7)	8.7 (16.3)
	Emotional Behaviour	15.0 (14.9)	30.6 (24.8)	13.2 (12.9)	11.6 (16.7)	3.1 (9.5)
	Communication	15.9 (34.5)	8.6 (15.5)	6.9 (8.5)	14.3 (19.4)	4.6 (10.0)
total		12.8 (14.2)	24.7 (18.8)	11.3 (9.6)	13.4 (12.6)	5.1 (7.8)
total SIP		23.3 (11.6)	23.8 (11.7)	15.6 (9.0)	20.1 (12.6)	6.8 (7.7)

* Follick *et al.* (1985)
** Deyo (1986)
*** Schuling *et al.* (1993)
**** Estimate derived from category scores.

by Datta *et al.* (1992). The literature gives an average period of rehabilitation between 12 and 30 weeks (Kerstein *et al.*, 1975; Sakuma *et al.* 1974; Van de Ven, 1981).

The mean Sickness Impact Profile scores of the bilateral lower limb amputees demonstrates that the consequences of amputation affect almost all aspects of daily life. The high level of impairments in work was to be expected, because patients had already retired, because of disability or old age. The relatively high level of impairment in home management is comparable with that of stroke patients (Schuling *et al.*, 1993) but much higher than that of patients with

Table 6: LIFE SATISFACTION of the amputees at follow-up (n=8)

	vascular amputees (N=6)		traumatic amputees (N=2)	
	Mean	Range	Mean	Range
Life in general	5	4-6	5	4-5
selfcare activities of daily living	5	4-6	6	–
leisure	5	4-6	5	4-5
togetherness with friends	5	3-6	6	5-6
togetherness with family	5	4-6	5	4-5
marriage	6	4-6	4	1-6
sexuality	5	4-6	3	1-5

1 = very dissatisfied
2 = dissatisfied
3 = rather dissatisfied
4 = rather satisfied
5 = satisfied
6 = very satisfied

rheumatoid arthritis or chronic low back pain (CLBP) (see Table 5). The individual scores on the physical dimension were high compared to those for rheumatoid arthritis and CLBP patients. In contrast to stroke, rheumatoid arthritis and CLBP patients, bilateral amputees showed fewer impairments in the recreation and pastime categories. The mean score on the psychosocial dimension is comparable to that of the rheumatoid arthritis and stroke patients. The mean score of the total SIP is comparable to that of CLBP and stroke patients.

In the "quality of life" measure patients were found to be rather satisfied to very satisfied with life. The social service system, which for example, enables home adjustments, as well as good family circumstances and the absence of cognitive disabilities were probably reasons which contributed to this result.

A lot of questions remained unanswered.

Further studies at different stages of rehabilitation and subsequent supportive care will be needed to shed more light on the functional outcome of bilateral lower limb amputees.

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Upper limb prosthetic use in Slovenia

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Abstract

The article deals with the use of different types of upper limb prostheses in Slovenia.

Four hundred and fourteen upper limb amputees were sent a questionnaire on the type of their prosthesis, its use and reasons for non-use, respectively. The replies were subject to statistical analysis.

Most of the questioned upper limb amputees (70%) wear a prosthesis only for cosmesis. The use of a prosthesis depends on the level of upper limb amputation, loss of the dominant hand, and time from amputation. Prosthetic success appears to be unrelated to age at the time of amputation and the rehabilitation programme.

The most frequent reason for not wearing a prosthesis is heat and consequent sweating of the stump.

More than a third of amputees are dissatisfied with their prostheses.

Introduction

Even though upper limb prostheses were known already in ancient Egypt, they have never succeeded to completely substitute the three functions of the human hand – motor, sensibility and expressive functions. As an extension of the stump, a prosthesis should improve, not impede, its function. It should be even the best prosthesis is only a poor substitute.

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used in the way the non-dominant hand is normally used (Hermansson, 1991). However,

As reported by various authors, an upper limb amputee accepts and uses the prosthesis if it is comfortable, functional and has a pleasing appearance. Acceptance and successful use also depend on the quality of the stump, amputation level, level of education and employment status of the user, time from amputation to fitting a first prosthesis, use of a temporary prosthesis, training in use, and patient's motivation (Millstein *et al.*, 1986; Roeschlein and Domholdt 1989). Opinions on the importance of manual dexterity and loss of the dominant hand, respectively, differ considerably. Patients of the same age and with the same amputation level, who after completed rehabilitation and training achieved the same degree of independence, may use the prosthesis throughout the whole day or be reluctant to wear it.

According to different reports, upper limb prosthesis are used with different levels of success (Fletcher, 1970; Herberts *et al.*, 1980; Stein and Walley, 1983; Heger *et al.*, 1985; Vitali *et al.*, 1986; Stürup *et al.*, 1988; Roeschlein and Dumholdt, 1989).

According to Atkins (1989), a high rejection rate of upper limb prostheses can be attributed to development of one-handedness, insufficient training in use, poor comfort, poor construction, and the reactions of other people.

Purpose

The objective of this study is to determine the use and reasons for non-use of different types of upper limb prosthesis in Slovenia. The study also considered how amputees and their environment react to their prostheses.

Methods of work

The dispensary files of all persons who visited the Orthotic and Prosthetic Outpatient clinic at the University Rehabilitation Institute Ljubljana between 1 January, 1988 and 31 December, 1992 were surveyed. Upper limb amputees with a permanent residence in Slovenia were selected. They were sent a questionnaire on the extent to which they actually used their prostheses.

The responses were statistically analysed by the SPSS program *(Statistical Package for Social Sciences)*. Data were analysed by frequency distribution, Chi-square test, variance analysis test, and Student's t-test.

Respondents

In the last five years (1 January, 1988–31 December, 1992), 414 upper limb amputees were examined in the Prosthetic and Orthotic Outpatient clinic of the University Rehabilitation Institute Ljubljana. Some came for an examination only once, whereas others came several times.

Some 295 responses (71.3%) were received. Of these, 266 (90.2%, representing 64.3% of the questionnaires sent) were filled in, and 29 were left blank (deceased, unknown, departed, etc.). Not everybody answered all questions. All the questions which were answered in these 266 responses were analysed.

At the time of amputation, the persons concerned were fairly young, aged 20.0 years on the average (SD 14.1 years). As many as 238 (of the 266 responses) or 89.5% of the amputations resulted from accidents (127 or 47.7% were war injuries).

More than half (163 or 61.3% of 266) had trans-radial amputations, 54 or 20.3% had trans-humeral amputations and 34 (12.8%) had partial hand amputations; disarticulations in joints were rare (3 or 1.1% had disarticulation at the shoulder, 2 or 0.8% at the elbow, and 10 or 3.7% at the wrist.

Some 245 persons answered the question about handedness before amputation, 132 (53.9%) lost the dominant hand, 85 (34.7%) the non-dominant hand. Twenty-three (9.4%) had a congenital deficiency of the upper limb and in 5 (2%) bilateral amputation had been performed at the same level.

Results and discussion

The response rate to the questionnaire was within normal values.

As many as 63.5% (169) of responding upper

Table 1: Use of cosmetic and functional prostheses in daily work and statistically significant differences (p) obtained by Chi-square test.

Prosthetic use	Type of prosthesis				Total		
	Cosmetic		Functional				
	no	yes	no	yes	no	yes	p
Getting dressed	96	43	55	44	151 63.4%	87 36.6%	**
Personal hygiene	114	25	71	28	185 77.7%	53 22.3%	*
Eating	108	31	67	32	175 73.5%	63 26.5%	
Housekeeping	94	44	55	36	149 65.1%	80 34.9%	
Job	43	52	26	36	69 43.9%	88 56.1%	
Smaller domestic repairs	87	52	36	62	123 51.9%	114 48.1%	****
Peasant labour	99	26	52	44	151 68.3%	70 31.7%	****
Car driving	62	43	35	50	97 51.1%	93 48.9%	**
Recreation	95	33	65	26	160 73.1%	59 26.9%	
In social setting	33	106	23	76	56 23.5%	182 76.5%	

*p<0.1, **p<0.05, ****p<0.001

Table 2: Influence of time since amputation to the first prosthetic fitting prosthetic use – statistical significance p = 0.5.

Prosthetic use (hrs/day)	First prosthetic fitting					
	< = 1 year		> 1 year		Total	
	no	%	no	%	no	%
1-6	11	21.6	14	28.0	25	24.8
7-12	19	37.3	8	16.0	27	26.7
> = 13	21	41.2	28	56.0	49	48.5
Total	51	50.5	50	49.5	101	100.0

limb amputees in Slovenia had a cosmetic prosthesis and no less than 69.5% (185) possess one single prosthesis. Considering body-powered prostheses, twice as many individuals had a prosthesis with a hand compared to those with a hook. Only 6 patients were provided with a myoelectric prosthesis.

Prosthetic use

In Slovenia, upper limb amputees wear a cosmetic prosthesis for about 10.2 hours and a functional (body powered or myoelectric) prosthesis for about 11.8 hours a day (no significant difference). This is a greater usage than reported by Millstein *et al.* (1986), according to whom amputees use a prosthesis with a cable operated hook about 8 hours a day, one with a cable operated hand 5 hours a day and a cosmetic prostheses 4 hours a day. However, what that author had in mind was use, whereas in this study the question was of wearing. Upper limb amputees in Slovenia make more extensive use of functional prostheses at housekeeping and farm work ($p<0.001$), at getting dressed and driving a car ($p<0.5$), and in personal hygiene ($p<0.1$) (Table 1). In other activities, prosthetic use is unaffected by the type of prosthesis.

The number of hours per day and the type of occupation in which a person uses a prosthesis depend on the following:

1. time from amputation to the first fitting of the prosthesis (Table 2)
2. amputation level (Tables 3 and 4)
3. age at amputation (Table 5)
4. present age (Table 6)
5. loss of the dominant hand (Table 7).

The time of daily prosthetic use is not related to:

1. the type of prosthesis
2. the evaluation of the rehabilitation programme.

Time from amputation to the first fitting of the prosthesis

The relation between the time after the amputation and the number of hours of prosthetic use per day is completely non-linear (it was established neither by correlation coefficient nor variance analysis test, but only by (Chi-square test). A most relevant point to be considered is whether the patient got his first prosthesis during the first year after the amputation or not (Table 2).

The answers also displayed that at work, all prostheses are more readily used by persons who got them soon after amputation ($p<0.1$), while in a social setting they are more readily used by those who got them later ($p<0.1$). Persons, provided with a functional prosthesis soon after the amputation, more often use it in attending to housekeeping ($p<0.1$), at work ($p<0.01$), and performing simple repairs at home and at peasant labour ($p<0.05$).

These findings correspond with the statements by Robinson *et al.* (1975), Jacobs and Brady (1975), and Bailey (1970) that one of the first reasons underlying unsuccessful prosthetic use is delayed post-surgical fitting in upper limb amputation. After the amputation, amputees quickly learn to compensate for their loss by using the other upper limb. This compensation is often so efficient that the patient finds the prosthesis encumbering and is reluctant to accept it.

Table 3: Amputees with partial hand amputation use their prostheses (all) significantly less than others.

Amputation level	Prosthetic use (hours/day)
Trans-humeral	10.5
Trans-radial	10.7
Partial hand	5.9
F value = 4.1	$p < 0.05$

Table 4: Influence of amputation level on prosthetic use and statistically significant differences (p) obtained by Chi-square test.

Prosthetic use	Amputation level						Total		
	T-H		T-R		hand				
	no	yes	no	yes	no	yes	no	yes	p
Getting dressed	41	13	96	72	24	2	161	87	****
							64.9%	53.1%	
Personal hygiene	51	3	120	48	24	2	195	53	****
							78.6%	21.4%	
Eating	49	5	114	54	22	4	185	63	***
							74.6%	25.4%	
Housekeeping	43	9	96	65	20	6	159	80	***
							66.5%	33.5%	
Job	13	19	50	64	16	5	79	88	**
							47.3%	52.7%	
Smaller domestic repairs	31	23	84	83	18	8	133	114	
							53.8%	46.2%	
Peasant labour	40	12	104	52	17	6	161	70	
							69.7%	30.3%	
Car driving	23	22	70	67	14	3	107	93	*
							53.5%	46.5%	
Recreation	47	5	103	49	20	5	170	59	***
							74.2%	25.8%	
In social setting	15	39	33	135	18	8	66	182	****
							26.6%	73.4%	

*p<0.1, **p<0.05, *** p<0.01, ****p<0.001

T-H-trans-humeral, T-R-trans-radial amputation.

Amputation level

Persons with a partial amputation of the hand wear the prosthesis the lowest number of hours, while there is no difference in daily wearing of prosthesis between trans-radial and trans-humeral amputees (p<0.05) (Table 3).

