TECHNICAL PROVISIONS IN WHEELCHAIRS

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I Abstract

With the help of some examples of technical provisions in and on wheelchairs we want to give you an impression of the possibilities in our centre for patient-directed practical/technical devices.

II Contents

1. Arm-support for hemiplegia patients
2. Wheelchair-seat with a canting construction
3. Small electronic wheelchair for two to seven year olds
4. Electronic wheelchair steering device that can be adjusted to the patient's needs.

1. The arm-support for hemiplegia patients

Fig.1

Fig.1: arm-support mounted on a wheelchair

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The indications to support a hemiplegic arm are:
- the tendency to partial dislocation and pain of the shoulder
- the hand begins to swell.

Possible ways to support the arm are:
- an armsling in various models
- a special arm-support in a wheelchair.

For those cases in which the patient can be helped with a wheelchair arm-support, we have made an universally applicable arm-support that fits any standard wheelchair.
It is fastened in the place of the standard arm-support. (Fig.2)

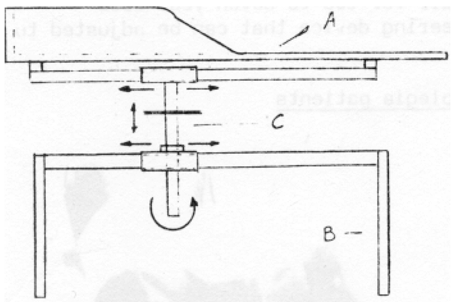


Fig.2: drawing of the arm-support with the several parts

The arm-support consists of three parts, viz.:

A. The part for the arm.
This consists of an upholstered arm-support with a raised rim at the back (elbow) so that the patient's arm cannot slide away sideways.

B. The wheelchair's brace.
This part is put on the normal place of the standard arm-support.

C. The turn - and shift construction.
This part contains the turn - slide - and height adjustment.
With the help of a double shift-construction the turning point can be made on any place below the arm-support.
There is no need to explain the height-adjustment and about the turning point we must mention that the turning-resistance can be adjusted by means of two friction plates. (see fig.2)

The pro's and con's of this arm-support versus a sling are:

A. When using a hollow support the arm is not really hidden away so that it can be used more easily.

B. Physiotherapists say that they have the impression that the spasm is less activated when a hollow arm-support is used.

C. The arm-support can only be used in those cases where the patient is bound to his wheelchair.

D. When a hypertone patient has to make a big effort (e.g. when propelling a wheelchair) associated reactions occur. Because of the hypertonia the patient loses his balance and the arm is less well supported.

<u>Conclusion</u>: The arm-support cannot replace the various armslings but it can be a good addition.

2. The canting construction of the body-formed seat or wheelchair seats.

In our center we have recently put many canting constructions in electric (electronic) wheelchairs for patients with e.g. muscle-dystrophia who sit in an individually adapted seat: the so called vacuum-pulled body-formed seat.
Regarding the fact that the child with muscle-dystrophia sits during a physically active period (school, work, meals, etc.) in a more or less horizontal position, we made a canting-construction that enables the child to sit during the non-acitve periods in a better and more restful position.
When canted more backwards the pressure between the body and the body-formed seat will be better spread over the complete contact area (the back + sitting part). This has several advantages:

- When the adjustment is regularly made use of (the patient can choose his own position and do it himself) the pressure in various places will vary and this has a favourable influence on the prevention of decubitus.
- When canted backwards the whole body is pressed deeper into the body-formed seat (When horizontal there is little pressure between the back and the backpart of the body-formed seat.). Thus the corrective influence of the body-formed seat becomes more apparent.
- For some children it is difficult to keep their heads well balanced in the horizontal position. This is very tiring so that here too we can say that a more canted sitting-position, combined with a head-rest has a relaxing effect.
- The canted position is also beneficial for breathing well.

In order to be able to adapt the sitting position to all circumstances, we have chosen in our center for a non gradual adjustable system that can be handled by the patient himself.
This by means of two switches that are built into the cupboard for the wheelchair steering device.
A foot-support, (possibly) a working tray, the head-rest and the arm-support are fastened on to the body-formed seat so that they can all cant with the body-formed seat. (Fig.3)

Fig.3: body-formed seat in normal position.

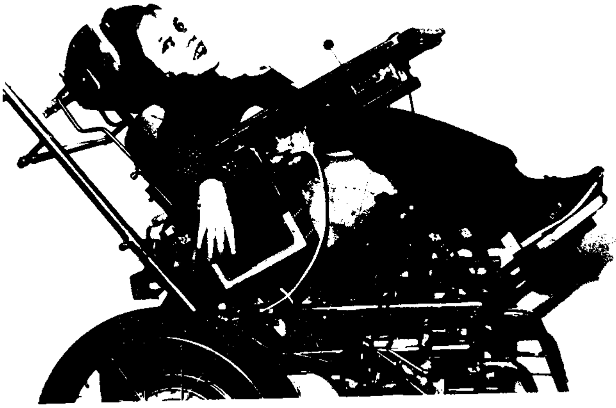


Fig.3: body-formed seat in canted position.

