Newsletter..



Prosthetics and Orthotics Clinic

Vol. 1, No. 4

Autumn 1977

Notes and Comments

The quantity of responses and dialogue we have been able to generate in the Newsletter from clinic team members still remains quite low. However, we have been pleased by the increased depth of interest shown by recent respondents to the Questionnaire. Again, we ask you to send in your responses promptly but by no means feel that you must restrict your comments to the printed questions. We urge you to comment on any subject that would be of interest to you and other team members.

We are also soliciting lead articles

from our subscribers for printing in future additions of the Newsletter. May we have your assistance in this area?

> Joseph M. Cestaro, C.P.O. Editorial Board

"Partial Foot Amputation"

Results of the Questionnaire Survey

There were fifteen replies by mail to the questionnaire on management of patients with partial foot amputation that appeared in the Summer 1977 issue of the NEWS-LETTER. Ten came from prosthetists, one from a physical therapist, and four from physicians.

The answers and remarks from all but one prosthetist are given below. One prosthetist, Lewis Meltzer of Miami, Florida, took the time and trouble to write a very thoughtful letter which is printed in full after the tabulation of the questionnaires.

- 1. Do you feel that patients with partial foot amputations require prostheses that extend higher than the distal third of the tibia?
 - A. No. Ankle high only.
 - B. The prosthesis should not be higher than maleoli.
 - C. Yes.

CERTIFIED PROSTHETISTS

- D. Very seldom
- E. Especially true for active people. Low activity people without deformities seem to function well with the least amount of appliance.
- F. Not in all cases, for example, we're using C. Fillauer's AC & PLIC socket w/posterior (6) split for a great percentage of our partial foot amputees.

G. No.

- H. I basically avoid terminating a prosthesis on the lower tibia. Often a shoe insert with the filler works fine. If a rigid ant. is used, I definitely do not stop at any point on the tibia.
- I. Transmetatarsal or longer No. All others - Yes.
- J. If hand users.
- K. Yes.
- L. No.

S

D.

- M. If full, pain free, weight bearing is possible on the remaining part of the foot - No. If not, then weight needs to be taken higher.
- E N. Yes.
- 2. Do you feel that most patients who receive partial foot amputations would function better with a Syme's amputation?
 - A. No.
 - B. No, as long as the plantar surface can tolerate weight bearing, a partial foot is better than Syme's.
 - C. No.
 - D. No.
 - E. Again active people and children who can possible avoid bone spurs and eventually develop an endbearing cosmetic BK. Surgery is impor-

Prepared by the American Academy of Orthotists and Prosthetists, 1444 N Street, N.W., Washington, D.C. 20005. Editor: A. Bennett Wilson, Jr., B.S. M.E.; Editorial Board: Joseph M. Cestaro, C.P.O., Charles H. Epps, Jr., M.D., Robert B. Peterson, R.P.T.

CERTIFIED PROSTHETISTS

tant. Good padding over bones is very beneficial.

- F. Yes, the large majority would increase their function and be relatively pain-free.
- G. No.

CERTIFIED PROSTHETISTS

M.D.'S

CERTIFIED PROSTHETISTS

H. No. I have seen too many patients function beautifully with partial foot and only a toe filler.

I. For P.V.D. patients a Symes amputation usually has a better chance to heal and the prosthetic fitting is better. For traumatic amputations as much length should be preserved to increase weight bearing surface and lever arm.

- J. Yes, but not all.
- K. Not necessarily.
- L. Yes, at least psychologically.
- M. No. A Syme's is much more radical than is often necessary and will not necessarily result in better function.
- H. N. Yes.
- 3. Do you agree with the author's list of advantages and disadvantages of this amputation?
 - A. Some.
 - Β.
 - C. Yes.
 - D. Yes.
 - E. I feel amputation sites for children should take bony overgrowth and foreshortening into account, i.e., disarticulation rather than partial foot types.
 - F. Not in its entirety, but generally speaking, yes. G. Yes.
 - U. 165.
 - H. Some of them.
 - I. Yes we do, however, prosthetic breakdown will still occur regardless which type is fitted.
 - J. No. They are not the indication for the procedure.
- S, O.M. K. ?
 - L. Yes.
 - _ M. Partially.
- N. Yes.
- 4. Do you feel that the sole or shank of the shoes or prosthesis should be rigid or flexible?
 - A. Flexible.
 - B. Flexible, to provide easy roll over the often tender distal anterior foot.
 - C. Rigid to metatarsal break, flexible distal from this point.
 - D. Rigid except for toe flexibility.
 - E. The sole should extend the toe break past the end of the amputation, rigid slightly past this point.