The level of amputation does not affect prosthetic use at work, in performing simpler home repairs and in peasant labour (Table 4). These occupations seem to be of greatest importance to those persons who are most keen to attend to them. In all other activities, persons with a trans-radial amputation wear their prosthesis more than others. The reason may be that the prostheses hampered others, which many put down as a remark or stated as a reason for their non-use. This corresponds with the conclusions by Millstein *et al.* (1986) that trans-radial amputees alone use functional prostheses in daily activities, whereas the others find prostheses useless in attending to daily activities. As reported by Stürup *et al.* (1988), higher level amputees do not use body powered prostheses, while Roeschlein and Domholdt (1989) claims that the loss of the elbow is of no consequence to successful prosthetic use.

Age at amputation

Functional prostheses are used for slightly longer periods of time by persons who were young at the time of amputation (r = 0.26, p<0.05), and cosmetic prostheses by persons now older (r = 0.30, p=0.001).

Persons using the prosthesis in getting dressed and eating (p<0.05) and in a social setting (p<0.01) were at amputation

Table 5: Influence of age at amputation on prosthetic use obtained by variance analysis test and F values.

Function	Use	Age at amputation (years)	F value and p
Getting dressed	yes	17.7	
	no	21.0	3.04**
Eating	yes	17.0	
	no	20.8	3.4**
Social setting	yes	18.3	
	no	24.1	8.16***

**p<0.05, ***p<0.01

Table 6: Influence of present age on prosthetic use obtained by variance analysis test and F values.

Function	Use	Present age (years)	F value and p
Job	yes	45.0	
	no	50.4	4.74**
Peasant	yes	54.8	
	no	51.2	2.75***

**p<0.05, ***p<0.01

characteristically younger than those who do not use their prosthesis in the above-mentioned activities (Table 5). As for attending to other tasks, no significant differences in age at the time of amputation were observed with regard to successful or unsuccessful prosthetic use.

Present age

The current age of amputees has even less influence upon prosthetic use. It is worth noting that persons using a prosthesis at work are now a little younger (p<0.05) than persons who do not, while those using it at peasant work are slightly older (Table 6).

Loss of dominant hand

All prostheses (p<0.05), particularly functional (p<0.01), are worn mostly by amputees who have lost the non-dominant hand and least by bilateral upper limb amputees. The loss of the dominant hand is not significantly related to the time of wearing cosmetic prostheses.

The loss of the dominant hand has the most significant impact upon the use of the prosthesis at eating, work, and recreation, where the prosthesis is most used by bilateral and congenital amputees and more often by non-dominant than dominant hand amputees (Table 7).

The above conclusions are contrary to those drawn by Stürup *et al.* (1988), according to whom a prosthesis is more widely used by persons who sustained the loss of the dominant hand. Likewise, they do not agree with the statement by Roeschlein and Domholdt (1989) that the loss of the dominant hand exerts no influence upon successful use of a body powered prosthesis.

Most of the respondents failed to indicate at which occupations and recreational activities,

Table 7: Influence of loss of dominant hand on prosthetic use and statistically significant differences (p) obtained by Chi-square test.

Prosthetic use	Amputated side						Total		
	Dominant		Non-dominant		Both/congen.				
	no	yes	no	yes	no	yes	no	yes	p
Getting dressed	84	40	45	34	16	9	145	83	
							63.6%	36.4%	
Personal hygiene	102	22	59	20	18	7	179	49	
							78.5%	21.5%	
Eating	105	19	51	28	13	12	169	59	****
							74.1%	25.9%	
Housekeeping	84	37	50	25	12	11	146	73	
							66.7%	33.3%	
Job	45	35	20	35	7	12	72	82	**
							46.8%	53.2%	
Smaller domestic repairs	69	55	40	39	10	14	119	108	
							52.4%	47.6%	
Peasant labour	87	33	47	28	12	4	146	65	
							69.2%	30.8%	
Car driving	56	49	31	33	10	2	97	84	
							53.6%	46.4%	
Recreation	90	25	51	19	13	12	154	56	**
							73.3%	26.7%	
In social setting	39	85	13	66	6	19	58	170	*
							25.4%	74.6%	

*p<0.1, **p<0.05, ****p<0.001

Table 8: Reasons for non-use of cosmetic and functional prostheses; statistically significant differences (p), obtained by Chi-square test.

Reasons for non-use	Type of prosthesis				Total		p
	Cosmetic		Functional				
	no	yes	no	yes	no	yes	
Damage possibility	120	22	86	15	206 84.8%	37 15.2%	
Weight	120	22	84	17	204 84.0%	39 16.0%	
Heat, sweating	81	61	51	50	132 54.3%	111 45.7%	***
Loss of sensation	113	29	88	13	201 82.7%	42 17.3%	*
Mood	116	26	88	13	204 84.0%	0 16.0%	
Other	104	38	81	20	185 76.1%	58 23.9%	

*p<0.1, ***p<0.01

respectively, they used the prosthesis. Those who answered the question stated that they habitually made extensive use of functional prostheses for peasant work. More than a third of them use functional prostheses for all sorts of peasant labour. In recreational activities, preference is given to the use, or rather, wearing of cosmetic prostheses. From the point of view of different branches of sport (walking, jogging, cycling, skiing, football, gymnastics, bowling), prostheses are mostly irrelevant to function. The respondents most frequently used both types of prostheses at cycling. Sports such as referred to by Millstein *et al.* (1986) differ from those favoured in other countries where certain branches of sport enjoy greater popularity than others.

The type of prosthesis

The fact that the type of prosthesis is not related to successful prosthetic use proves that in answering the question the respondents were not really referring to the number of hours per day during which they used the prosthesis but rather to how long they wore it. Thus, there seems no point in dividing persons into active, i.e. successful prosthetic users, and partially active and passive users, as proposed by Kejlaa (1992) and Roeschlein and Domholdt (1989).

Table 9: Influence of amputation level on reasons for non-use of prostheses and significant differences (p), obtained by Chi-square test.

Reasons for non-use	Amputated level						Total		p
	T-H		T-R		hand				
	no	yes	no	yes	no	yes	no	yes	
Damage possibility	48	9	144	26	24	2	216 85.4%	37 14.6%	
Weight	44	13	145	25	23	3	212 83.8%	41 16.2%	
Heat, sweating	22	35	101	69	19	7	142 56.1%	111 43.9%	***
Loss of sensation	51	6	139	31	18	8	208 82.2%	45 17.8	*
Mood	45	12	147	23	22	4	214 84.6%	39 15.4%	
Other	45	12	128	42	22	4	195 77.1%	58 22.9%	

*p<0.1, ***p<0.01
T-H-trans-humeral, T-R-trans-radial.

Table 10: Influence of present age on non-use of the prosthesis due to heat and sweating obtained by variance analysis test.

	Present age (years)
use	47.4
non-use	53.9
	F value = 10.15 p < 0.01

Table 11: Influence of age at amputation on non-use due to weight of the prosthesis obtained by variance analysis test.

	Age at amputation (years)
use	18.7
non-use	25.3
	F value = 7.65 p < 0.01

Evaluation of the rehabilitation programme

The number of hours of prosthetic use does not depend on the evaluation of the rehabilitation programme (either for all prostheses together or separately by types of prostheses). No interconnection was established either by the variance analysis test or Chi-square test. This means that there is no interconnection between the rehabilitation programme that the persons were subject to and the number of hours during which they use prostheses.

What stops amputees from using a prosthesis

Table 8 refers to reasons that stop amputees from using a prosthesis, displayed separately for different types of prosthesis. The most frequent reasons are heat and sweating, and only in the third place (17.3%) the loss of sensation, even though McDonnell *et al.* (1989) state that the prosthesis weakens the amputee's sense of position in space.

The most frequent reasons to stop using a functional prosthesis are heat and sweating, and the loss of sensation. These two reasons are characteristically affected by the level of amputation (Table 9). Heat and sweating are most disturbing to persons with Trans-humeral amputation ($p<0.01$), and the loss of sensation to persons with a partial hand amputation ($p<0.1$).

The amputees, who stop using the prosthesis because of heat and sweating, are now younger ($p<0.01$) than the others, while other reasons for unsuccessful use are unrelated to age (Table 10).

Age at amputation has a significant influence only upon prosthetic non-use due to the weight of the prosthesis. The persons identifying the weight of the prosthesis as a reason for not using it, were significantly older at the time of amputation ($p<0.01$) (Table 11).

The persons who resist using the prosthesis due to loss of sensation, were fitted with their first prosthesis later after the amputation

Type of prosthesis	Reactions in social milieu						Total	
	Negative		Medium		Positive			
	No.	%	No.	%	No.	%	No.	%
Cosmetic	16	12.6	9	7.1	102	80.3	127	58.0
Functional	16	17.4	9	9.8	67	72.8	92	42.0
Total	32	14.6	18	8.2	169	77.2	219	100.0

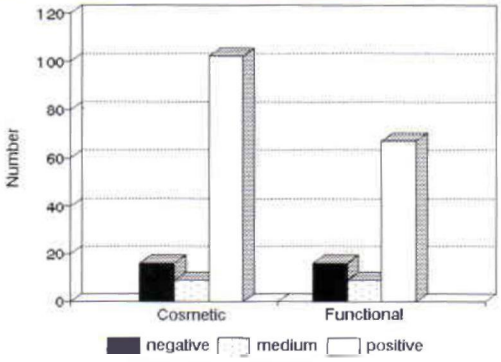

Fig. 1. Reactions in amputees' social milieu.

($p<0.05$) than those who did not identify this reason. The time lapse from amputation to the first prosthetic fitting had no significant effect upon the other reasons for non-use.

Acceptance of the prosthesis by the amputee's social milieu

Healthy people in Slovenia react to different types of prostheses in much the same way (Fig. 1). This may result from the fact that among functional prostheses there are twice as many prostheses with a hand as a hook, so they do not differ greatly in appearance from cosmetic prostheses, A high percentage (169 or 77.2%) of the respondents report positive reactions from the population at large to the prosthesis. This percentage is much higher than the percentage of the amputee's expectations (126 or 53.8%).

Fulfilment of the amputee's expectations

It is interesting to note that no significant differences exist in the fulfilment of the amputee's expectations between cosmetic and functional prostheses (Fig. 2). A surprisingly high percentage of cosmetic prostheses have met expectations, from which it may be concluded that a large number of amputees are very sensitive about their cosmetic appearance. This is confirmed by the high percentage of cosmetic prostheses which are provided in Slovenia and by functional prostheses for the hand being fitted twice as often as the hook.

Table 12: The fulfilment of the amputee's expectations is significantly related to the number of hours per day during which they use a functional or cosmetic prosthesis (variance analysis test).

Satisfied with prosthesis	Use (hrs/day)	
	Cosmetic	Functional
Yes	11.9	14.1
Medium	4.9	9.8
No	7.2	8.0
	F value = 12.0 $p < 0.001$	F value = 8.1 $p < 0.001$

The fulfilment of expectations is not affected by the time lapse since amputation to the first fitting of a cosmetic or functional prosthesis.

The fulfilment of the amputee's expectations is significantly related to the number of hours per day during which they use a functional prosthesis ($p<0.001$) (Table 12). The persons stating that the functional prosthesis has met their expectations use it longest during the day, whereas those disappointed with the prosthesis use it the least hours in a day.

Cosmetic prostheses are worn most by persons according to whom the prosthesis has met their expectations to a limited extent. They are worn least by persons with whom the prostheses has failed to fulfil any of their expectations (Table 13).

Type of prosthesis	Fulfilment of the amputee's expectations						Total	
	yes		partially		no			
	No.	%	No.	%	No.	%	No.	%
Cosmetic	67	46.5	15	10.4	53	36.8	144	57.7
Functional	59	58.4	12	11.9	28	27.7	101	42.3
Total	126	53.8	27	11.5	81	34.6	234	100.0

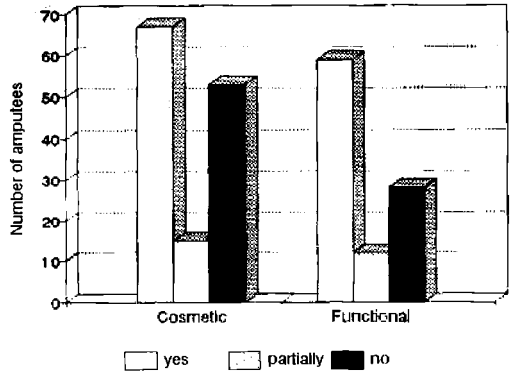

Fig. 2: Type of prosthesis does not influence significantly the amputees' expectations (Chi-square test).

The fulfilment of the amputee's expectations is not significantly related to either the age at amputation or the current age.