A safety-catch has to be built in so that the patient can not drive the chair in a canted position because there is the danger that the whole wheelchair begins to cant.

3. Small electronic wheelchair for two to seven year olds.

We have developed a small electronic chair more from a social than a medical point of view. (Fig.4)

Fig.4: 12 voltage version of the wheelchair.

Children from two to seven years old often sat in a push-wheelchair (so they were always dependent on others) and these chairs were not adapted to their surroundings (e.g. the situation in class), especially where the height is concerned.
Since the group of children who were both physically and mentally capable of steering a wheelchair was fairly large, we developed this small wheelchair.
The main points were:

1. The child must be level with children of the same age that do not sit in wheelchairs.
2. The measures of the chair should be in accordance with the age group.

The final product (see fig. 4 and 5) is a standard chair with a small semi body-formed seat, a working-tray with steering device, a head-rest and a foot-support but it goes without saying that all this can be adapted to a patient's specific needs.
The chair can also be made with a completely electronic and a semi-electronic steering device.
Semi-electronic is an electrical on-off system with a slow start, for those children who have not enough controlled muscle activity in order to operate a fully electronical steering.
But also the operation can be individually adapted. (see the next issue).
You can also choose for a 12 voltage and a 24 voltage design.
The first is obviously meant for indoors. The 24 voltage design however is, because it is faster and more powerful and has a larger action-radius, also suitable for outdoor activities. (Fig.5)

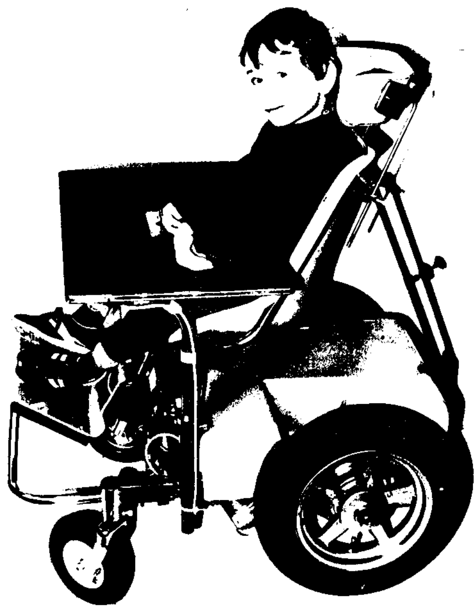


Fig.5: 24 voltage version of the wheelchair.

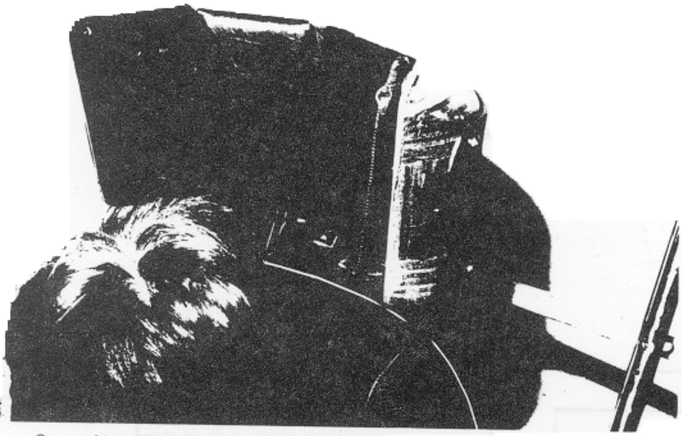
4. Special steering devices for wheelchairs.

A number of patients lack the motorial and/or mental power to be able to handle the various (electronic) wheelchair steering-devices that are now being made.
When the patient has still so much function left that he can drive independently, we develop a steering-device that is completely grafted on the possibilities which the patient still has.
Here follow two examples:

1. A twelve year old boy with spastic quadriplegia, whose tonus is so high that neither his arms nor his legs can be used for the directing of a wheelchair. By means of a special body-formed seat (which lowers the tonus as much as possible, because it gives much flexion in the hips and the spine) (Fig.6) this boy is capable after a long and intensive training to make minimal but controlled movements with his head.

Fig.6: Tonus lowering sit-position

First we made a head-rest with one switch. After sometime the boy was able to control this switch (with which we had connected a little train or a bell). Through a head-rest with two switches we finally came to a head-rest with four switches. This proved to be the maximum that this boy could handle Proceeding from there we had to develop a fitting wheelchair steering device. In the end we used 3 of the 4 switches for steering and the 4th can be used for all kinds of other aids and appliances such as e.g. a typewriter, a communication apparatus, teaching machine etc. (Fig. 7)
Switch D is the just mentioned switch for all kinds of appliances. Switches A, B and C are necessary to propel the wheelchair. The switches B and C are for the right and left engine of the wheelchair respectively, whereas switch A (push-on, push off type) determines whether it goes forwards or backwards.



ig.7: View from the top of the head-rest.

