

Technical note

Driving appliances for upper limb amputees

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Abstract

The advice given to upper limb amputees in the United Kingdom with regard to the use of driving appliances has often been somewhat variable. At best a full rehabilitation package has been provided, including the fitting of the appliances to the person's vehicle and contact with the driver's instructor, to the other extreme of issuing driving appliances to patients with no instruction at all. Though upper limb amputations are not a relevant or prospective disability, all drivers with a "limb disability" are legally required, in the UK, to declare changes in their physical state to the Driver and Vehicle Licensing Agency. This study examines the current usage of driving appliances. It was found that the level of upper limb loss has little effect on where the driving appliance is placed or on any other aspect of driving method used.

Introduction

Upper limb amputations are much less common than lower limb amputations and in most regional prosthetic centres in the UK the ratio of presentation is approximately 1 upper limb amputee to 25 lower limb amputees (Department of Health and Social Security, 1986). Though congenital deficiencies are different from amputations, both in terms of the psychological effect and the prosthetic acceptance and usage, in clinical practice the prosthetic management is similar for both. For the purpose of providing appropriate appliances

to assist in driving, the prosthetic management of the transverse congenital deficiency is identical to that of the amputee.

In the UK the driver and Vehicle Licensing Agency's (DVLA) licence categorically states that a driver should inform the agency if there is any physical change in his or her condition. However, a survey on diabetes and driving revealed that about a fifth of all diabetic drivers had not informed the DVLA or their motor insurers of their diabetes (Saunders, 1992). No such survey has been carried out on the amputee population. The majority of patients do drive or return to driving after upper limb amputation and are usually under the care of the multidisciplinary team at the regional or sub-regional Disablement Services Centres.

There is no comprehensive literature available to give to upper limb amputees which would advise them where to place a ball appliance on the steering wheel, how to change gear or use the hand brake, or how these details vary with level or site of amputation (UK Forum of Driving Assessment Centres, 1991^{1,2}). For example should the left trans-humeral amputee place the steering ball in the same position as a right trans-humeral amputee? The advice given has often been varied and inconsistent. The authors carried out a prospective study of upper limb amputees to ascertain how these patients were currently using the driving appliances provided and whether an appropriate pattern of usage could be determined. In the following descriptions it should be remembered that in the UK vehicles drive on the left side of the road and consequently are right hand drive with the hand brake and gear change normally operated with

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the left hand. It might be presumed that in countries where left hand drive vehicles are the norm, a similar study would give results which would be a mirror image of those outlined in the following pages.

Method

Sixty adult upper limb amputees (more than 17 years of age) consecutively attending the prosthetic clinic were asked to complete a structured questionnaire. In some cases assistance was given. Two forms were used, one asking questions specific to the left amputee and the other for the right amputee.

After an initial and successful pilot study of 10 patients the study was extended to include a further 50 patients. All the questionnaires were completed during the clinic attendance itself, hence there were no non-responders.

Results

Of the 60 questionnaires completed, 2 contained insufficient or conflicting information, and another supplied the patient's name, level and site of loss with the statement, "I do not drive". These 3 questionnaires were therefore removed from the results. Readers are reminded that driving was on the left side of the

Table 1. Methods of steering for right amputees (34)

Method	Number of Patients	Comments
No steering ball used	7	Of these patients, 6 steady the steering wheel with a prosthetic hand when changing gear or using the hand brake. The other, a forequarter amputee, drives an automatic. All 7 steer by palming the wheel round with their sound hand. (See Fig. 1a).
Steering ball mounted on the left side of the wheel (between 9 and 10 o'clock position)	13	All of these patients use the ball in their sound hand. Of these 11 drive automatics. The other 2 drive manuals one steadying the wheel with a passive hand and the other with her trans-radial stump, whilst changing gear or using the hand brake (See Fig. 1b).
Steering ball mounted on the right side of the wheel (between 12 and 5 o'clock position)	14	Of these 14 patients none uses the sound hand on the steering ball, except when parking. Automatics are driven by 2 of the amputees and the 12 drivers of manuals all control the wheel using a prosthetic appliance on the steering ball whilst changing gear, while steering and when operating the hand brake. (See Fig. 1c).



(a)



(b)



(c)

Fig 1 Methods of driving for right amputees.

(a) No motoring ball used.

(b) Ball mounted on the left side of the wheel (between 9 and 10 o'clock position).