The majority of persons with a cosmetic prosthesis stated that it had not met their expectations as it was merely cosmetic and unsuitable for work. Secondly the view was expressed that it is aesthetically deficient. The fact that the prosthesis is not applicable at work, being more of an encumbrance than aid, is another reason for non-use.

Surprisingly enough, a third of the respondents were of the opinion that a functional prosthesis, too, is just a cosmetic aid. The reason underlying this belief may be that these amputees were not included in a suitable rehabilitation programme. Another third of the respondents, fitted with a functional prosthesis, stated that the prostheses were poorly made, not strong enough, and unreliable. These are further reasons for unsuccessful prosthetic use.

Conclusion

In the last few years, an obvious improvement in the general attitude to prosthetic use can be observed in Slovenia, though the use of upper limb prostheses is far from satisfactory.

In Slovenia, the use of upper limb prostheses is related to factors which are not under human control (level of amputation, loss of the dominant hand, age at amputation) and also factors that can and must be controlled. Two most outstanding of these are:

1. time from amputation to the first prosthetic fitting
2. type of prosthesis.

Another area open to external control is a suitable rehabilitation programme. Its influence upon the use of functional prostheses however has not been confirmed by this study.

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Treatment of congenital subluxation and dislocation of the hip by knee splint harness

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Abstract

The results are reported from a study of 103 cases fitted with the knee splint harness (KSH) which is an orthotic device used for the treatment of congenital subluxation and dislocation of the hip. The knee splint harness consists of a harness attached to posterior plastic shells at the knee which prevent flexion beyond 90 degrees while permitting full and free knee extension. No case was encountered in a 10 year period which failed to reduce. In cases of hip subluxation, reduction was obtained within an average of 5.8 days. In cases of dislocation, reduction was obtained in 6.7 days on average. Follow-up roentgenograms, established that there were no cases presenting with any sign of ischaemia of the epiphysis.

Introduction

Congenital dislocation of the hip has been discussed among Japanese orthopaedic surgeons for many years, being one of the most commonly encountered conditions in Japan. The Lorenz method was introduced into Japan in 1920 and since then has proved a most reliable treatment method. It was considered that aseptic necrosis of the femoral head resulted from the rigid fixation of the hip in frog type plaster casts. The splint described by Von Rosen (1956) which was applied to infants below 2 months old was difficult for the parents to handle. The Pavlik (1957) harness has been commonly used in Japan since introduced in 1957. In Japan, this harness design has been modified by different manufacturers. Some of these are however considered to be inadequate, especially those where the longitudinal straps are attached at the incorrect location at the knee which may cause knee contracture. The author has used the Pavlik harness since 1966 and occasionally reduction has been unsuccessful and contracture of the knee encountered. In these cases, the harness has been removed for a period of time and then reapplied with a successful result achieved in most cases. Reduction was most easily achieved in those cases where in addition to the harness a posterior knee splint (KS) was fitted to the affected side (series 1 – 20 cases). In this article we also report upon our experience in the use of the knee splint harness (KSH) (Fig. 1) and the treatment results obtained (series 2 – 83 cases).

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Materials and Methods

One hundred and three cases were examined and treated at the department of Orthopaedic Surgery, Kure National Hospital and Fukushima Orthopaedic Clinic over the past 10 years.

Series 1: Pavlik harness was applied coupled with a posterior knee splint (KS) to prevent more than 90 degrees of flexion of the knee (Fig. 2). The splint was applied at the same time as the Pavlik harness or subsequently when reduction was not achieved after a period of 3 weeks.

Series 2: Knee splint harness (KSH) was applied to 30 cases of subluxation and 53 cases of dislocation.

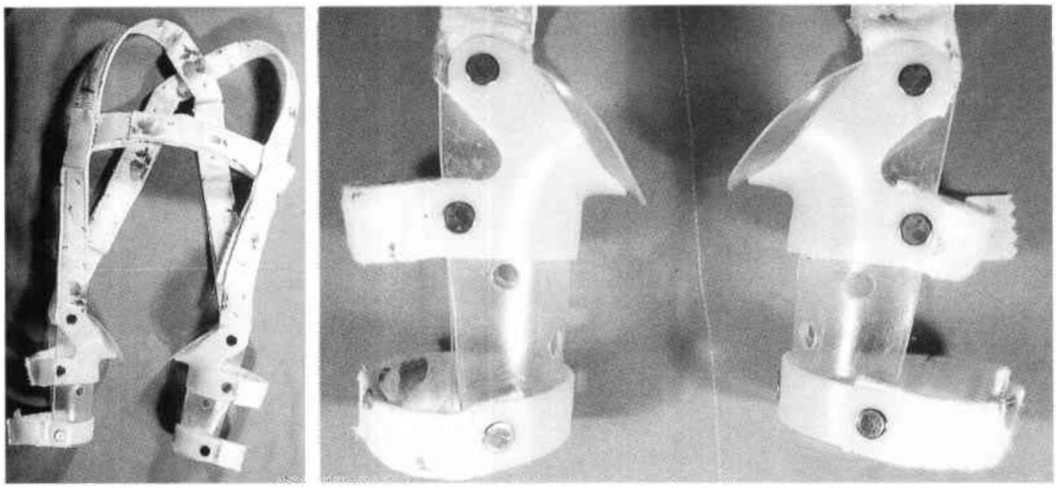

Fig 1. Knee splint harness (KSH) (left). The knee splint is composed of posterior plastic shells with circumferential retaining cuffs (right).

Methods

At the initial patient visit, the hips were examined by the following method. The left hip was held by the thumb and index fingers of the left hand and the knee joint held in 90 degrees of flexion by the right hand of the examiner. With the hip joint in a position of horizontal adduction, the femoral head was palpated posteriorly and with the hip joint in a position of horizontal abduction, the head was then palpated anteriorly. Compressive force was applied to the femoral head posteriorly to determine mobility of the head and check joint stability. The right hip was examined in a similar manner.

The classification of acetabular dysplasia and dislocation according to Dunn (1976) is as follows:

Grade 1: Acetabular dysplasia is minimal or zero, the femoral head is slightly subluxed by application of compressive force (subluxation of the hip).

Grade 2: Dysplasia is moderate, the femoral head is displaced slightly or moderately as observed roentgenographically.

Grade 3: Dysplasia is severe, the superior border of the femoral head is located above the level of the acetabulum as observed roentgenographically.

The KS is a plastic splint comprising posterior thigh and calf sections angled at 90 degrees at the knee joint (Fig. 2). The KSH is a combination of harness and splint. The harness is designed to permit knee flexion from 0 to 90 degrees and hip flexion from 90 degrees to the maximum.

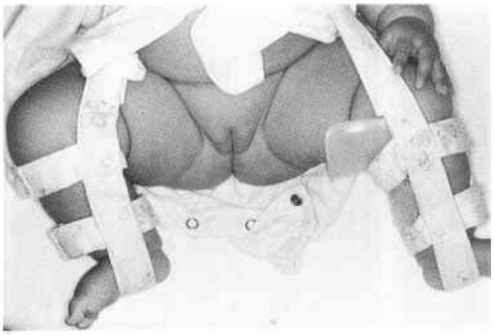

Fig 2. Pavlik harness with knee splint (KS) are applied to the left knee joint. The right knee is flexed at more than 90 degrees and the longitudinal strap is displaced posterior to the axis of the knee. The left knee is flexed at less than 90 degrees and the longitudinal strap is located over the axis of the knee.

Results

Series 1

Nine cases (7 female, 2 male) were treated by Pavlik harness coupled with KS. Reduction was obtained in all cases in 2 to 14 days (averaging 6 days).

Eleven cases were treated initially with the Pavlik harness above, but in 6 of these cases reduction was not obtained after 3 to 12 weeks of treatment. Following the addition of the KS to the harness, reduction was achieved in all 6 cases within 3 weeks (averaging 8.8 days).

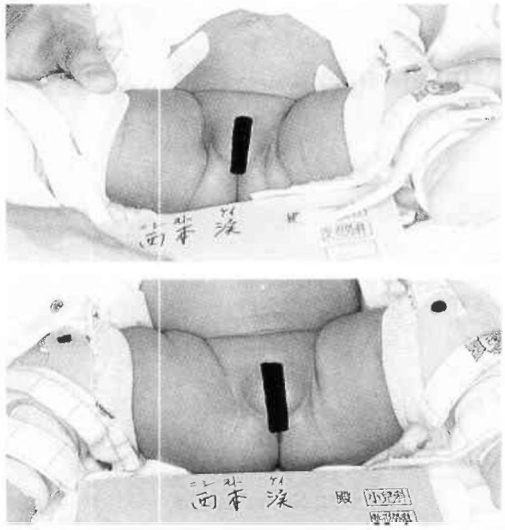

Fig 3. N.K. a one month old female. KSH applied on 16 December 1988. The left hip was adducted immediately after application (top). The adduction contracture at the left hip was corrected within 3 days (bottom).

Series 2

Subluxation of the hip (Grade 1)

Thirty cases were analysed. The sex ratio of female to male was 15 to 15. The age ranged from 2 to 6 months at the time of application (average 3.7 months.) The incidence was 12 right, 17 left and one bilateral. Grade 1 acetabular dysplasia was found in 27 cases with 3 cases of normal development. Reduction was achieved 1 to 17 days after application (average 5.8 days). The period of application ranged from 3 to 15 weeks (average 6.1 weeks). The acetabular dysplasia disappeared between 3 months and 9 months after birth, (average 5.8 months) (Fig. 3).

The period of follow-up ranged from 2 to 57 months (average 11.6 months). The final roentgenograms revealed normal development in 28 hips, acetabular dysplasia in one hip and one hip with a smaller epiphysis than in the unaffected side (Table1).

Dislocation of the hip

Fifty-three cases were analysed in this study. The sex ratio was 39 female to 14 male. Incidence was 17 right, 35 left and one bilateral. Age at application ranged from one to 6 months, (average 2.5 months). The grades of dysplasia and dislocation according to Dunn's classification were 8 Grade 1, 11 Grade 2, 34 Grade 3. Reduction was achieved one to 39 days after application (average 6.7 days). The period of application was 4 to 18 weeks (average 8.0 weeks). Acetablar dysplasia disappeared at 3 to 9 months after birth (average 5.9 months). Follow-up was at 4 to 60 months (average 13.6 months). Final roentgenograms revealed normal development in 44 cases, smaller epiphysis than in the unaffected hip in 2 cases, acetabular dysplasia in 2 cases and lateralization of the head in 2 cases. Those cases with abnormal findings are expected to become normal (Table 2).

Representative case presentation

Series 1

Case 1: M.Y. a 3 months old female. At first visit, Grade 3 dislocation was noted in left hip and a Pavlik harness applied on 14 November, 1983. Reduction was not obtained, and adductor contracture was not improved until 4 January, 1984. The posterior KS was applied after 51 days of harness wear. Reduction was thereafter obtained in 7 days and the KS was worn for a

Table 1. Subluxation of the hip

Cases	30
Sex	female – 15, male – 15
Side	R – 12, L – 17, bil. – 1
Age	2 – 6 months, ave. – 3.7
Grade	Gr. 1 – 22, Gr. 2 – 5
Dysplasia	27 – present, 3 – absent
Reduction	3 – 17 days, ave. 5.8
Application	3 – 15 weeks, ave. 6.1
Disap. of dysplasia	3 – 9 months, ave. 5.8
Follow-up	2 – 57 months, ave. 11.6
Result	normal – 28
	acetabular dyplasia – 1
	small epiphysis – 1

Table 2. Dislocation of the hip

Cases	53
Sex	female – 39, male – 14
Side	R – 17, L – 35, bil. – 1
Age	1 – 6 months, ave. – 2.52
Grade	Gr. 1 – 8, Gr. 2 – 11, Gr. 3 – 34
Reduction	1 – 39 days, ave. 6.7 days
Application	4 – 18 weeks, ave. 8 wks
Disap. of dysplasia	3 – 9 months, ave. 5.9 months
Follow-up	4 – 60 months, ave. 13.6 months
Result	normal – 44
	small epiphysis – 2
	acetabular dysplasia – 2
	lateralization – 2

total of 14 days. The Pavlik harness was removed on 12 March 1984 and follow-up roentgenogram at 7 years old revealed a normal hip.

