Choosing, adjusting and looking after a manual wheelchair

Backrests

Reclining backrests or not

Many people find themselves equipped with a reclining backrest without having asked for one, sometimes even being unaware that it is there or even using it.

If it is not used it can produce major inconveniences:
- The chair is heavier
- The added brackets at the base of the backrest contribute to its deformation and make it less comfortable. This necessitates a backrest stabiliser which complicates the folding.
- The most serious is that a chair with a reclining backrest is delivered with rear wheels placed further to the back in order to avoid falls to the rear when put in a heavily reclined position. This in turn produces the following complications:
  - The increased length of the chair impairs its handling
  - The arms and the hands are in a worse position in relation to the hand rims reducing the force which can eventually damage the shoulders.
  - A large proportion of the weight is displaced onto the front castors so that the chair looses all its manoeuvrability when steering and altogether handles worse. All things being equal, a wheelchair rolls proportionately better the more weight there is on the rear wheels. Tyres with a greater diameter give less resistance to movement than smaller ones. The overall resistance is calculated by multiplying the coefficient of the rotation of each wheel by the weight on them. This fact is fundamental and will be referred to later on when we discuss the correct positioning of the rear wheels and in the choice of front castors.
  - It is more difficult for an attendant to tip the chair back to get over obstacles.

Backrest Tubes

Wheelchair manufacturers tend to make chairs where the backrest tube is no longer in the prolongation of the tube making up the base. The backrest tube is joined onto the base tube by a plastic joint which is not as solid and reduces the rigidity of the whole. The two backrest tubes have a tendency to bend together with use so that the fabric of the backrest slackens and no longer supports the back correctly.
Semi-permanent Adjustable Backrests

The angle between the backrest and the seat on these wheelchairs can be adjusted with an alan key. This adjustment is semi-permanent as it can only be modified with the use of a tool. It is a much better design as it does not present you with the same complications as adjustable backrests. It is unfortunately not available on less expensive chairs.

Adjustable Backrest Canvas

The canvas of some backrests is positioned with Velcro straps enabling you to adjust them if they become slack. However it would appear that with the Velcro, the fabric tends to slacken more quickly meaning constant.

Height of the Backrest

If there are no particular requirements, a height of about 40 cm seems to be the general norm.
A higher backrest is needed for taller people or if there is a lack of muscle. If the backrest is too high, it can be uncomfortable and can deform the back.
A low backrest is best kept for people with good upper body balance.

Rear handles

The height of the handles is usually in relation to the height of the backrest.

A person who needs an attendant to push needs to have the handles in the correct position for the attendant. If it is difficult to get the right height of backrest in relation to the height of handles, there exist adjustable height handles which can be very practical. This option can however complicate the chair and make it slightly heavier. This should only be chosen when absolutely necessary.

There are also folding handles which give a sleeker line to the chair and give the impression of increased independence as it appears that the person cannot be pushed.

Folding Backrests

During the 80’s, you could not normally take off the wheels so it was practical to have a folding backrest. There was a joint located on a level with the arm rests. It was a good way to reduce the volume of the chair in order to get it into a car more easily. At the time, backrests tended to be higher.
It seems more sensible to keep a rigid backrest and to remove the wheels for ease of transport. There are three advantages:
- The weight of the chair is split up making the heaviest part about 4.5 kg lighter.
- Being lighter, handling is easier.
- Having no additional joint at the base of the backrest makes the chair lighter and the increased solidity reduces the play which slackens the fabric of the backrest.

We must encourage attendants to remove the rear wheels as it is quick to do and makes it much easier to lift the chair. There are certain cases where having a folding backrest is advantageous.

For example when someone puts their chair in front of the back seats of the car by rolling it along the foot well and that the height of the roof is too low.

The Armrests

Not all wheelchair users need armrests. Some people think their appearance is better without. Each individual must judge for themselves what is best for their wellbeing.

Well adjusted armrests can relieve the pressure on the back by taking some of the strain on the elbows. They can help avoid pain and the back from becoming curved. It is important that the armrests are not adjusted too high or it can create tension in the shoulders.