(c) Ball mounted on the right side of the wheel (between 12 and 5 o'clock position).

road, and hence the vehicles were right hand drive. Of the 57 patients who responded, the number of trans-radial and trans-humeral patients, and their choice of gearbox was as follows:

	Automatic	Manual
Trans-radial (41)	12	29
Trans-humeral (16)	9	7

Of those amputees using an automatic gearbox, most had Automatic Driving Licences only. One of these patients, who has a shoulder

disarticulation, had passed an advanced driving test and now instructs others. Only one patient was actually required by the DVLA to drive an automatic, even though he had driven previous to his amputation and was a trans-radial amputee. Of the 57 amputees the distribution of amputation by side was:

Right upper limb amputee	34
Left upper limb amputee	23

The methods of steering used by right and left upper limb amputees are shown in Tables 1 and 2.

Table 2. Methods of steering for left amputees (23)

Method	Number of Patients	Comments
No steering ball used	8	Of these patients, 7 change gear with a passive prosthetic hand and 1 operates the autoshift with a passive prosthetic hand. All 8 steer by palming the steering wheel round with the sound hand, though some added that they also use the prosthetic hand on the wheel at all times.
Steering ball mounted on the left side of the wheel (10 o'clock position)	3	All three patients drive automatics, and 2 of them use a cup on stem appliance in the prosthesis to help steady the wheel. One added that he also uses the steering ball in the sound hand in certain circumstances, and the third patient, a trans-humeral amputee, always uses the ball in his sound hand. (See Fig. 2a).
Steering ball mounted on right side of the wheel (between 12 and 4 o'clock position)	12	All 12 patients use the steering ball in their sound hand. Of these 5 drive automatics. Of the 7 drivers of manuals, 6 use a passive prosthetic hand, and one uses a cup on stem appliance to change gear. (See Fig. 2b). All 14 drivers using manual gearbox vehicles operate the hand brake by reaching across with their sound hand, resting the prosthesis on the wheel whilst they do so (See Fig. 2c).



(a)



(b)



(c)

Fig. 2. Methods of driving for left amputees.

- (a) Ball mounted on left of wheel (10 o'clock position).
 (b) Ball mounted on the right side of the wheel (between 12 and 4 o'clock position). Passive hand or cup on stem (inset) used to change gear.
 (c) Hand brake operated by reaching across with sound hand.

Discussion

In this study, modifications to vehicles were found to be rare, and only involved minor changes to switch controls, such as indicators being moved from left to right of the steering wheel. It was interesting to note that the ratio of automatics to manuals is very similar for both left and right amputees.

Left upper limb amputees, when they use a steering ball, mostly set it up for use with the sound hand, (about 2 o'clock position). They change gear with the prosthetic hand or appliance. To operate the hand brake they reach across with their sound hand, resting the prosthesis on the steering wheel whilst they do so.

Right upper limb amputees driving manual gear shift vehicles set up the steering ball, if they use one, in such a position that it can be used in conjunction with an appliance in the prosthesis, between 1 o'clock and 5 o'clock position). This enables gear changing to be carried out with the sound hand.

Since many of the patients' limb deficiencies were congenital in origin, it is difficult to determine whether left or right dominance played any part in the way in which the appliances were used, but it may account for some of the methods of usage that fell outside of the patterns outlined above.

Those driving automatic vehicles mostly set up the steering ball so that it can be used with the sound hand, irrespective of the side of amputation.

Conclusion

The level of upper limb loss following either an amputation, or a congenital deficiency, has little effect on where the driving ball appliance is placed, or on any other aspect of the driving method used, with the exception that the higher the level of loss, the more likely it is that the patient will choose a vehicle with an automatic gear box. This seems fairly logical as neither steering nor gear changing can be easy using a prosthesis when the amputation is above the elbow level. Using an automatic gearbox frees the sound hand for steering, and obviates the need to use the gear shift whilst on the move. About two thirds (70%) of trans-humeral

amputees use automatic gear box vehicles as compared to less than half (44%) of trans-radial amputees.

A quarter (26%) of the patients in this study did not use a steering ball (all of these were males) and of the remaining three quarters (74%) issued with a ball and clamp for use with a prosthesis, over half (46% of the total) use the ball in the sound hand. Since the steering ball was designed for use in conjunction with the prosthesis, it does beg the question as to whether it really is a satisfactory shape for use with a sound hand.

The question of the use of a passive prosthetic hand or a cup on stem appliance to operate the gear lever and hand brake also needs to be addressed.

With the recent introduction of car safety designs like air bags inflating from the centre of the steering wheel, in cases of impact, the inappropriateness of many current driving appliances becomes evident. New designs need to take these factors into account, in addition to the pattern of usage of the driving appliance.

Lastly it would be beneficial to have a succinct and diagrammatic instruction booklet to provide upper limb amputees with relevant updated information and advice in order to assist them in driving, thus helping to reach their optimum rehabilitation potential.

Acknowledgement

The authors would like to thank Mrs. J Kay-Sportelli for typing the manuscript.

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