Case 2: O.T. a 3 months old female, delivered by Caesarean section. Grade 3 dislocation in left hip. No reduction was obtained after 3 weeks application of the harness. Following application of the KS

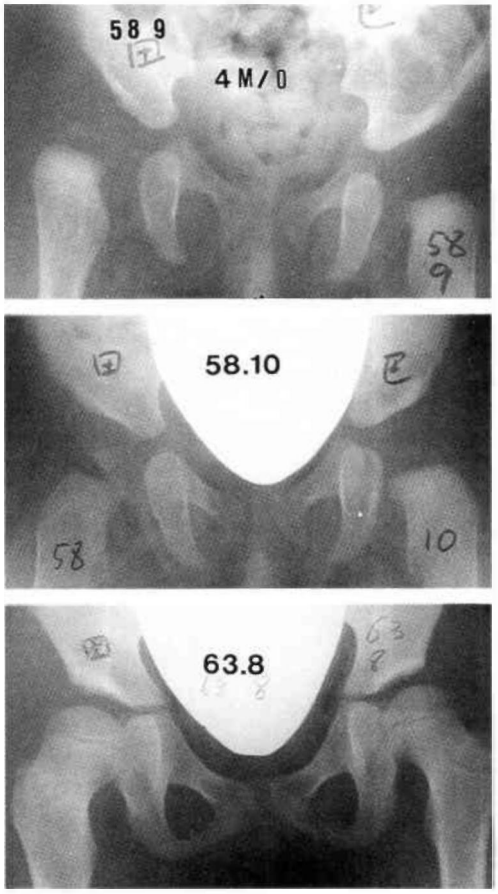

Fig 4. (Top) Series 1 T.T. a 4 month old female diagnosed as Grade 3 dislocation. Pavlik harness was applied on 14 September 1983. Two weeks later reduction was still not obtained. On 27 September, knee splint was applied to the right knee. Three days later, reduction appeared to have been achieved but dislocation still occurred when the hip was adducted. The roentgenogram was taken on 14 September 1983 prior to application of the harness.

(Middle) Stable reduction was accomplished on the 17th day of knee splint application. Pavlik harness had been worn for 4 months and 1 week, the knee splint harness for 2 weeks. The roentgenogram was taken on 21 October, 1983.

(Bottom) The follow-up roentgenogram at the age of 5 years revealed normal hip.

reduction was obtained in 5 days. A roentgenogram at age 12 months revealed an almost normal hip (Fig. 4).

Series 2

Case 3: I.C. a 1 month and 3 weeks old female. At fist examination, Ortolani's click sign was evident. Roentgenogram revealed Grade 3 dyspasia and dislocation. The KSH was applied on 27 April 1990. On 2 May, reduction was obtained by abducting the left hip. On 9 May stable reduction was obtained and on 13 June 1990, the KSH was removed. The roentgenogram revealed a round epiphysis and disappearance of acetabular dysplasia.

Case 4: H.A. a 4 months old female. Grade 3 dysplasia and dislocation was noted in left hip on 13 September 1991. A Pavlik harness had been worn for 3 weeks at another clinic without reduction being achieved. One week later this same treatment was repeated unsuccessfully. Arthrography of the hip revealed inverted limbus. At time of first examination in our clinic a Pavlik harness was again fitted and the hip appeared to be reduced in the abducted position but posterior dislocation was induced by adduction. The KSH was applied on 7 February 1992 and stable reduction was obtained in a few days. The KSH was removed on 9 March. On 27 August 1992, the roentgenogram revealed that the epiphysis was round although smaller than that of the right side, and acetabular dysplasia was also improved without lateralization of the head.

Discussion

In 1957, Pavlik reported a harness for the treatment of congenital dislocation of the hip. This was introduced into Japan in the same year. It has been proved by many Japanese orthopaedic surgeons that the incidence of aseptic necrosis of the femoral head can be reduced in frequency by this method. Pavlik stated that femoral head necrosis was due to compressive forces exerted on the head by the action of the adductor muscles with circulatory disturbance in the head as a secondary problem. The mechanism of reduction applied by the Pavlik harness is to keep the hip in more than 90 degrees of flexion with the knee in full extension so that the hamstrings induce the femoral head to locate fully in the acetabulum

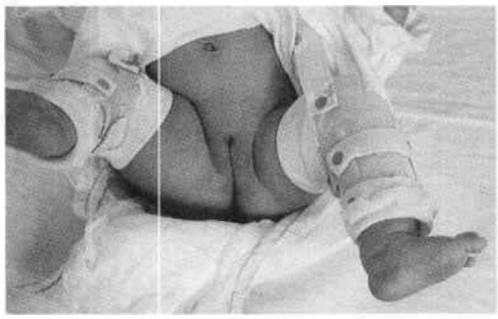

Fig. 5 KSH applied with stockinette sleeves. The left hip is flexed with abduction and external rotation and the right hip is extended with adduction and internal rotation.

by the action of the hip extensor mechanism.

We, however, consider that the process of reduction requires that the hip and knee are both kept in 90 degrees of flexion and that the abductive force applied to the hip by the weight of the legs relieves contracture of the adductors, and reduction is thereby induced.

According to Pavlik, the age of application ranged from 2 to 12 months. Takahashi (1985) reported age at the start of initial treatment ranging from 3 to 12 months. The spontaneous reduction rates he achieved were 60% in cases of hip dislocation and 97.9% in subluxation. Twenty-six out of 219 hips required manual reduction and 6 surgical reduction. Aseptic necrosis was observed in 11 joints (6.2%) and lateralization was observed in 21 joints (11.9%). It has been proved in the Series 1 group trial that keeping the knee in 90 degrees flexion or less brings the dislocated hip into reduction. The KSH keeps the hamstrings in tension by blocking knee flexion to more than 90 degrees and blocks hip flexion to less than 90 degrees. Therefore when the hip extends, the hamstrings become tightened and the hip is consequently induced into internal rotation by the strong medial hamstrings which rotate the hip medially. When the hip flexes, it rotates externally because the sartorius and biceps become tightened due to the prevention of more than 90 degrees of knee flexion (Fig. 5). The mechanism of reduction utilised in the early stages is mainly the correction of adduction contracture (Fig. 4). Iwasaki (1983) reported that when the hip was abducted by the harness the adductor muscles were then stretched by the weight of the lower limb. The KSH is more effective in correcting adductor contracture than the Pavlik harness because the former can be applied at an earlier age and also keeps the hip in abduction. The Pavlik harness tends to hold the hip in a position of more than 90 degrees flexion and the knee in more than 90 degrees flexion. The KSH holds the hip and knee in 90 degrees of flexion so that the adductors are stretched more effectively. The KSH is precisely attached to the transverse axes of the knee so that it permits active knee extension thus preventing the development of knee flexion contractures (Fig. 6). Once the hip is reduced, stability of abduction and adduction, and internal and external rotation are provided by the KSH so that reduction is then maintained by tension of the hamstrings. We have applied the KSH to infants from the age of one month. Stockinette sleeves are used on the limbs to prevent skin problems and infants should also be bathed daily and the skin condition checked by the mother. We have not experienced knee

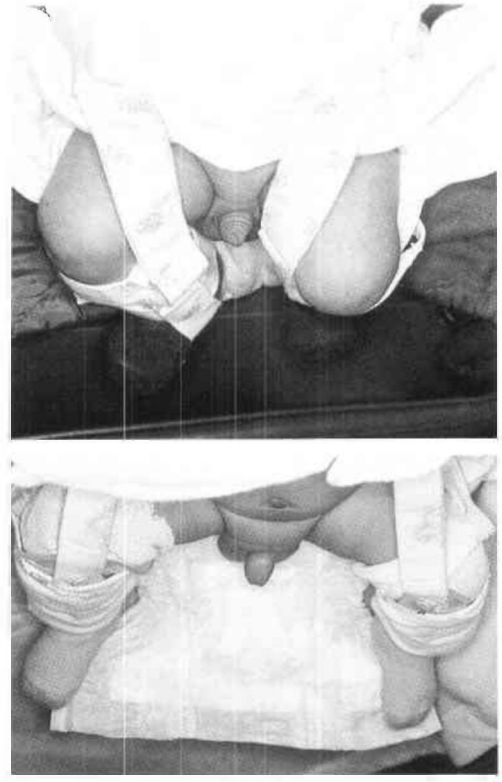

Fig 6. Comparison between Pavlik harness (top) and KSH (bottom) immediately after application. Hip abduction is greater in KSH than in Pavlik harness in the same patient with left dislocation. The longitudinal straps are located posteriorly to the knee joint in Pavlik harness whereas on the KSH the longitudinal straps are located over the axes of the knee.

flexion contracture problems. Complications with this harness were limited to mild dermatitis during the early phase of this study which was resolved by use of skin cream. Additionally no delayed reduction or aseptic necrosis of the femoral head has been encountered. No other treatment method or surgery has been required in the treatment of all such cases over the past 10 years. Eight cases have now been followed up for a period of more than 3 years, with no evidence of any Perthes-like change found roentgenographically.

Summary

1. The knee splint harness (KSH) has been used for the treatment of 103 cases of hip disorders in children since 1983.
2. Age at time of application was one month and upward.
3. No instances of failed reduction occurred and no other method of treatment was required.
4. Reduction was obtained in all cases in one to 39 days, (average 7 days).
5. The KSH was used for the treatment of unstable hips which were difficult to keep reduced and which were easily dislocated by adduction of the hip.
6. On follow-up, no ischaemic change of the epiphysis was detected roentgenographically.
7. The period of application ranged from 2 to 3 months. When stable reduction was established collectively by dynamic hip examination, symmetrical abduction, loss of adductor contracture and strong extension of the affected hip, KSH should be removed.
8. There have been no complications encountered in the use of KSH except for mild skin rash.

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Technical note

A trans-femoral brim adapter for CAD CAM measurements

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Abstract

A computer aided design/computer aided manufacture (CAD CAM) brim measurement adapter was designed for use with a Berkeley casting stand. This measurement adapter accommodates all IPOS/CANFIT-PLUS trans-femoral brim sizes and shapes, allows brim positioning, provides adequate stability, and provides a substantial cost saving by using existing, functional hardware as a base.

Introduction

The successful application of computer aided design/computer aided manufacture (CAD CAM) technology to the production of prosthetic sockets is contingent on the acquisition of reliable input data (Engsberg *et al.*, 1993). In the IPOS/CANFIT-PLUS trans-femoral system the input method involves selecting the appropriate brim for a patient, taking a series of circumference measurements along the stump, and entering the data into a computer. These measurements are used mathematically to produce an image of a quadrilateral or ischial containment socket on a computer screen for modification and/or carving. Since the final socket shape is based on brim dimensions and physical measurements from the patient, accurate measurements from the stump and appropriate brim selection are imperative.

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Reliable and accurate CAD CAM measurements cannot be achieved without suitable, stable brim positioning. A brim support system must support the total body weight of the patient, conform to a variety of brim sizes and shapes, be adjustable to the patient, be stable and secure, be relatively inexpensive, and be simple to use and install. Failure to provide a stable brim support system will lead to erroneous measurements due to proximal/distal limb movement inside the brim and/or excessive brim distortion.

The success of the Berkeley casting frame, as well as the abundance of Berkeley stands in the prosthetic and orthotic community, makes this an ideal platform for a CAD CAM oriented measurement stand. A Berkeley casting frame is adjustable for height, has a high degree of stability, and is easy to set up and operate.

An adapter has been developed to integrate IPOS CAD CAM quadrilateral and ischial containment brims with the Berkeley casting stand. The adapter takes advantage of features present in the Berkeley base while providing the necessary options for successful brim selection, brim positioning, and measurement of the stump. This note will describe the design criteria, fabrication procedure, and operation of such a measurement jig.

Method

Design criteria

The CAD CAM brim measurement adapter was designed based on the following criteria:

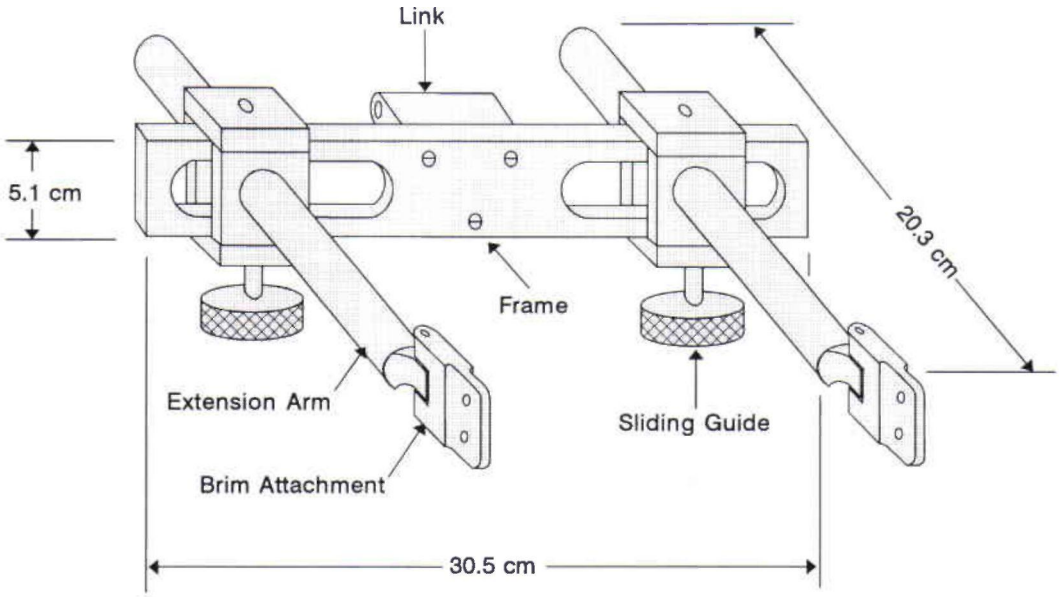

Fig 1. Outline and dimensions of brim adapter.