F. We think in terms of the SACH foot function using rigid soft tissue support w/flexible forefoot.

G. Flexible.

CERTIFIED PROSTHETISTS

D.'S

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- H. Depends on patient's gait, toe off phase especially. Generally rigid to the ball of the shoe and flexible in the toe area.
- 1. Usually, a rigid shoe and/or prosthetic foot functions better. However, we do have success using a modified Winnipeg Symes Prosthesis, which is partially flexible.
- J. Rigid.
- K. Rigid.
- L. Do not know.
- M. It depends largely on the level of amputation, the shoe control which is achieved and the residual ankle function. In general it needs to be rigid proximal to the metatarsal heads and capable of flexing to about 15° under the metatarsal heads when loaded.

Sometimes, e.g. when the metatarsal heads are painful or in a very proximal level amputation, it needs to be rigid throughout and with a rocker base. If there is adequate ankle function, and reasonable shoe control on the residual foot, the prosthesis should flex at the ankle too.

N. Rigid.

- 5. Please comment if you have experience with the "ankle-foot orthosis" type of treatment mentioned here and described by Fillauer.
 - A. I have been using the same basic idea for several years with good success.
 - B. I have used this on one patient and he was quite pleased.
 - C.

CERTIFIED PROSTHETISTS

D.'S

L.

- D. No experience.
- E. No experience. I added another approach to my repertoire.
- F. No experience.
- G. Yes.
 - H. I have used the AFO with a toe filler attached a few times recently and am very satisfied with the results.
- I. Yes, only very limited.
- J. Yes, occasionally useful.
- K. No.
- Σ L.
 - _M. No experience.
 - N. No experience.
- 6. Would you be willing to contribute to an "atlas" or "catalog" of methods for providing prostheses for partial foot amputations?

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CERTIFIED PROSTHETISTS

ED PROSTHETISTS	- A.	Yes.
	В.	Yes.
	C.	Yes.
	D.	Yes.
	E.	Yes, although my experience is limited (which is probably the situation 90% of the time). A ready reference such as this may help us all solve the unique problems each of these am- putees present.
E	F.	Enthusiastically.
CER	G.	Yes.
	Н.	At present I have nothing new to contribute.
	_1.	Yes, we would.
S.'O'W	– J. K. L.	Yes. No. Do not feel qualified to do so. Yes.
P.T.	_N.	No, not enough experience.

CONCLUSIONS

It can be seen that although there is a wide variation of opinion about partial foot amputations and prostheses, more than half of the practitioners feel that partial foot amputations can provide better function than the Syme's.

Nearly all of the respondents would be glad to contribute to an "atlas" or "catalog" of methods for providing prostheses for partial foot amputations.

Mr. Meltzer's letter, which follows, seems to sum up the state of the art and is reproduced here in full.

September 27, 1977

Newsletter Questionnaire AAOP 1444 N Street, N.W. Washington, D.C. 20005

The following are the answers to your questions as per your request from the Newsletter Questionnaire, copy enclosed.

NAME: Lewis N. Meltzer, C.P.O.-

1. Do you feel that patients with partial foot amputations require prostheses that extend higher than the distal third of the tibia?

It has been my experience that patients with partial foot amputations occasionally cannot tolerate the Fillauer type orthosis. Yet, for cosmetic purposes, they prefer it rather than something extending above the shoe. I have fitted a few and only succeeded with one. This is after extended trials by myself and the patient. Yet, the two who were not satisfied, preferred to wear nothing and have been lost to follow up. Several years ago I worked with polypropylene or similar AFO's with toe fillers and steel shanks in the shoe, and those seemed to work satisfactorily. I think that Mr. Pritham's idea merits trials. My only concern is cosmetic acceptance when compared to the Fillauer type.

