A Clinical Review of the Adult Hip Guidance Orthosis (ParaWalker) in Traumatic Paraplegics

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Summary

Twenty Adult traumatic paraplegics with neurologically complete lesions between C8 and T12 have ambulated using a ParaWalker (adult hip guidance orthosis), for a minimum of 6 months at home. At follow up, on average 20 months from the date of issue of the orthosis, 17 patients (85%) were still regularly using their ParaWalker. Patients achieved independent use of the orthosis and low energy ambulation both indoors and outdoors on a variety of surfaces.

A new classification of adult paraplegic ambulation using an orthosis is described.

Key words: Spinal injuries; Paraplegia; ParaWalker (Adult hip guidance orthosis).

For many paraplegics, though by no means all, the wish to walk is a high priority. The benefits are not solely social or psychological, the incidence of osteoporosis and urinary calculi is claimed to be less, and cardiovascular and bowel function may be improved (Abramson, 1948).

Successful walking however, depends on many factors not least of which is the level of the neurological deficit. Paraplegics with complete lesions between T1 and T6 were found not to use their orthoses at all, and patients with T7-T11 lesions used their orthoses for standing purposes only (Rosman and Spira, 1974).

The measured energy cost of ambulation by paraplegics in an orthosis is clearly of great importance; Gordon and Vanderwalde (1956) found that using a swing through gait with crutches and conventional bracing required an energy of 5-6 times the basal rate, a level of activity which they felt no individual could possibly sustain.

Rose (1981) increased mobility and independence for spina bifida children in a scientifically designed Hip Guidance Orthosis (HGO) pointing out that low energy cost ambulation, independent doff and don and transfer, were essential prerequisites for low-thoracic level paraplegic walking ability, in these children. Following the success of the HGO it seemed a logical progression to design an adult sized version (ParaWalker) to see if the same principles of paraplegic ambulation (Rose, 1979, 1981) could be applied to the heavier, taller adult with a neurologically complete lesion at the thoracic level.

The ParaWalker comprises a pair of rigid leg braces articulating with an equally rigid body brace via low friction ball bearing hinges. By positioning the hip ahead of the foot by either hip flexion or hyperextension the leg is able to swing forward under the influence of gravity, provided that adduction is prevented. The extreme rigidity of the orthosis allows guidance of the swinging hip joint path in relative abduction, preventing it colliding with the stance leg. The energy for forward movement comes from the upper limb musculature manipulating crutches and allowing the patient to move forward on the stance leg (Butler and Major, 1984).

Rigidity of the larger orthosis is insufficient to prevent deformation at the knee and hip articulation often preventing a free swing through of the other leg. To resist this the patient has to expend energy by pushing down on his ipsilateral crutch. Further energy expenditure is also necessary due to the height, and weight changes of the adult compared with the child. This has led to design modifications to allow electrical stimulation of the hip musculature, as an assist for the orthosis, but none of the patients reported below used this 'hybrid' type of orthosis.

Patients and methods

Twenty adult complete paraplegics who had been fitted and trained in the use of the ParaWalker and had had at least 6 months use of it at home formed the trial group.

We undertook a review to answer the following questions:

1. What is the frequency and nature of use of the ParaWalker?
2. Of what value is the ParaWalker to these patients?
3. What problems were encountered in its use?

All 20 patients had a neurologically complete lesion between C8 and D12, 18 of them between D4 and D9. All had been fitted and trained in Oswestry prior to use at home. Nine patients were interviewed in person and 11 interviewed by telephone by one of the authors (BNS). Interviews conducted by telephone were lengthy and detailed, and in no way represented a simple 'head counting' exercise. The neurological status of these patients was confirmed by medical records from referring Spinal Injury Units and further examination at the time of fitting of the ParaWalker.

The level of walking ability achieved was classified according to:

- A. The ability to doff, don and transfer, independently or dependently?
- B. The value of the orthosis to the patient?
- C. How far and where the patient was able to walk?