- accommodate all IPOS brim shapes by providing mediolateral adjustments for circumference and anteroposterior adjustments for quadrilateral and ischial containment styles;
- easy adjustment of brim position in the sagittal and transverse plane;
- no interference with Berkeley base adjustments;
- ability to bear 200 kg of vertical load on the weakest point;
- provide stability and security for the patient;
- simple to install and configure;
- relatively inexpensive.

Components

All jig components were machined out of aluminium stock to provide a light-weight adapter (Fig. 1). A link section was used to connect the brim adapter to a Berkeley casting stand using the standard interface. The hinge attachment mechanism permitted rotation in the transverse plane by adjusting a screw on the Berkeley stand. Since the link segment was secured to the adapter by three bolts, different links could be interchanged for different measurement stands.

A 30.5 cm long central adapter frame was cut out of 1.9 cm by 5.1 cm bar stock. Two 2.5 cm by 10.2 cm tracks were machined out of the bar to allow mediolateral adjustment of the brim attachments. The two extension arms were cut from 20.3 cm by 2.5 cm rod and machined to connect to the brim attachment section. By tapering the ends of the extension arms, 180 degrees of motion was permitted and adequate brim clearance was maintained.

The extension arms were secured to the adapter frame by two sliding guides. These guides functioned as dual u-clamps while allowing extension arm movement along, and at right angles to, the adapter frame. Since a screw could be placed at the top or bottom of the clamp, sufficient clearance was provided between the locking screw and the proximal shelf of the plastic brim.

Operation

Installation

IPOS CAD CAM brims are installed on the adapter using two sets of threaded studs supplied with the plastic brims (medial and lateral). The studs are inserted from inside the brim, through the attachment plate, and secured outside the plate. These studs may have to be trimmed to avoid discomfort to the medial side of the contralateral limb.

Once the brim was securely attached to the adapter, the brim adapter was installed directly into the quadrilateral brim interface unit on the

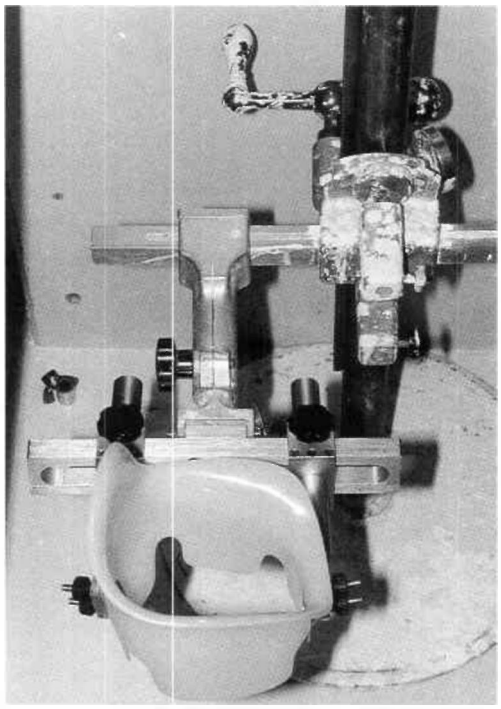

Fig 2. Brim adapter mounted on a Berkeley stand.

Berkeley stand using standard insertion and locking techniques. Since this unit was integrated into the existing attachment interface, the adapter could be used interchangeably with other Berkeley attachments (i.e. quadrilateral brim, casting rings, etc.).

Patient setup

Before using this measurement system, the clinician should pull one ply stockinette across the top of the brim. The patient should be oriented such that he/she faces away from the stand and is securely positioned between the parallel bar supports.

Once the patient is properly positioned, the brim adapter can be raised, using the Berkeley stand, until approximately 90% of the body weight is supported by the brim. Upon loading, brim deformation can be expected in the ischial region. The amount of deformation can be limited by reducing the amount of body-weight that is transferred to the brim.

Using the adapter and the casting stand, the brim can be positioned by adjusting for hip flexion, abduction/adduction, and/or rotation in the transverse plane. Abduction, adduction, and hip flexion can be adjusted using original Berkeley components while transverse rotation can be performed using the jig outriggers. When the brim is in a satisfactory orientation, the clinician can take distal measurements or a cast from the residual limb as required and outlined by the CAD CAM system.

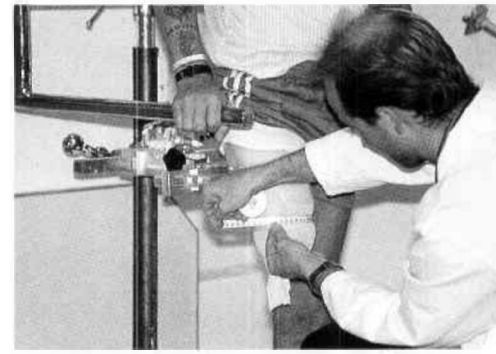

Fig 3. Patient position during CAD CAM measurements.

Maintenance

Maintenance of the brim adapter is minimal. If the adapter is kept clean (i.e. free of plaster build-up that inhibits free movement of the components), no lubrication or other regular maintenance is required.

Conclusion

The IPOS brim adapter defined in this paper provides an easy to use, low maintenance option for using existing casting hardware for CAD CAM oriented measurements. By changing the interface link section this adapter could be used with a variety of measurement stands.

Acknowledgements

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Technical note

How does vacuum forming affect Pelite mechanical properties?

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Abstract
Pelite® is a polyethylene closed cell foam commonly used as an interface material in prosthetics. Both normal and vacuum-formed Pelite were tested under compression and under shear loading. For shear testing, the results were not significantly different for normal and vacuum-formed Pelite. For normal Pelite, the slope of the stress-strain curve was 1.17MPa (±0.14) while for vacuum-formed Pelite it was 1.24MPa (±0.22). Compressive results, however, were significantly different. Below 80kPa of applied compression, the slope of the stress-strain curve for normal Pelite was 0.99MPa (±0.11) while for vacuum formed Pelite it was 0.72MPa (±0.12). Between 80kPa and 200kPa of applied compression, the slope of the stress-strain curve for normal Pelite was 0.45MPa (±0.03) while for vacuum formed Pelite it was 0.55MPa (±0.05). Reasons for the differences and their significance to interface mechanics and computer-aided prosthesis design are discussed.

Introduction

An amputee using a lower-limb prosthesis typically wears a cushioning liner between the stump and the prosthetic socket. Pelite, which is an expanded closed cell polyethylene foam made up of units of hydrocarbon chains, is commonly used for this purpose. Typically used in 3mm or 5mm thickness, Pelite is well suited for use with recently developed computer aided design/computer aided manufacturing (CAD CAM) prosthetic socket fabrication systems (Davies and Russell, 1979). It deforms plastically under heat and pressure to conform to the inside socket shape.

Clinical experience suggests that Pelite is altered by the vacuum forming process. A qualitative description is that it becomes thinner and more rigid. The change is important because the liner has less of a cushioning effect on the stump, i.e. the distribution of the normal and shear forces between the stump and socket is altered. In addition, inconsistencies in mechanical properties in different regions of the liner occur, and this further affects performance. At bony prominences, which require the socket to be curved to relieve interface stress, the Pelite becomes more thin and rigid than the surrounding regions of the liner.

In current clinical practice, the changes in Pelite thickness and stiffness as a result of vacuum forming are usually not planned or desirable. A prosthetist will typically overcome them by altering the liner after vacuum forming, for example placing an additional backing material on the outside of the liner. Alternatively more layers of Pelite could be added before vacuum forming to regions anticipated to become too thin.

In this technical note, changes in Pelite mechanical properties as a result of vacuum-forming are investigated. The purpose is to provide the initial work to determine quantitatively how the changes in Pelite mechanical properties from vacuum forming alter interface stresses. Finite element model

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analysis of the stump, liner, and socket will be conducted subsequent to the investigations described here to evaluate interface stress sensitivity to the measured Pelite liner mechanical property changes. If important interface stress changes are found then subsequent work will investigate techniques to overcome the detrimental effects of vacuum-forming and instead alter the liner properties in a favourable way. In other words, we would like to control liner properties during fabrication so that favourable stump prosthetic socket interface stresses as opposed to unfavourable ones are created.

There are a limited number of studies in the rehabilitation literature investigating mechanical properties of interface materials. Most of them have been conducted on shoe insert materials which are similar to the prosthetic materials of interest here, however the stress levels in those studies were higher than those encountered by amputees using prosthetic limbs. Four studies are of relevance to the work in this technical note. Campbell *et al.* (1982) found that under compression some closed-cell foam interface materials had a three part load-deformation curve: a high initial slope, a moderate intermediate slope, then a high final slope. He called those materials "moderately deformable" and suggested they represented the best class of interface materials because the slope changes were gradual. Materials that have only two distinctly different slopes, low and high, are less optimal, and Campbell called those "very stiff" or "highly deformable" materials, depending on their moduli. Loading history effects on Pelite mechanical properties were also investigated. Campbell *et al.* (1984) found that after release from seven days of sustained loading at 50% strain, 1.6mm thick Pelite suffered 25% elastic strain, i.e. was only 75% of its original thickness. After repetitive loading of 250,000 cycles at 294kPa, approximately 25% elastic strain was found. But in another study where 5mm thick Pelite was loaded at 392kPa for 10,000 cycles at 1Hz, the elastic strain was only 2% (Brodsky *et al.*, 1988). Thus the results suggest elastic strain is dependant on the number of cycles and initial thickness. Kuncir *et al.* (1990) suggested there are relationships between cell dimensions, uniformity, and reticulation and proposed such relationships are of tremendous clinical relevance because these properties strongly affect the distribution of stress and the time dependent recovery characteristics of the materials. A more complete description of the theory of closed cell foams where quantitative relationships are described is presented by Gibson and Ashby (1988).

Despite recognition of the importance of liner properties and relationships between cell structure and liner properties, the effects of vacuum forming, a technique commonly used in prosthetics to fabricate a socket liner, on Pelite foam structure or mechanical properties has not been investigated. The purpose of this study was to compare normal and vacuum formed Pelite. Mechanical performance of normal and vacuum formed Pelite under compressive loading and under shear loading was evaluated. Loading magnitudes in the ranges of recent interface stress measurements on trans-tibial amputees (Sanders *et al.*, 1993) were used. Subsequently, beyond the scope of this technical note, effects of the different properties on interface stresses will be investigated using a finite element model.

Methods

Specimens

For testing of normal Pelite, sheets of 5 mm thickness of Pelite were obtained from a distributor (Durr-Fillauer Orthopaedic, Incorporated; Chattanooga, TN). For vacuum formed testing, flat specimens were constructed by fabricating parallel pipe plaster/cornstarch casts using computer aided software (Shapemaker©, Prosthetics Research Study, Seattle, Washington). Socket vacuum forming was conducted using a number 2 Pelite truncated cone with end pads. An oven temperature of 220°C and a vacuum pressure of 98kPa were used. Vacuum formed sheet thickness was 2.79mm (±0.27). Normal specimen thickness was 4.95mm (±0.21).

For compression testing, 2.54cm diameter disks were cut using a punch press. Specimens were taken from the central 80% of the width and length of a sheet to avoid thickness changes at the corners. For shear testing, 9.0mm x 9.0mm specimens were cut using a custom designed device that held two scalpel blades parallel during cutting. Specimens were square to within ±0.07mm tolerance. Specimens were

taken from the central 80% of the width and length of a sheet. For compression testing, five normal and five vacuum formed specimens were used. For shear testing, ten normal and ten vacuum-formed specimens were used.

To gain insight into structural differences between normal and vacuum formed Pelite, thin cross-sectional slices cut perpendicular to the surface were prepared and examined using a light microscope. A qualitative assessment of the structure was conducted.