Many wheelchairs have the option of height adjustable armrests allowing for a perfect adjustment giving comfort and stability taking into account the height of the person and the thickness of the cushion. This is a very good solution.

Armrests that can be lifted thanks to a mechanism located at the back of the backrest near the frame of the seat are very easy to use and very solid. They can also often be removable. They are not usually height adjustable. Armrests can also protect you from the wheels. They keep your clothes protected from the wheels keeping them clean and more importantly they stop your hips or thighs from rubbing against the wheels causing injuries to those usually with no sensibility.

In cases where there are no armrests, mudguards can be fitted. Check the solidity of mudguards as they can be subjected to frequent knocks.
The Seat

Seat Width

A well chosen seat width allows for a narrower chair allowing you to get through narrower doors and passages which can be a vital consideration.

A well chosen width will be more comfortable. If it is too narrow you may feel uncomfortable or even hurt yourself on the armrests or mudguards. If the chair is too wide, the seat and backrest canvas will give too much, reducing support. Back pains may even ensue.

The correct width allows you to fit the palm of your hand between your hip and the side of the armrest or guard. This margin allows for more substantial clothing during the winter months.

Seat Length

Many wheelchairs offer a choice of at least two seat lengths. You need to choose the correct length in order to support the entire length of the thigh in order to avoid any weight of the legs being put on the buttocks. It is essential that the front of the seat does not cut across the calf. A long enough seat makes lateral transfers easier by giving adequate length in front of the wheel.

Seat Height

On most wheelchairs you can adjust the distance of the seat from the ground. In the vast majority of cases, a distance of between 48 and 51 cm from the ground is suitable. The height must allow the knees to pass under a table or desk, to be able to reach things easily and to be at the same height as able bodied people when they are seated on standard chairs.

If the person is very tall, the seat must be raised high enough to allow the feet rests to be far enough from the ground, otherwise they risk a forwards fall if the ground is uneven.

On the other hand, if a person uses their foot to move forwards, the seat must be lower. This can often be the case for people with hemiplegia.
**Seat Tilt**

Most of the time, the seat should not be fully horizontal. The front of the seat should be between 2 and 4 cm higher than the rear. This tilt helps maintain the pelvis comfortably settled into the seat and helps prevent the lower back from curving. The lumbar curve is maintained and the risks of back pain are reduced. The risk of a forward fall is also greatly diminished.

It is also a useful way of reclining the back rest in order to find the ideal position. The spine feels differences in the vertical plain more than the angle between the torso and the thighs. A gentle tilt of the backrest and seat can be much more effective than only tilting the backrest.

This adjustment is obtained by changing the relative height between the tyres and the front castors.

**Position of the Rear Wheels**

Choosing the position of the rear wheels is the most important adjustment and the most critical. It requires a balance between contradictory requirements which vary from person to person.

**Rear wheels in a forwards position:**

**Advantages:**
- Excellent manoeuvrability and movement with a minimum of effort.
- Risk of a forward fall is diminished as there is less weight on the front castor meaning they won’t be blocked by obstacles as much.
- The chair is not as long.
- The extension of the arms to reach the hand rings is longer so the demand put on the shoulders is reduced. This gives you more force and less pain.

**Disadvantages:**
- There is a risk of backwards falls hence the need for an anti tip device or a mastery of ‘wheelies’.
- Lateral transfers are more difficult as there is less seat length in front of the wheels.
- Sometimes impossible to climb a hill.
- The point of balance is such that the front castors do not rise off the ground as high
when doing wheelies making it more difficult to pass over curbs and other such obstacles.

**Rear wheels in a position to the rear** reverse the advantages and disadvantages described above.

It is clear that the best synthesis varies from person to person.

**1st case:** a person with little strength in their arms like a tetraplegic would do better to choose a position towards the front as movement is easier and the tendency for tipping on hills has no impact as they do not have the strength to climb them.

**2nd case:** a heavy person must have the wheels in a forwards position to avoid tipping backwards. This is caused by the extra weight itself; as it is usually carried on the stomach, the centre of gravity is further forwards. The manoeuvrability is maintained and as the wheels won’t be under such pressure they don’t risk deteriorating or becoming maladjusted as much. Problems with bad adjustments are quite frequent in this case.