The problem with these on and off systems of the 2 engines of the wheelchair is that when you use one engine the chair makes a weak bend. The other engine is namely dragged along. Therefore the at that moment not used wheelchair-motor has to be stopped.
This however makes it very difficult to correct the direction of the wheelchair when in motion since the engine stops running as soon as the switch is let go.
Because of these problems we made the brake function time dependent. (Fig.8)

Fig.8.

In the picture shown above T is the time when the switch is not used. We see that the brakes work minimally if the button is not pressed for a short time. If the time is longer than Te the brakes work maximally, that is the motor is blocked almost completely.
This combined with a gradual running start of the engines gives the following picture of the speed as the function of the pressing of the button. (Fig.9)

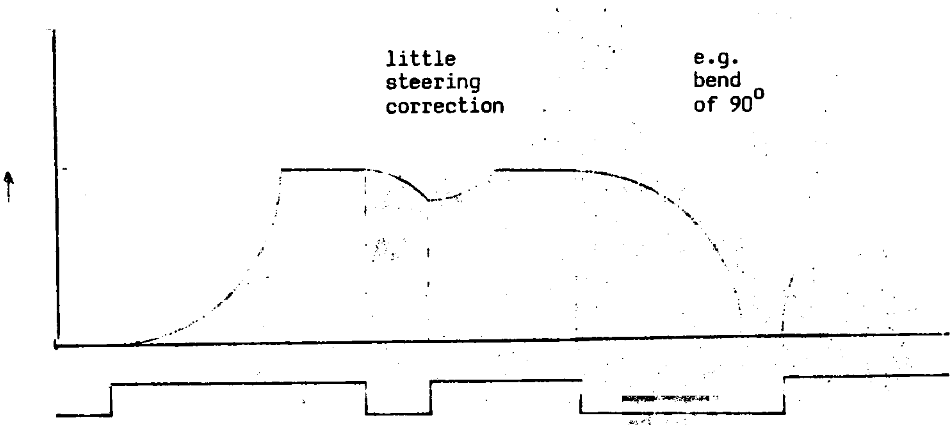
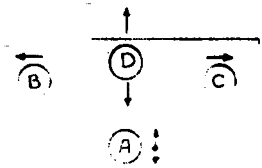


Fig. 9.

We see that the engine shows a small lowering of the number of rev's when corrected a little, and when the button is not used for a longer period of time, the engine is practically blocked.
All this resulted in the fact that this boy considering his possibilities after a fairly long training, can drive with this wheelchair quite well and independently.

2. A ten year old girl with spastic athetotic quadriplegia. She could not be helped with the standard wheelchair steering devices either. Only her right leg could be used a little. We made a foot-support for her with 4 fairly large switches on it. (Fig. 10)
Like in example 1 we have again one switch A (type push-on, push-off) for the choice: backwards or forwards.
Then there are the switches B and C for the right and left engine respectively, and the fourth switch D to use both engines at once.
What we made for her has, when compaired to the above, a slow start, but the variable brake on the engines cannot be used, because she cannot carry out a small correction when driving.
Then the immediate braking of the engine has several advantages again.
The chair stops practically at once after the switches have been released.



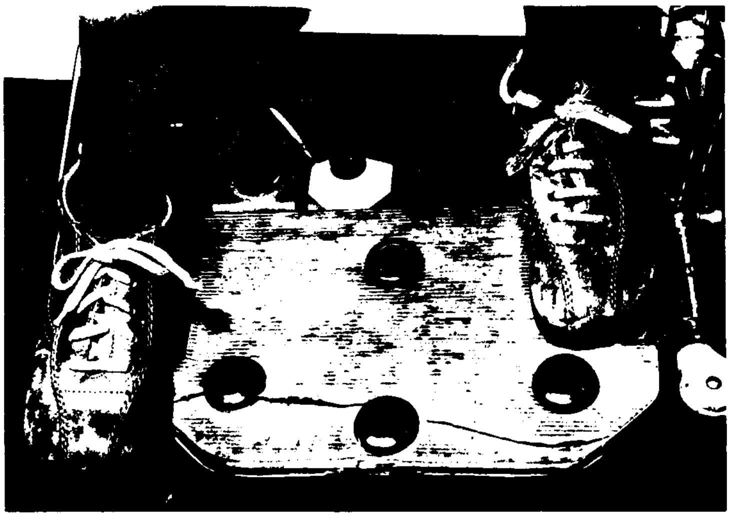


Fig.10: Foot-support with 4 switches.

Conclusion:Alltogether we can say that both children can make optimal use of these wheelchairs, which are grafted on their possibilities and they are now no longer dependent on a push-chair and therefore they have become much more independent.