Compression testing

Compression testing was performed using an Instron™ (Canton, MA) testing machine with a 2000N load cell. Displacement was measured with a Schaevitz™ (Pennsauken, NJ) linear velocity displacement transducer (LVDT) (DC-D 500) with the bore attached to the base and the core attached to the crosshead. A single trial was performed to pre-condition the specimen. A strain rate of 0.5cm/min and a maximal stress of 200kPa were used. Subsequently, data were collected during two consecutive tests of loading and unloading at a strain rate of 0.5cm/min with 60 seconds between the tests. Data acquisition was performed with an A/D board (Data Translation DT2801A, Marlboro, MA) and a personal computer at a sampling rate of 1Hz.

Only a single specimen at a time was placed between the platens during testing. Though stacks of specimens would reduce edge effects, stacks of Pelite were not used here because it was desirable to test the materials in the same configuration as they would be when in a prosthetic socket. Thus testing of stacks of materials is considered an area of further research; differences with data here might provide further insight into foam mechanics.

Shear testing

Testing was performed to provide insight into Pelite response under shear loading, information that combined with the compression data above might expand insight into mechanics of the closed cell foam when loaded at the stump-socket interface. Using the apparatus shown in Figure 1, two specimens at a time were tested under shear loading. The crosspiece mass was 19.2 grams. Care was taken to ensure that the aluminum slats were parallel to each other so

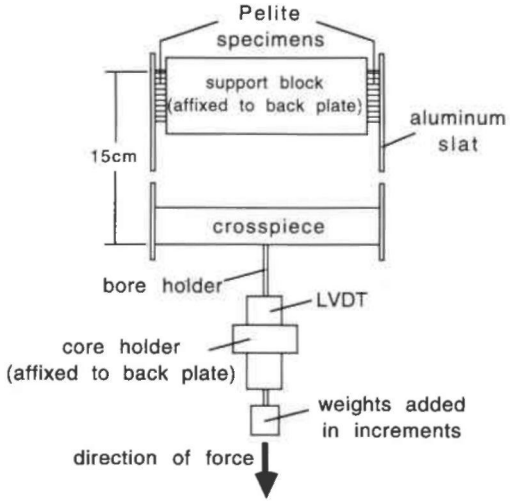

Fig 1. Two 9.0mm x 9.0mm specimens were tested under shear loading as shown.

that the Pelite was not pre-stressed in torsion before the weights were added. After a single pre-conditioning trial, two consecutive tests of loading and unloading were performed with 60 seconds between the tests. Loads to 575 grams were applied in 10 steps. Approximately 5 seconds elapsed after each load addition before a measurement was recorded.

Force and deflection measurements were converted to stress and strain data respectively. The initial dimensions of the normal and vacuum formed Pelite specimens were used for the area term in the stress calculations and for the initial thickness in the strain calculations.

"Apparent moduli" were calculated from compression testing results. The term "apparent" is used so as not to confuse the results with true moduli, which is a parameter measured from accepted standards testing procedures. For soft closed cell foams such as Pelite, standards have not as yet been approved thus means of obtaining true moduli are not yet specified. For shear testing results, the slopes of the stress-strain curves are presented. Again, no standard shear test has been approved for soft closed cell foams, thus "apparent shear modulus" is the terminology used here.

Results

Compression testing results for normal Pelite were different from results for vacuum formed Pelite. Typical stress-strain plots are shown in

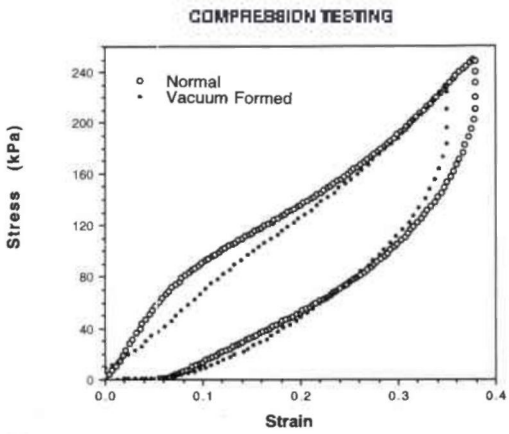

Fig 2. Typical compression testing results for normal and vacuum formed Pelite.

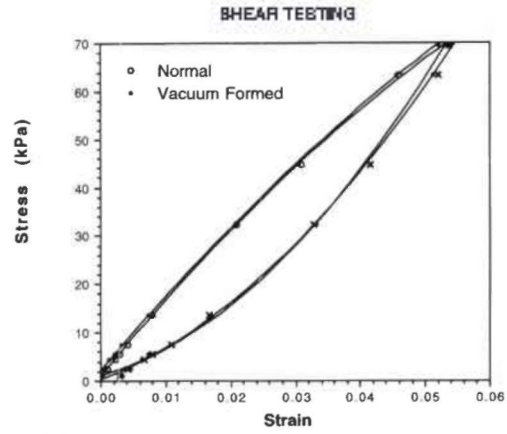

Fig 3. Typical shear testing results for normal and vacuum formed Pelite.

Figure 2. Two apparent moduli, which were linear least square fits to the data, were calculated for each trial, one for the range 0kPa to 80kPa and one for the range 80kPa to 200kPa. The basis for selection of 80kPa as the division point was this was the stress of the greatest slope change in the curves. Only the loading phase of each trial was considered in this analysis. Normal Pelite apparent modulus averaged 0.99 (±0.11) MPa at stresses between 0Kpa and 80kPa while it was 0.45 (±0.03) MPa at stresses between 80kPa and 200kPa. Vacuum formed Pelite apparent modulus was 0.72 (±0.12) MPa at stresses less than 80kPa while it was 0.55 (±0.05) MPa at stresses between 80kPa and 200kPa (Table 1). The differences between normal and vacuum formed were significant ($p<0.01$) for both the 0kPa to 80kPa range and the 80kPa to 200kPa range. Elastic strains after the second and third trials were minimal.

Shear test results were not significantly different for normal and vacuum formed specimens (Fig. 3). Apparent shear moduli were 1.17 (±0.14) MPa and 1.24 (±0.22) MPa respectively. Linear least square fits to the data were used to calculate the slopes. Elastic strains after the second and third trials were minimal.

Examination with a microscope showed that normal and vacuum formed Pelite had different structures. Cells on the surfaces of vacuum formed specimens were collapsed while those in the mid-region of the cross-section were circular or elliptical with their major axes parallel with the surface. Thus there was a "skin" of compressed cells on the top and bottom surfaces. Normal Pelite, however, showed rounded cells throughout with minimal or no "skins" on the surfaces.

Discussion

In previous research, maximal stance phase interfaces stresses on tibial flare, lateral, and posterior regions on trans-tibial amputees ranged from 46kPa to 205kPa for normal stress and 9kPa to 54kPa for shear stress (Sanders *et al.*, 1993). On trans-femoral amputees normal stresses ranged from -6kPa to 345kPa (Appoldt *et al.*, 1968). Thus results presented in this technical note show that within those ranges normal and vacuum formed Pelite demonstrated different mechanical properties.

The differences can be explained by alterations in the cellular structure. Vacuum formed Pelite as evidenced by its elliptical cell structure in the central region lost the integrity

Table 1: Thicknesses and mechanical properties for normal and vacuum formed Pelite.

Type of Pelite	Thickness (mm)	Compressive Apparent Modulus (MPa) [0 to 80kPa]	Compressive Apparent Modulus (MPa) [80 to 200kPa]	Shear Apparent Modulus (MPa) [0 to 70kPa]
Normal	4.95 (±0.21)	0.99 (±0.11)	0.45 (±0.03)	1.17 (±0.14)
Vacuum formed	2.79 (±0.27)	0.72 (±0.12)	0.55 (±0.05)	1.24 (±0.22)

of vertically oriented structural elements within the foam, resulting in reduced resistance at low loads. Thus the lower part (0kPa to 80kPa) of the compression testing stress-strain curve for vacuum formed Pelite had a lower apparent modulus than that for normal Pelite. At higher loads, however, the cells were collapsed thus loads were transferred across the cell walls. Thus at high loads (80kPa to 200kPa) the apparent modulus was higher than for normal Pelite. Shear testing results provide further insight into cell response to stress. The lack of a significant difference in apparent shear moduli for normal and vacuum formed Pelite but the presence of a difference in structure suggests that vacuum formed cells responded differently than normal cells. Vacuum formed Pelite had "skins" of collapsed cells on the top and bottom surfaces, and presumably those regions underwent minimal lateral deformation. The lack of deformation in the skins, however, was compensated for by excessive deformation in the elliptical cells, thus under shear loading the elliptical cells deformed more easily than the normal cells. This interpretation is consistent with the interpretation of compressive testing results described above. The vacuum formed Pelite had a weaker cell structure. To evaluate the above suggested hypotheses, cellular structural modelling, similar to that suggested by Kuncir *et al.* (1990) for body support interface materials and more formally described by Gibson and Ashby (1988) for foams in general, should be conducted.

The findings presented here are consistent with results presented in the literature. Campell *et al.* (1982) suggested that the slope differences for different regions of the stress-strain curves are of clinical relevance. Thus changes in the slopes of normal vs. vacuum formed Pelite might explain the clinically observed performance differences for normal vs. vacuum formed Pelite. In addition, literature results suggest that for a short number of load cycles (less than 10,000 cycles), elastic deformation is minimal, a finding supported by results presented here. Reports from the literature do suggest, however, that long-term loading does affect Pelite mechanical properties, thus further research should consider long-term loading effects on the results.

If subsequent investigation using finite element analysis demonstrates that stump-socket interface stresses are highly sensitive to Pelite mechanical property changes encountered during vacuum forming, then an exciting concept is introduced to prosthetics. During liner fabrication, control of Pelite local properties might possibly be used to control interface stress distributions. This could be accomplished in a practical manner by altering the cell dimensions in the closed cell Pelite foam, possibly using local thermal control. Thus liners would be custom designed to the needs of the individual patient. The concept of variable mechanical property liners is currently practised clinically, but the methods are time consuming and impractical. A prosthetist typically cuts out a region of the liner and replaces it with a new material that is of more appropriate mechanical properties for that skin region. For example, nylon reinforced silicone is commonly placed at very sensitive soft tissue sites. However, clinical results are not necessarily always beneficial, in part because the edges at the interface of the two linear materials is a source of subsequent skin irritation. In addition, the fabrication processes are extremely time consuming. A liner that was continuous but with local changes in mechanical properties, for example a liner with locally variable micro-cell sizes, would be more optimal.

Acknowledgements

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The Brian Blatchford Prize

The Brian Blatchford Prize has been established by the Blatchford Family to honour the memory of Brian Blatchford. It is awarded every three years at the World Congress of the International Society for Prosthetics and Orthotics.

The next Prize will be awarded at the Eighth World Congress of ISPO to be held in Melbourne, Australia from 2–7 April 1995. On this occasion the Prize will be £2,500 and will be awarded to an individual who has an outstanding record of innovative achievement in the field of prosthetics and/or orthotics. The achievement should be related to prosthetic and/ or orthotic hardware, or scientifically based new techniques which result in better prostheses or orthoses.

The President, in seeking to identify the recipient of the award, will also consider nominations or applications from National Member Societies or individuals. Such nominations or applications should contain a justification together with a curriculum vitae of the candidate and should reach the President of ISPO by 1 November 1994 at the following address:

M. L. Stills,
Orthopaedic Surgery Department,
UT Southwestern Medical Centre,
5323 Harry Hines Boulevard,
Dallas,
Texas 75235-8883
USA

The prizewinner shall make a presentation based on his work at the eighth World Congress which shall be duly published in Prosthetics and Orthotics International.

The President and Executive Board of the International Society for Prosthetics and Orthotics and the Blatchford family reserve the right to withhold the Prize should no suitable candidate be identified.

Prosthetics and Orthotics International, 1994, 18, 49-51

Technical note

New walking aid for primary mobilization of an infant with deficiency of all four limbs

S. BALOGH, T. GÖNCZY, R. BUJDOSÓ and L. KULLMANN

National Institute for Medical Rehabilitation, Budapest, Hungary

Abstract

The authors report on a new device for the primary mobilization of a boy with severe deficiencies of all four limbs. This device allows independent mobility.

Introduction

The supply with technical aids in the case of loss of all four limbs is always difficult, especially in respect of primary mobilization. Studying the available literature, the authors found references published mainly in the thalidomide era. On first provision sockets were usually fixed to platforms on casters as by Aitken (1972) and Tippy *et al.* (1979) or to three wheeled carts, (Motloch and Elliot, 1966). Trunk swing, especially if the upper limbs are not deficient, may provide the means for a slow advancement. The children, as seen from photographs in the publication of the results, did not appear happy with the movement achieved since the motion needed great effort. The other form of provision was a socket fixed on platforms and bars (Marquardt and Martini, 1979; Radford and Steensma, 1957) to achieve an upright position but without mobility. Swivel walkers requiring rocking motions (Motloch and Elliot, 1966) on the other hand are usually not the first aids provided for mobilization. The aim of the authors was the supply to the child of a device which would permit active communication.