**3rd case:** a paraplegic affected quite high, at ease on two wheels but having little balance should keep the wheels more to the rear in order to pass over obstacles like curbs that their strength and agility allow for.

**4th case:** an amputee of the legs must obviously have the wheels in a rear position. The errors in adjustment in this case are very rare.
The Breaks

On a wheelchair the brakes are only used as parking brakes. Most models work with a system of levers that work by going over the point of balance. This principle is small and light and works well when in a good condition and correctly adjusted.

Good quality wheelchairs have very good brakes, which is not always the case with cheaper chairs. This is a serious factor for consideration.

The breaks can get in the way of lateral transfers because of protruding handles. The plastic cover on the handles can also catch clothing at the moment of transfer. These are details that can make you miss a transfer and end up on the floor.

These types of brakes mean that you need to have well inflated tyres and require frequent adjustments.

We now see drum brakes that have handles at the rear which is safer if the chair is under the responsibility of an attendant. These drum brakes can, on certain chairs, be controlled by the user. The braking is very strong, progressive and requires little adjusting.

Rear wheel technology

You can get either spoked wheels or mags also called composites. Average weight of the complete wheel including tyre and hand rim:
- Spoked wheel 2 kg
- Plastic mags 2.4 kg
- Lightweight mags 2.040 kg

Spokes

These kinds of wheels are tried and tested and their solidity is irreproachable. They are lightweight and flexible and offer a more comfortable ride.

On higher quality chairs you often get fewer spokes and they are not crossed. This style reduces the weight, but in our opinion should only be used by people of more modest weight.
Mags

These are mostly injected plastic and are very solid. They are slightly heavier than an equivalent spoked wheel. The rims can sometimes be rather too small and a well inflated pneumatic tyre can slip off easily.

Other mags are made with injected metal and the saving in weight is negligible. They are less comfortable and a lot more expensive but for some the aesthetic aspect is the deciding factor.

On some top quality chairs, you can get carbon fibre mags. They are much lighter and we know of no inconvenience apart from the price.

Mags are easier to clean, but get even dirtier.

Up to you to decide!

Cambered wheels or not

Cambered wheels refer to the angle of the tyre in the vertical plane. If both wheels are vertical and therefore parallel, the angle is 0°, there is no camber.

Sport chairs, particularly basketball chairs have a very high camber. The main reason for this is to avoid injury to the hands. When the wheel bases come together, the hands would come into contact, by cambering the wheels, the hands stay protected.

The reasons people favour cambering in a non sport environment is that there is more force and it is more ergonomic for the arms to work in an inclined plane than in a vertical plane.

Turning is also easier as the force needed by the arms is lessened. This is due to the fact that the diameter of the wheels is greater if the wheels are cambered than if they are vertical. Less effort is needed to propel the chair forwards.

These theoretical advantages (for which we haven’t studied the calculations) are negligible for the vast majority of users compared to the major inconvenience of considerably widening the chair.

The trend for cambered wheels came in during the late 90’s and is disappearing but we thought it was worth discussion.
Rear wheels

**The most common rim size is 24”**. 22” rims have a diameter 5 cm smaller than 24” rims and should only be used to reduce the length of the chair by 2.5 cm and to facilitate lateral transfers. The reduced diameter reduces in turn the efficiency of propulsion and the choice in tyre quality. Doing wheelies is also more difficult.

**The most common tyre size is 24” x 1” 3/8.** These tyres are comfortable and roll well on decent ground. Tyre pressure is normally between 58 and 72 psi.

**You can also get 24” x 1” tyres** which are narrower and roll easily on good ground. The pressure can go up to 116 psi however 72 is usually enough to provide a comfortable ride. Basic wheelchairs usually come with basic tyres that suffice for people who don’t move about very much. You can get excellent tyres with a life expectancy of 8 to 10 times longer and the risk of punctures is much lower.

The advantages of solid tyres are avoiding punctures and the need to inflate them. But it must be said that it produces more resistance when moving and the comfort of the ride is decreased. It would appear to us that solid tyres should only be used in hospitals, homes and other such communities.