2. Do you feel that most patients who receive partial foot amputations would function better with a Syme's amputation?

This seems like an ambiguous question which I feel I can only answer by saying it would depend on the individual. At the same time, all else being equal, partial foot amputation would be my choice were I to need that type of amputation as I could more easily walk without a prosthesis either around the house or at night.

3. Do you agree with the author's list of advantages and disadvantages of this amputation? Yes.

4. Do you feel that the sole or shank of the shoes or prosthesis should be rigid or flexible?

Here, again, this would depend on the patient as I have seen patients desiring no prosthesis.

5. Please comment if you have experience with the "ankle-foot orthosis" type of treatment mentioned here and described by Fillauer.

The Fillauer method I have tried has included a section of Silastic R.T.V. in the anterior distal socket for comfort and total contact. This is laminated over the cast rather than after the prosthesis is made. With this, I still have had only one satisfied patient. The other two required several attempts at fitting and yet the patients were not satisfied.

6. Would you be willing to contribute to an "atlas" or "catalog" of methods for providing prostheses for partial foot amputations?

I would be willing, if I felt I had something specific to offer as an alternative, but I have not found it to date.

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Sincerely,

Lewis N. Meltzer, C.P.O.

Should Functional Ambulation be A Goal for Paraplegic Persons?

Michael J. Quigley, C.P.O.¹

The goal of functional ambulation for paraplegic persons is a subject of long debate in virtually all rehabilitation settings. Such factors as lesion level, motivation, attitude of the clinic team, age, body build and occupation are important determinants when orthoses are prescribed for ambulatory purposes. Despite the various orthotic designs available, and the philosophies that accompany each design, the majority of paraplegic persons will either reject their orthoses or not have them prescribed.

Personal experiences and published reports indicate that when a thoracic level lesion is present, only about two percent of patients fitted will reach the level of household ambulation. There are many reasons for this, the main one being the excessive energy expenditure needed to ambulate in an orthosis. The donning procedure for most orthoses is difficult and time consuming, and once the orthoses are on the patient they often interfere with transfer activities. In addition, crutches are needed for stability while standing and ambulating, which limits the use of the hands and arms. Other problems with standing and ambulation for paraplegic patients are the lack of bladder control while standing and obviously abnormal walking pattern.

In this brief article, I will review some of the more pertinent articles on this subject, and then present my opinion concerning the provision of lower-limb orthoses for paraplegic persons.

The history of the orthotic treatment of paraplegia does not go back much further than World War II, since previous to that time about 90 percent of the spinal-cord-injured persons died from genitourinary infections. The development of antibiotics to combat these infections reversed the fatality rate shortly after World War II (4).

¹Rehabilitation Engineering Center, Rancho Los Amigos Hospital, Downey, California. The physiological benefits of standing persons with paraplegia were first mentioned by Abramson (1) in 1948, who stated that an hour of standing each day will prevent osteoporosis in the lower limbs and helps to prevent urinary calculi and genitourinary infections. In 1964, Rusk (7), stated that "circulation and nutrition, as well as morale, are also aided by keeping the patient in the upright position for several hours each day".

Rusk also recommended that the tenth thoracic vertebra be used as a landmark when prescribing orthoses; lesions at or superior to this level are usually given double-bar long leg-braces with a pelvic band and Knight spinal attachment (current terminology is LSHKAFO, or lumbo-sacral-hip-knee-ankle foot orthosis); lesions inferior to T₁₀ level are prescribed the same orthoses without the spinal attachment, and lesions inferior to L₁ are fitted without a pelvic band.

Hahn (3) and Scott (9) from Craig Rehabilitation Hospital in Denver, Edberg (2) from Rancho Los Amigos Hospital in Downey, and Warren et. al., (11) from the University of Washington, do not advocate the use of the pelvic band on paraplegic patients. Edberg feels that the pelvic band must apply excessive pressure against the skin to be effective, that it causes difficulty in donning the orthosis, limits flexibility and adds excessive weight. Hahn and Scott state that the two most important considerations for orthotic design for paraplegics are ease of donning and control of ankle dorsiflexion, hence the so-called Craig-Scott design KAFO (Fig. 2) has no pelvic band, only one thigh band, and a fixed but adjustable ankle joint.