The walking status of each patient was therefore described as either:

A. Independent or dependent.

B. Functional or therapeutic.

C. Indoor or outdoor.

The full definition of this classification is shown in Table I.

Table I Proposed classification of paraplegic ambulation using an orthosis

A. 1. Independent:	The patient is able to doff and don the orthosis and to transfer from chair to standing and vice versa without help from another person.
2. Dependent:	The patient needs assistance, from another person, to doff and don orthosis and in transfers.
B. 1. Functional:	The orthosis allows the patient to perform practical tasks of daily living at home or at work.
2. Therapeutic:	The orthosis is used mainly for exercise and affords some psychological and social benefits as well as the therapeutic effects of standing and walking.
C. 1. Indoor walking:	The patient walks mainly indoors, at home or at work, or in the Physiotherapy Department. The patient may walk in the garden or in the immediate vicinity of his or her house, but no more than 50 metres from the home.
2. Outdoor walking:	The patient frequently walks outdoors for a distance greater than 50 metres and usually much further, over varying terrain such as grass, gravel paths and pavements.

Results

There were 20 patients, all male. The mean age was 28 years (range 20 years to 39 years). The average weight was 69 kg (10 st 13 lb), range 48 kg to 89 kg (7 st 8 lb to 14 st). The mean height of the adults was 1.75 m (5'9"), range 1.60 m to 1.90 m (5'3" to 6'3"). The mean follow up was 1 year 8 months (range 6 months to 3 years 8 months) and the average time from injury to fitting of the ParaWalker was 3 years 5 months (range 3 months to 8 years 3 months).

Eleven patients had used long leg calipers prior to using the caliper and all had employed a swing through gait and without exception found it tiring and unstable. At time of assessment for fitting of the ParaWalker 10 out of the 11 patients had abandoned their long leg calipers.

Nineteen of the 20 patients were either in full employment or full time study at the time of the injury. Twelve of these patients were manual workers. At the time of follow up 9 patients were in full employment, 3 in part-time employment and 8 were unemployed.

Walking status

The walking status achieved according to the criteria above is shown in Table II.

Patients walking outdoors regularly managed distances of several hundred yards and 4 had walked up to half a mile without undue difficulty.

Of the 3 patients who abandoned their ParaWalker all did so approximately 1 year after use. 2 of these patients found the ParaWalker too tiring to use and 1 patient injured his arm in an incident unrelated to the ParaWalker, but hoped to return to using it in the near future. All three patients were *dependent* therapeutic

Table II Walking status achieved by patients using the ParaWalker

	Number of patients
Independent therapeutic outdoor	8
Independent therapeutic indoor	9
Abandoned	3

Table III Number of occasions ParaWalker used per week

Frequency	Number of patients
Greater than 3 times a week	4
1-3 times a week	11
Less than once a week	2
Abandoned	3

Table IV Number of hours ParaWalker used on each occasion

Number of hours	Number of patients
Greater than 3 hours	2
Between 1 and 3 hours	13
Less than 1 hour	2
Abandoned	3

1 patient used his orthosis 5 days a week for 6 hours a day while another for only 1 hour every 2 weeks.

indoor walkers prior to abandoning the orthosis and their average height was 1.80 m (5'11") and weight 83 kg (13 st 2 lb).

Frequency of use

This is shown in Table III and Table IV.

Physical, psychological and social benefits

Of the 17 patients still using the ParaWalker 14 admitted to a strong feeling of physical and mental well being associated with its use and many welcomed the opportunity to talk to the friends and relatives at normal standing eye level.

Independent use of ParaWalker

Seventeen of the 20 patients achieved independent doff and don and standing from and sitting in a wheelchair. The 3 patients who failed to achieve this all eventually abandoned their ParaWalker.