All correspondence to be addressed to L. Kullmann, National Institute for Medical Rehabilitation, H-1528 Budapest, 123, P.O. Box 1, Hungary

Case history

Szabolcs K., male, was born with serious deficiencies of his four limbs. His upper limbs end between the upper and middle third of the humerus, the right side being somewhat longer. He has free shoulder joint movements. The left

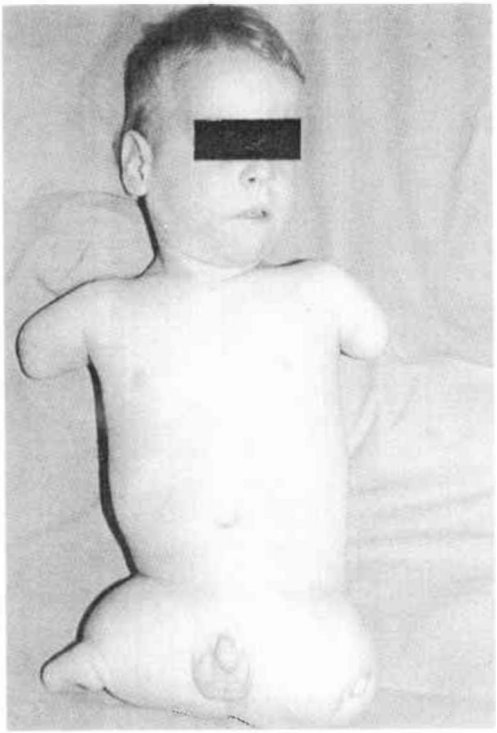

Fig. 1. Szabolcs K. with deficiency of four limbs.

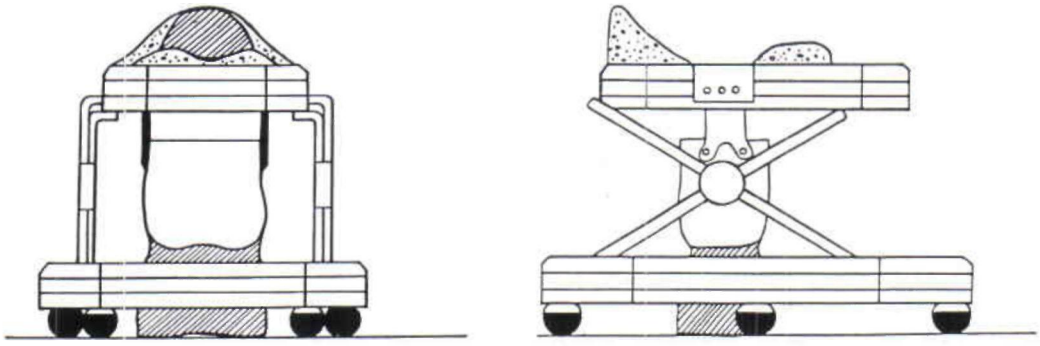

Fig. 2. Anterior and lateral views of the device.

lower limb is completely missing. There is a toe-like residual limb on the right side (Fig. 1). No calcified bones are visible in his right lower limb on the X-ray pictures at the age of one year. His mental development is normal. The development of movement is retarded due to the deficiencies. He can change prone and supine positions but cannot climb or crawl and cannot sit up. He was institutionalised in a health care children's home. His problem was studied with the aim of mobilisation. The aim of the fitting was the production of an aid which could be controlled by the child i.e. the device could be steered and stopped. A pelvic socket was laminated with varying stiffness to permit entry. This was fixed to a semi-rigid foam (plastazote) sole coated with rubber. This socket was suspended elastically on a commercial infant's go-cart, the centre of gravity of the child being below the centre of rotation (Fig. 2). This suspension permits the child to interact with the device and also permits full control. During the manufacturing process the child learned to adapt to the upright position, to losing and recovering balance and his deep back muscles and abdominal muscles were thus strengthened, since good active movements of the lumbar spine are necessary to control the device. This was followed by gradual training with the aid. First the child got into the socket, held in the upright position. On the next day he got into the complete device and was tilted from balance and helped to recover. These exercises were further developed into periodic movements copying the phases of gait. By tilting his pelvis he produces the "toe off" phase. He lifts his weight on his arms or on both his arms and chin while he swings his socket forward, lands on the edge of the sole and then regains balance by achieving complete support by the sole (Fig. 3). Steering is achieved with his arms, facilitated by the planet-wheels of the walker, and by swinging the socket in the desired direction. He became independently mobile within one week.

Discussion

The aid described in this publication is basically different from those published in previous references. The socket ends in a rubber sole and is elastically suspended in the frame. The principle of the aid is similar to a person supplied with prostheses and a rolling walker. It is important, that there is the possibility of rapid movement and the coverage of large distances

Fig. 3. Phases of "walking" with the device.

with relatively little muscle work. The danger of accidents is very small. Finally it was possible to teach the use of the aid very quickly. Szabolcs was able to move around indoors safely, without hitting furniture, and became mobile outdoors too. This increased mobility had a remarkable effect on his mental development.

REFERENCES

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MARQUARDT E, MARTINI AK (1979). Orthesen und funktionsverbessernde operationen für kinder mit gliedmassenfehlbildungen der unteren extremitäten. *Therapiewoche* **29**, 3132-3146.

MOTLOCH WM, ELLIOT J (1966). Fitting and training children with swivel walkers. *Artificial Limbs* **10(2)**, 27-38.

RADFORD J, STEENSMA J (1957). The lower extremity toddler amputee: training procedures. *Phys Ther Rev* **37**, 1-6.

TIPPY LV, KELLER KM, SCHOENECKER PL (1979). Management of a child with multiple congenital anomalies. *ICIB* **17(6)**, 11-16.

The Forchheimer Prize

The Forchheimer Prize has been established by the Forchheimer family to honour the memory of Sylvia and Alfred Forchheimer. It is awarded every three years at the World Congress of the International Society for Prosthetics and Orthotics.

The next Prize will be awarded at the Eighth World Congress of ISPO to be held in Melbourne, Australia, 2 7 April 1995 for the most outstanding paper on Objective Clinical Assessment, Clinical Evaluation, or Clinical Measurement published in Prosthetics and Orthotics International during the three years prior to the Congress.

The President and Executive Board of the International Society for Prosthetics and Orthotics and the Forchheimer family reserve the right to withhold the Prize should no suitable paper be published.

Prosthetics and Orthotics International, 1994, 18, 52-53

Book Review

The manufacture and use of the functional foot orthosis.
R. J. Anthony
Karger, 1991.
ISBN 3-8055-5298-X.
220pp. USD 158.50 GBP 86.10

In his preface the author states that the biomechanical discussions in the volume are "somewhat beyond the basic level" and this is a view that I would strongly endorse.
The Introduction comprises an interesting review of the evolution of the "Root" functional orthosis which provides a valuable historical perspective on the development of this relatively new area of orthotic practice.

Chapter 1 reviews the indications for the use of functional foot orthoses and the biomechanical theory underlying their function. Some of this material is quite readily acceptable, however some is less so, indeed the author states that it is "not yet backed up by experimental and clinical research". In addition, as a bioengineer, I had some difficulty with the use of the term "compensation" here and in later chapters, to refer to an abnormal position of the foot joints which is an involuntary consequence of an impairment of the structure or neuro-muscular control of the foot, rather than as a result of any voluntary adjustment in alignment.

The following two chapters deal with negative casting techniques. Five casting techniques are described and their respective advantages and disadvantages discussed. Finally the method of assessing the quality of the cast is described. This material is very detailed, however I found it relatively easy to follow due to the excellent quality of the many illustrations.

Orthosis fabrication is dealt with in Chapter 4 which commences with a rather clear explanation of the differences between the Root functional orthosis and the so-called "standard biomechanical orthosis". This is followed by a detailed description of the fabrication process used for both designs, including such factors as negative and positive cast preparation, the manufacture of the orthosis shell, the application of posts and finishing procedures. Surprisingly, the author states that "the choice of fabrication process is up to the individual clinician and is based on an understanding of the prescription variations that exist and on the individual's comprehension of the concepts of clinical biomechanics and pathomechanics".

Chapter 5 deals with the subject of prescription writing. A valuable feature of this chapter is the description of the acquisition of the biomechanical data required to formulate an orthosis prescription.

The treatment of the "basic pathological foot types" is described in the following chapter. Foot conditions covered comprise forefoot invertus, forefoot evertus, rearfoot varus and rearfoot valgus and their various causes. This material also is extremely detailed and in contrast to previous chapters perhaps suffers from a lack of appropriate illustrations or figures.

Finally, Chapters 7, 8 and 9 describe the critique of the orthosis, fitting the orthosis and some common problems with orthotic therapy and their management.

This book is packed with information. Probably its strongest aspect is the detailed descriptions of the orthosis fabrication processes and, at least from my view point, the weakest its justification for the prescription criteria. I had considerable difficulty linking the Indications for the Use of Functional Orthosis in Chapter 1 with Prescription Writing in Chapter 5 and Treatment of the Basic Pathological Foot Types in Chapter 6.

This is very definitely a book for foot specialists and regrettably it highlights the problem of the terminological differences which exist between the podiatry profession and most other health care professions. I have no doubt that the functional foot orthosis is an extremely valuable treatment tool when used correctly.

Unfortunately this book does little to help the non-expert understand better their place in the overall management of foot disorders. Finally, it emphasizes the need for objective evaluation of the many theories propounded in it.

David N. Condie
Rehabilitation Engineer
Dundee Limb Fitting Centre
Dundee, Scotland

Proposed Amendment to the Constitution

The following amendment to ISPO's Constitution has been formulated by the Executive Board and will be discussed and voted on by the International Committee at its meeting which will be held in association with the World Congress in Melbourne, 2–7 April, 1995.

The proposed addition to the Constitution, Clause 4.5.10, formally recognises the role of International Consultants to the Executive Board.

Before the International Committee discusses this proposal, the Constitution requires it be published to the International Committee and Members and Fellows for comment. Any such comments should be received by the Honorary Secretary before 1 November, 1994.

> 4.5.10 The President, with the approval of the Executive Board, may appoint International Consultants with regard to identified tasks in relation to specific countries or geographical regions.

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Prosthetics and Orthotics International, 1994, 18, 55-56

ISPO Update Course on
Lower Limb Amputations and Related Prosthetics and Compound Fractures

26th-30th September 1994
Ljubljana, Slovenia

Introduction

The format of this **fourth update** course following the Consensus Conference on Amputation Surgery, in Glasgow, October 1990 will be review lectures based on the presentations at the consensus conference and the points from the discussions leading to contemporary recommendations. Consideration will also be given to the treatment of compound fractures.

Ample time will be allocated for elucidation and discussion with the participants. The course is aimed at orthopaedic surgeons, general surgeons, rehabilitation specialists, prosthetists, orthopaedic technologists and other members of the amputation team, primarily from Central and Eastern Europe.

Venue

The Institute for Rehabilitation of the Republic of Slovenia, 61000 Ljubljana, Linhartova 51, Slovenia.

Course Fee

The course fee is DEM 175 which covers lectures, Consensus Conference Report, coffee and tea. Lunches can be provided at a subsidised cost

Accommodation

Accommodation can be arranged at the Holiday Inn at a cost of DEM 197 per night for single occupancy and DEM 265 per night for double occupancy; at the Hotel Grand Union or Hotel Slon at a cost of DEM 85 for single occupancy and DEM 122 for double occupancy; or at Hotel Lev at a cost of DEM 73 for single occupancy or DEM 98 for double occupancy. Prices include breakfast. Alternatively accommodation can be arranged in a hostel at a cost of DEM 50 for single occupancy and DEM 70 for double occupancy without breakfast.

Transport

By plane to Ljubljana International Airport. Bus transportation between the airport and Ljubljana is DEM 5 per person and a taxi is DEM 50

Sponsorship

Prospective participants are encouraged to seek sponsorship from local offices of such agencies as Ministry of Health, Ministry of Social Services, British Council, World Health Organisation and any other local agencies.

(continued overleaf)

Name_____
Male/Female (Delete as appropriate)
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Institution address_____

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Telex: _____
Profession _____

I require accommodation in:
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Double ☐

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Hotel Grand Union ☐
Hotel Slon ☐
Hotel Lev ☐
Hostel ☐

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Time _____ Flight No._____
Expected date of departure_____
Time _____ Flight No._____
Registration Fee for Update Course DEM 175
Payment enclosed as bank draft ☐
Payment to be made on arrival
Date_____
Signature _____

Collaborators

The course is organised in collaboration with the World Health Organisation, Institute for Rehabilitation of the Republic of Slovenia, the Physical Medicine and Rehabilitation Association of Slovenia, World Orthopaedic Concern and the International Committee of the Red Cross.