Hussey and Stauffer (5) studied the ambulatory function of 164 spinalcord-injured patients at Rancho Los Amigos Hospital and stated that "no patient achieved any form of functional ambulation without pelvic control* and there appeared to be no effective method of bracing patients to overcome this deficit". The nerve supply for the pelvic control muscles is affected by a thoracic lesion.

Rosman and Spira (7) reported similar problems in ambulating patients with thoracic lesions. In a study of 35 patients with lesions from the T1 to T₁₁ level who were fitted with orthoses for ambulation, only one patient was ambulating out of the hospital, and five used the orthosis for standing only. The report concluded "that there is an essential difference between the 'occupation' of walking in the 'non-pressured' rehabilitation environment and walking when faced with the problems of everyday life". It further concludes that "some disabled persons with unusual strength, willpower, and motivation for walking will successfully overcome the difficulty, effort, and social strain involved in the continuous use of braces", but that "most will eventually relinquish these goals because the effort proves too great".

Pneumatic orthoses (Fig. 1) were developed and first used in the United States, amid great fanfare, in 1973. Three major evaluations by Silber (10), at New York's Bird S. Coler Hospital, Ragnarsson et. al., (6) at the Institute of Rehabilitation Medicine, New York University, and by the Committee on Prosthetics Research and Development, National Academy of Sciences (13) on a total of 62 paraplegic persons indicate that the orthoses were lighter than metal designs and required less energy for ambulation but severe mechanical limitations, such as donning and inflation problems, outweigh these advantages when the orthoses are used outside of an institutional setting.

A study by Cerney (12), at Rancho Los Amigos Hospital, comparing energy costs for eight paraplegics

^{*}The Term "pelvic control" used here refers to the ability of the abdominals to move the pelvis when body weight is on the crutches.



Fig. 1. Ortho-Walk Type B Pneumatic Orthosis.

walking versus using a wheelchair concluded "The average velocity for paraplegic walking was less than half of normal while oxygen uptake per minute was increased by 50 percent. These two factors combine to create an oxygen uptake per meter than is increased six times". Similar data for the same patients using wheelchairs, again compared to normal individuals, showed "only a two to six percent increase in the physiological factors and a ten percent decrease in velocity". Despite the poor track record I have documented, ambulation is still considered a goal for paraplegic patients in most rehabilitation settings. Obviously, the patient will fail to reach this goal in most cases, so why do most of us expend our energies in this area? I feel there are benefits to be gained by providing ambulation training. For one, nearly all new paraplegic persons believe they will walk again, and it is virtually impossible to convince them otherwise. These patients feel that they are being deprived of their chance for complete rehabilitation if they are never given the opportunity to try to walk. Psychologically, they must prove it to themselves. After these patients are convinced that walking is impractical, they will concentrate more heavily on becoming wheelchair-independent.

A physician I worked with in Chicago told the story of an obese, bilateral above-knee amputee who wanted to be fitted with prostheses so he could walk again. They physician refused to prescribe a prostheses as he knew that the patient could never use them, and told the patient he would not be able to walk again. The patient immediately suffered a nervous breakdown in the clinic and re-



Fig. 2. Craig-Scott Orthosis

quired hospitalization. From that day on, the physician prescribed prostheses for patients with similar problems so they could convince themselves of the impracticality of ambulation and, more important, have a longer period of time to accept reality.

A small percentage of patients do ambulate in orthoses (Fig. 3), espe-



Fig. 3. Polypropylene Knee-Ankle-Foot Orthoses for Paraplegia

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cially those patients with pelvic or hip control or sensation. It is impossible to predict successful ambulators, and patients should be given a chance to succeed. Obviously, patients who lack motivation, are very obese, or who lack strength and endurance will never succeed and should be dissuaded from trying to ambulate.

In this article I have attempted to back up my personal experiences with information from published reports, and then to justify why most paraplegics are given ambulation training despite the poor prognosis. We would appreciate your thoughts on this subject and therefore encourage you to complete the attached questionnaire.