Functional use

Some enterprising patients were able to perform minor household tasks at home with the ParaWalker, but for the majority, because of the necessary use of

crutches in walking and standing, few other activities were possible. Ten patients were able to get into the passenger seat of a car, with some difficulty, depending on the size of the car. Two patients had driven the car with the ParaWalker on but found it difficult and did not often repeat the exercise. The problem being the bulkiness of the orthosis jamming on the steering wheel and controls.

Cosmesis

Only 2 patients complained that the ParaWalker was unsightly to wear.

Complications

There were very few complications associated with the use of the ParaWalker. There were no pressure sores and although most patients suffered one or two falls during early use only 1 patient injured himself significantly (fractured distal end of radius). Patients were followed up at the gait laboratory every 6 months and had their ParaWalkers assessed in the workshop. Minor repairs were usually required but no ParaWalker had broken suddenly resulting in a fall or preventing any further use.

Overall patient assessment

See Table V.

Table V Overall patient assessment of ParaWalker

	Number of patients
Highly delighted	5
Pleased	10
Non-committal	3
Dislike	2

Discussion

Prior to the development of the ParaWalker, useful ambulation had, in our experience, been impossible for neurologically complete thoracic level paraplegics. All that had been achieved by these patients with conventional bracing was a swing through gait at an energy cost too great to be of value (Gordon and Vanderwalde, 1956). We are therefore encouraged that 85% of our patients still have independent and regular use of the ParaWalker and that 75% are enthusiastic regarding its use.

The principle benefit gained was a physical and mental well being experienced by the patient by being able to ambulate without undue effort in an upright and reciprocal manner. In particular the ability to talk to a friend or relative on a standing eye level was much appreciated.

Patients were able to walk on a variety of surfaces including gravel paths, lawns and pavements and negotiate gentle inclines and small steps. Outdoor

Table VI Summary of details of individual patients

Patient	Age	Neuro deficit	Previous orthosis	Time from injury to issue of P.W.*	Follow up time from fitting of P.W.*	Doff and don ability	Frequency of use/week
1	25	D4 complete	None	6 y 9 m	6 m	Independent	× 3
2	24	D6 complete	Long leg calipers	2 y 3 m	1 y 8 m	Independent	× 2-3
3	28	D6 complete	None	3 y	2 y 5 m	Independent	× 2
4	30	D9 complete	Long leg calipers	2 y 2 m	1 y	Independent	× 5
5	25	D6 complete	Long leg calipers	6 y 2 m	1 y 10 m	Independent	× $\frac{1}{2}$
6	20	D5 complete	Long leg calipers	1 y 4 m	6 m	Independent	× 2-3
7	28	D7 complete	Long leg calipers	8 y 3 m	6 m	Independent	× 7
8	27	D4 complete	None	11 m	3 y 1 m	Independent	× 7
9	31	D9 complete	Long leg calipers	3 y 3 m	6 m	Independent	× $\frac{1}{2}$
10	27	D6 complete	None	1 y 9 m	2 y 8 m	Independent	× 1
11	37	D7 complete	None	1 y 11 m	10 m	Independent	× 4
12	22	D7 complete	Long leg calipers	2 y 11 m	11 m	Independent	× 1
13	22	D4 complete	None	9 m	3 y 7 m	Independent	× 2
14	33	D7 complete	None	1 y 5 m	1 y 5 m	Independent	× 3
15	27	D6 complete	Long leg calipers	6 y 1 m	7 m	Independent	× 2
16	39	C8 complete	Long leg calipers	4 y 4 m	2 y	Independent	× 2
17	26	D4 complete	Long leg calipers	6 y 9 m	1 y 7 m	Independent	× 1
18	28	D12 complete	Long leg calipers	7 m	3 y 8 m	Dependent	Orthosis
19	28	D6 complete	None	3 m	3 y	Dependent	Orthosis
20	36	D4 complete	None	7 y 8 m	1 y 10 m	Dependent	Orthosis

* = ParaWalker

walkers were generally able to walk several hundred yards regularly and some had walked up to half a mile without undue difficulty.