Registration Form

Mail or fax to Dr. J Steen Jensen, ISPO, Borgervaenget 5, 2100 Copenhagen Ø, DENMARK. Fax No: (45) 31 18 16 69. Bank drafts should be made payable to ISPO.

Preliminary Programme

Monday

War injuries
Compound Fractures

Tuesday

Education, Training and Appropriate Technology NL WHO Viewpoint
Amputation Surgery – General Considerations

Wednesday

Basic Biomechanics
Materials
Clinic Team Approach
Patient Care including Physiotherapy

Thursday

Trans-femoral (Above-knee) Amputations and Prosthetics

Friday

Knee Disarticulation Amputations and Prosthetics

Trans-tibial (Below-knee) Amputations and Prosthetics

Further Information

Should you require further information contact: Dr. J Steen Jensen, ISPO, Borgervaenget 5, 2100 Copenhagen Ø, DENMARK. Fax No: (45) 31 18 16 69.

Provisional Faculty

Croatia:	B. Lagerkvist	(Doctor)
Denmark:	H. Hermanova	(Doctor)
	J. Steen Jensen	(Surgeon)
Germany:	G. Neff	(Surgeon)
Hungary:	L. Kullman	(Surgeon)
Ireland:	A. de Bont	(Pros/Orthotist)
Slovenia:	Č. Marinček	(Doctor)
Sweden:	R. Hammer	(Surgeon)
	B. Persson	(Surgeon)
Switzerland	J. Gehrels	(Pros/Orthotist)
UK:	R. Ham	(Physiotherapist)
	N. A. Jacobs	(Bioengineer)
	A. Jain	(Surgeon)

Local Organising Committee

Chairman:	Črt Marinček
Members:	Franc Hočevar
	Martin Štefančič

Please send application form to:

Dr. J. Steen Jensen
ISPO
Borgervaenget 5,
2100 Copenhagen Ø
Denmark

Prosthetics and Orthotics International, 1994, 18, 57-58

ISPO Update Course on
Lower Limb Amputations and Related Prosthetics and Compound Fractures

14th-18th November 1994
Panama City, Panama

Introduction

The format of this **fifth update** course following the Consensus Conference on Amputation Surgery, in Glasgow, October 1990 will be review lectures based on the presentations at the consensus conference and the points from the discussions leading to contemporary recommendations. Consideration will also be given to the treatment of compound fractures.

Ample time will be allocated for elucidation and discussion with the participants. The course is aimed at orthopaedic surgeons, general surgeons, rehabilitation specialists, prosthetists, orthopaedic technologists and other members of the amputation team, primarily from Central and South America and the Carribean.

Venue

The El Panama Hotel, Panama City, Panama.

Course Fee

The course fee covers lectures, Consensus Conference Report, coffee and tea and is as follows:

	Members	Non-members
Specialist Doctors	US$125	US$150
Residents	US$100	US$125
Prosthetists/Therapists	US$75	US$100
Medical Students	US$65	US$75

Languages

Simultaneous translation will be provided between English and Spanish.

Accommodation

Accommodation can be arranged at the El Panama Hotel at a cost of US$95 per night.

Transport

By plane to Panama City International Airport. Local transportation is available between the airport and Panama City.

Sponsorship

Prospective participants are encouraged to seek sponsorship from local offices of such agencies as Ministry of Health, Ministry of Social Services, British Council, World Health Organisation and any other local agencies.

Collaborators

The course is organised in collaboration with the World Health Organisation, ACOPPRA, the Panamanian Society of Orthopaedic Surgeons, World Orthopaedic Concern and the International Committee of the Red Cross.

(continued overleaf)

Name_____
Male/Female (Delete as appropriate)
Mailing address _____

Institution address_____

Tel: _____ Fax:_____
Telex: _____
Profession _____

I require accommodation in El Panama ☐

Expected date of arrival _____
Time _____ Flight No._____
Expected date of departure
Time _____ Flight No._____
Registration Fee for Update Course:
Payment enclosed as bank draft ☐
Payment to be made on arrival ☐
Date_____
ISPO Membership No. _____
Signature_____

Registration Form

Mail or fax to Dr. J Steen Jensen, ISPO, Borgervaenget 5, 2100 Copenhagen Ø, DENMARK. Fax No: (45) 31 18 16 69. Bank drafts should be made payable to ISPO.

Preliminary Programme

Monday

War Environment in Developing Countries
Compound Fractures

Tuesday

Amputation Surgery — General Considerations
Basic Biomechanics

Wednesday

Trans-femoral (Above-knee) Amputations, Prosthetics and Physiotherapy
Knee Disarticulation Amputations, Prosthetics and Physiotherapy

Thursday

Trans-tibial (Below-knee) Amputations, Prosthetics, and Physiotherapy
Ankle and Foot Amputations and Prosthetics

Friday

Prosthetics supply in Central and South America and the Carribean
ACCOPRA Annual Meeting.

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A. Brown	(Finance)
A. Saldana	(General Coordinator)
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Fax No: (45) 31 18 16 69.

Please send application form to:

Dr. J. Steen Jensen
ISPO
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2100 Copenhagen Ø
Denmark

Calendar of Events

1-5 May, 1994
20th Canadian Medical and Biological Engineering Society Conference, Vancouver, Canada.
Information: CMBEC Secretariat, c/o National Research Council, Room 393, Bldg. M-55, Ottawa, Ontario, K1A OR8, Canada.

31 May-2 June, 1994
Annual Meeting of International Medical Society of Paraplegia, Japan.
Information: IMMSOP '94 Annual Meeting, Japan Organising Committee, Orthopaedic Dept. of Tokushima University, Kuramotocho, Tokushima-shi, 770, Japan.

31 May-3 June, 1994
8th World Congress of Orthopadie + Reha Technik International, Essen, Germany.
Information: Verlag Orthopadie Technik, 4600 Dortmund 1, Reinoldestrasse 7-9, Postfach 10 06 51, Germany.

1-3 June, 1994
'Beyond Normalization Towards One Society For All', Reykjavik, Iceland.
Information: 'Beyond Normalization', Iceland Tourist Bureau, Congress Dept., Skogarhlid 18, 101 Reykjavik, Iceland.

4-8 June, 1994
Annual Conference of the American Physical Therapy Association, Toronto, Canada.
Information: APTA, 111 N. Fairfax Street, Alexandria, VA 22314, USA.

17-22 June, 1994
Annual Meeting of the Rehabilitation Engineering Society of North America, Nashville, USA.
Information: RESNA '94, Suite 700, 1101 Connecticut Ave. NW, Washington DC 20036, USA.

21-24 June, 1994
10th Congress of the International Society of Electrophysiology and Kinesiology, Charleston, USA.
Information: Dr. R. Shiavi, Biomedical Engineering, Box 6117, Station B, Vanderbilt University, Nashville, TN 47235, USA.

July, 1994
1st International Rehabilitation Medicine Conference, Kuala Lumpur, Malaysia.
Information: The Secretariat, Rehabilitation Unit, University Hospital, Lembah Pantai, 59100 Kuala Lumpur, Malaysia.

2-6 July, 1994
12th International Symposium of Biomechanics in Sport, Budapest, Hungary.
Information: ISBS '94 Symposium Secretariat, Dept. of Biomechanics, Hungarian University of Physical Education, H-1123 Budapest, Alkotas u.44, Hungary.

5-8 July, 1994
Dundee '94 – International Conference on Clinical Gait Analysis, Dundee, Scotland.
Information: Dundee '94 Secretariat, Dundee Limb Fitting Centre, 133 Queen St., Broughty Ferry, Dundee DD5 1AG, Scotland.

10-12 July, 1994
Society for Research in Rehabilitation Summer Meeting, Nottingham, England.
Information: Dr. N. Lincoln, Stroke Research Unit, General Hospital, Park Row, Nottingham, NG1 6HA, England.

10-15 July, 1994
2nd World Congress of Biomechanics, Amsterdam, The Netherlands.
Information: Biomechanics Section, Institute of Orthopaedics, University of Nijmegen, PO Box 9101, 6500 HB Nijmegen, Netherlands.

20-26 August, 1994
17th International Conference on Medical and Biomedical Engineering, Rio de Janeiro, Brazil.
Information: Dr. C. G. Orton, International Organization for Medical Physics, Gershenson Radiation Oncology Center, Harper-Grace Hospitals, 3990 John R., Detroit, MI 48201, USA.

26-27 August, 1994
1st International Symposium on the Lumbar Spine, Brussels, Belgium.
Information: International Society for the Study of the Lumbar Spine, c/o Sunnybrook Medical Centre, Room A309, 2075 Batview, CDN Toronto, Ontario M4N 3M5, Canada.

4-9 September, 1994
6th European Regional Conference of Rehabilitation International, Budapest, Hungary.
Information: Rehabilitation Secretariat, ISM Ltd., The Old Vicarage, Haley Hill, Halifax HX3 6DR, England.

21-23 September, 1994
Biological Engineering Society AGM and Annual Scientific Meeting, Keele, England.
Information: Mrs. B. Freeman, BES, RCS, 35 Lincoln's Inn Fields, London, England.

28 September-1 October, 1994
International Meeting on Knee Prostheses, Naples, Italy.
Information: Prof. V. Montelone, II Divisione Ortopedia e Traumatologia, Ospedale Cardarelli, Via A. Cardarelli 9, 80131 Napoli, Italy.

9-13 October, 1994
6th Biennial Conference of the International Society for Augmentive and Alternative Communications, Maastricht, The Netherlands.
Information: Van Namenand Westerlaken, PO Box 1558, 6501 BN Nijmegen, The Netherlands.

14-16 October, 1994
Biomedical Engineering Society Annual Fall Meeting, Tempe, Arizona, USA.
Information: BMES, PO Box 2399, Culver City, CA 90231, USA.

11-15 October, 1994
American Orthotic & Prosthetic Association: Annual National Assembly, Washington, USA.
Information: AOPA, 1650 King St., Suite 500, Alexandria, VA 22314, USA.

7-10 December, 1994
8th International Conference on Biomedical Engineering, Singapore.
Information: The Secretary, 8th ICBME 1994, Dept. of Orthopaedic Surgery, National University Hospital, Lower Kent Ridge Rd., Singapore 0511.

1995

17-18 February, 1995
ISPO (UK) Annual Scientific Meeting, Hull, England.
Information: Mr. D. Simpson, ISPO Hull '95, NCTEPO, University of Strathclyde, 131 St. James' Rd., Glasgow G4 0LS, Scotland.

16-18 February, 1995
11th International Seating Symposium, Pittsburgh, USA.
Information: Elaine Trefler, University of Pittsburgh Medical Centre, Dept. of Conference Management, Nese-Barkan Building, Suite 511, Pittsburgh, PA 15213, USA.

18-19 March, 1995
11th Annual Conference of the Association of Prosthetists and Orthotists, Telford, England.
Information: Mr. W. Dykes, APO Conference Co-ordinator, NCTEPO, University of Strathclyde, Curran Building, 131 St. James' Rd., Glasgow G4 0LS, Scotland.

27-31 March, 1995
12th World Congress of the International Federation of Physical Medicine and Rehabilitation, Sydney, Australia.
Information: IFPMR Congress Secretariat, DC Conferences, PO Box 629, Willoughby NSW 2068, Australia.

2-7 April, 1995
8th World Congress of the International Society for Prosthetics and Orthotics, Melbourne, Australia.
Information: Congress Secretariat, 8th World Congress of the International Society for Prosthetics and Orthotics, 84 Queenbridge St., South Melbourne, Victoria, Australia 3205.

Summer, 1995
Medicon '95: 7th Mediterranean Meeting on Medical and Biological Engineering, Israel.
Information: Prof. S. Siderman, c/o Prof. W. Welkowitz, Dept. of Electrical Engineering, PO Box 909, Piscataway, NJ 08854, USA.

16-19 July, 1995
7th International Conference on Mobility and Transport for Elderly and Disabled People, Reading, England.
Information: 7th Int. Conf. Secretariat, Disability Unit, Dept. of Transport, Room S10/21, 2 Marsham Street, London SW1P 3EB, England.

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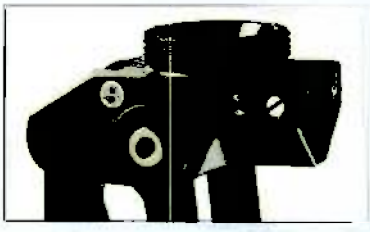

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