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NEWSLETTER QUESTIONNAIRE

(Return to AAOP, 1444 N Street, N.W., Washington, D.C. 20005)

ADDRESS (Optional):					
PR	OFESSION: MD[] PT[] OT[] CP[] CO[] Counselor[] Other[]				
1.	Do your experiences in this area of ambulation training for paraplegics correlate with the authors?				
	YES NO COMMENTS:				
2.	Does your clinic routinely provide lower-limb orthoses and ambulation training to parap- legic persons?				
3.	Do you agree with the author's indications for ambulation training? YES NO WHAT ARE YOUR INDICATIONS?				
4.	How much and what type of ambulation training is provided to paraplegic persons in your area?				
5.	What orthotic designs do you recommend for paraplegic patients?				

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6. Is it practical to expect ambulation with LSHKAFO's?

Newsletter... Prosthetics and Orthotics Clinic

Enclosed is my check for \$8.00 for a 1-year subscription to the Prosthetics and Orthotics Clinics Newsletter. (Foreign Subscription Price is \$9.00)

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Newsletter...



Prosthetics and Orthotics Clinic

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Issued Quarterly

A Proposal for Delivery of Externally Powered Upper-Limb Prostheses

There are about 322,000 amputees in the United States today. Of this number, approximately 9,000 people have upper-arm amputations and 16,000 have forearm amputations. Many arm amputees choose not to wear a prosthesis for three major reasons; 1) lack of sensory feedback, 2) poor function and 3) poor cosmesis.

Unfortunately, the vast majority of physicians, therapists, and prosthetists seem to believe that new amputees should always be provided a hook first, and a hand later, if the hook is accepted. Nearly all patients, however, want a hand first and dread the thought of using a hook for obvious cosmetic and psychological reasons. In a great number of cases, the hook and prosthesis are rejected due to the undue amount of attention attracted to the wearer.

Body powered mechanical hands are heavy, cumbersome, and far less prosthetic hands has been for unilateral amputees who are engaged in light-duty work and are very conscious of cosmesis.

The introduction of the VA- Northwestern University, Otto Bock, Variety Village, and other powered hands and elbows for prostheses should change the dismal attitude concerning prosthetic hands. These prostheses are extremely cosmetic, and require very little body motion and little or no harnessing to control the hand. The hand can be controlled easily whether the wearer is reaching for something over his head or behind him, which was previously very difficult. Powered prostheses are of greatest value for patients with high amputations, whether they are unilateral or bilateral. These patients are normally present complicated problems because they lack the muscle power and leverage to control mechanical prostheses, but they can easily con-

"Powered prostheses have received a very cool reception in the United States due to—high cost and a greater expertise required to fit."

functional than hooks. The same amount of harnessing and body power is required to control these hands as with the hooks. The cosmetic gloves that cover these hands are easily stained, torn, and discolored. The major indication for trol powered prostheses by myoelectric or switch controls.

Powered prostheses have received a very cool reception in the United States due to a number of factors; the cost of the prostheses is high four to five times that of conven-

tional prostheses-and therefore many third-party payers refuse to pay for them. The prosthetist fitting an externally powered prosthesis must be well trained in order to evaluate myoelectric potentials and to properly fit and maintain the prosthesis. As most prosthetists have no background in electronics, more that a short orientation course is required. Even after thorough training is obtained, the prosthetist may only see two or three patients per year requiring these types of prostheses, and therefore much of the information will be forgotten. In many cases, components that were intended to be modular in concept and simply plugged in need to be reworked or redistribued around on the socket in order to accommodate a long or non-standard type of amputation. In a study conducted by the Veterans Administration 18 prosthetists were involved in an evaluation of powered prostheses. All prosthetists were given a one-totwo-week course by the VA on myoelectric prostheses and patients were referred to them through VA clinics for fittings. Despite all this education, prosthetist errors were responsible for more malfunctions than any other cause. Faced with all of the above facts plus the fact that the cosmetic glove is still a problem. most prosthetists chose not to handle externally powered prostheses. Further, since such a small percentage of the amputee population can be fitted with this type of prosthesis,

Prepared by the American Academy of Othotists and Prothetists, 1444 N St., N.W., Washington, D.C. 20005. Editor: A. Bennett Wilson, Jr., B.S. M.E.; Managing Editor: Brian A. Mastro, B.A.; Editorial Board: Joseph M. Cestaro, C.P.O., Charles H. Epps, Jr., M.D., Robert B. Peterson, R.P.T. most prosthetists find it impractical to invest the great amount of time and money for education and equipment before they can provide satisfactory service.