The main drawback was that the necessary use of crutches in standing and walking prevented free use of the hands and restricted the practical value of walking.

Motor car use is also vital in the ordinary life of a paraplegic. Many patients were able to walk to and get into the passenger seat of a car with the ParaWalker on unaided, but this was often dependent on the size of the car. Two patients had driven their cars wearing the ParaWalker but both found it difficult because lack of space allowed jamming of the orthosis on the steering wheel.

Of the 3 patients who abandoned the ParaWalker, 2 did so because the orthosis was too tiring to use. Both had been issued with an early orthotic design, now abandoned. The third patient blamed the failure to use the ParaWalker on a somewhat non specific injury to his arm. All 3 failed to achieve independent use of the orthosis and were above average height and weight, these factors would seem to mitigate against continued use of the orthosis.

Although the ParaWalker is worn outside patient clothes, only 2 patients were concerned that the ParaWalker was cosmetically unattractive.

In view of the advances that are being presently made in improving paraplegic ambulation, and the attention it is prone to receive in the media, we feel that it is important to have a means of classifying paraplegic ambulation that will allow mature and critical comparison with other orthoses and systems employing electrical stimulation (El Masri, 1986).

We found it impossible to designate the walking states achieved by our patients according to the Hoffer Classification as had been our initial intention.

Table VI Summary of details of individual patients (contd)

No. of hour used on each occasion	Indoor use	Outdoor use and distance travelled	Passenger in car	Patient assessment
2-3	Yes	Yes, up to $\frac{1}{2}$ mile	Yes	Highly delighted
2-3	Yes	Yes, 200 yds regularly	Yes	Pleased
2	Yes	Yes, 100 yds regularly	Yes	Highly delighted
6	Yes	Yes, $\frac{1}{2}$ mile	Yes	Highly delighted
2	Yes	Yes, up to $\frac{1}{2}$ mile	Yes	Pleased
$\frac{3}{4}$	Yes	Yes, up to $\frac{1}{4}$ mile regularly	Yes	Highly delighted
4-5	Yes	Yes, 200 yds regularly	Yes	Pleased
1	No	Yes, $\frac{1}{2}$ mile regularly	No	Pleased
1	Yes	Yes, 400 yds	Yes	Non-committal
1	Yes	No	Yes	Pleased
1	Yes	No	No	Non-committal
3	Yes	No	No	Pleased
1	Yes	No	No	Pleased
2-3	Yes	No	Yes	Pleased
1	Yes	No	No	Highly delighted
$\frac{3}{4}$	Yes	No	No	Pleased
1	Yes	No	No	Non-committal
	Orthosis abandoned, too tiring to use			Dislike
	Orthosis abandoned, too tiring to use			Dislike
	Orthosis abandoned, due to arm injury, satisfactory until then			Pleased

The classification that we have introduced concentrates on three aspects of orthotic use and function, and more accurately distinguishes the level of walking ability achieved.

It is impossible to give strict guidelines as to patient selection. Many inter-relating factors are involved and need to be carefully considered. Clearly the ParaWalker is unsuitable for elderly patients or those with significant cardiac or respiratory disease. Excesses of height and weight are undesirable but should not in themselves exclude a patient from being considered suitable. Patient motivation is the key factor, but this is difficult to measure and clinicians must use their own judgement in this respect.

It is important that patients appreciate the limitations of the ParaWalker, or for that matter other similar bracing systems. All patients in this study were fully informed as to the likely benefits of the orthosis and this has contributed to the high success rate in this series.

We are encouraged by these early results and we intend to continue recommending the ParaWalker to selected patients. This research was undertaken to provide scientific data in a field prone to misleading media attention. We hope that other clinicians at present prescribing alternative walking braces for adult paraplegic patients will report their full clinical data so that adequate comparisons can be undertaken.

Acknowledgements

We are grateful for the secretarial skills of Bunty Hill, Carol Morris and Barbara Taylor.

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