It has been shown that in areas where prosthetists learned enough about powered prostheses to be able to properly fit and maintain them, the prostheses received wide acceptance. John Billock, C.P.O., in Warren, Ohio uses a number of different powered prosthesis systems, including hybrid models using components of different systems on severely disabled upper-limb amputees that are referred from all over the Midwest. William Sauter at Ontario Crippled Childrens Center has also proven the practicality of powered systems on adults and children. In each area, however, institutional support has been the determining factor. Mr. Billock's success was achieved after years of participation in the research program at Northwestern University and Mr. Sauter's work is done in a large Rehabilitation Center. Similarly, the Bock system is used in Minneapolis due to a great amount of support from the Germany-based Otto Bock Company to its United States headquarters in Minneapolis. The Otto Bock Company is presently offering a free one-week course on the basic below-elbow system, and plans future courses on advanced powered components.

We are faced with the situation that powered upper-limb prostheses

are presently available but are not used for the many reasons stated previously. How do we solve the service delivery problem, particularly for the more severely disabled upper-limb amputee? I suggest that specialized fitting centers are the best solution to the problem. Such centers can be privately owned or located in an institution. The advantage of this system is that the prosthetist would see enough patients to become truly expert in the

"It seems obvious—"powered prostheses will be more common than body powered prostheses."

area of powered prostheses, and could well afford the expense of taking all relevent courses or preceptorships and obtaining the necessary staff and equipment.

I have visited one such center in Warren, Ohio, which is owned by John Billock, C.P.O. Mr. Billock and his staff at Warren Orthotics and Prosthetics Restoration Laboratory fit three to four powered upperlimb prostheses per month, including all levels of amputation. His staff includes a full time electrical engineer and an electronics technician. There are enough equipment and spare parts available so that essentially all maintenance is carried out on the scene, which avoids long delays when repairs are done elsewhere. Patient referrals are mostly

from the Midwest and East Coast, although patients from the West Coast are not uncommon. One patient being seen during my visit had a right shoulder disarticulation and a left above-elbow amputation and was being fitted with powered hands, elbows and wrist rotators controlled by switches. Components from at least three manufacturers had to be made compatible in the ten-month long project.

I feel that a total of four centers in the United States could adequately handle the patient load. The average prosthetist with a good understanding of powered prostheses will be able to treat most unilateral belowelbow patients, so referrals to a powered prosthesis center will usually be for more difficult cases. It will be important for private centers to be closely allied with a rehabilitation center, as these patients will require therapy, counseling, and other services while the prosthetic services are being performed.

It seems obvious to me that powered prostheses will be more common than body powered designs within the next twenty years, and it is time now to establish an efficient service delivery system.

> by Michael J. Quigley, C.P.O.

Concerning Suspension Alignment, and Control

In the prescription of any prostheses consideration is naturally given to the proper means of suspending the prosthesis and maintaining it in place. In contrast, not as much concern seems to be given to this crucial matter in the prescription of an orthosis.

Paradoxically, this relative state of neglect is undoubtedly due to the very success with which suspension has been incorporated in most conventional orthosos. To cite but one example, the shoe that inevitably must be used with any ambulatory AFO, KAFO, or HKAFO provides for suspension of the device as well as providing support to the ground.

In recent years with the expansion of new technology in the area of prosthetics and orthotics there has developed a corresponding interest in new techniques to overcome shortcomings in conventional devices. In the process, however, new problems can arise as a result of the intertwining roles played by various components of the device under consideration, and it would therefore appear worthwhile to attempt to sort out these various roles with special emphasis on suspension in order to clarify the picture, and possibly, as a result, to suggest new and unique applications for the various suspension systems available.

For clarity a brief glossary has been prepared, and is included at