Front castors

The choice of front castors is one of the most important in the configuration of your wheelchair. There is a trend at the moment for very small front castors that is difficult to understand. It seems to us that this fashion has come about through a misunderstanding between manufacturers, retailers and users. Each believes that the other two have solid reasons for choosing such castors.

Many users have told us that they have had real problems using these castors and when they change their wheelchairs, they will choose bigger ones. These very small castors only work well if the weight on the front of the chair is
almost nil, which implies a very unstable chair used by very few people.

The drive is very poor, they are uncomfortable and block against the smallest obstacle risking a forwards fall. These are the most dangerous falls and we know of several people who have broken a leg or ankle this way.

With this warning in mind, what should you choose?

**Diameter**

The largest diameter is 8’ / 20 cm and the smallest is 4’ / 10 cm. A large diameter is very practical outdoors however inside turning becomes more difficult and they can catch on the heels if the feet are not in the right position.

**Type of tyre**

You can have:
- Hard solids which we would only advise for use inside.
- Inflatable tyres which are comfortable and efficient in all situations but are difficult to inflate as the valve is always quite inaccessible.
- Foam filled tyres. They are almost as good as inflatables without the need for inflating. The life expectancy is less than solids.

**Width of castors**

This can be between 15 and 50 mm. Wider widths are good for soft surfaces.

The best choice is a good balance between the diameter, the type of tyre and the width. Ideally you would test various configurations which is not always possible.

**Adjusting the angle of the front forks**

This angle is of vital importance. This should be fixed at the moment of delivery of a new chair but it can happen that a last minute change in the height of the rear wheels has not been accompanied by the corresponding adjustment of the front castors. The angle can also need readjusting after a certain period of use.
The correct angle

The theoretical angle of the fork should be 90° with the ground. You can even obtain better manoeuvrability if the angle between the axis of the fork and the ground behind the point of contact of the castor is slightly less than 90°.

Effects of the angle

If angle $a$ is greater than 90° the chair will have no manoeuvrability. When the chair is used indoors, where changes in direction and pivoting are incessant, the arms are easily tired out.

If angle $a$ is equal to or slightly less than 90°, you get optimal manoeuvrability and there are no inconveniences.

If angle $a$ is much less than 90°, the chair is not stable enough in a straight line. This is rarely the case as the pressure put on the fork has a tendency to increase angle $a$, and to decrease manoeuvrability.

There are many systems used to adjust this angle but are easy to understand if you have a basic understanding of mechanics. What is more, there will be detailed instructions in the users’ manual.

The choice and position of the foot rests

The foot rest is made up of the support which links the front of the frame to the foot plate.

Simple foot rest

These are the most common and do not allow you to raise the leg. There is usually a choice of two different angles which allow you to position the foot rest closer or further away from the chair. Choose the option closes to your morphology, or your needs according to your disability.
Articulated foot rest

It allows you to raise your legs with the degree of inclination required. These footrests are usually only for people who have particular requirements linked to their disability like knee problems or oedema.

The foot plate

The foot plate is either in two parts which fold up either side, or in a single piece which lifts up to one side.

Footplate in two parts

Each plate is fixed to the support and enables easy folding. The problem with this system is that there can be a gap between the two which allows the feet to slip through.

Single piece footplate

These are very solid and it is easier to place the feet where you like. It can also look good, however it can be more difficult to fold.

Maintenance

One of the virtues of a manual wheelchair is that it requires little maintenance; a reason to do it properly and regularly.

• Check the tyre pressure regularly. The drive will be much better and the brakes will work correctly.

• Regular adjustment of the brakes

• Check of all screws, nuts and bolts and tightening if necessary.

• Clean and oil the wheel axels.

• Maintenance of the front forks.

• Adjustment of the front forks if necessary.

• Regular cleaning of the whole chair is a good idea as it is an extension of the body.
• Seat canvas these days is very solid however it sometimes needs changing as over time it can slacken and will not be as comfortable.

**Wheelchair and Image**

Everyone in our society thinks about the image they give to other people. Disabled people are no different and may be even more sensitive to this.

The only problem is that no one, as far as we know, has researched into what image disabled people give to the general public according to their wheelchair, electric or manual, compact, with small or large castors, high backrest or low, bright paintwork or discreet.

People make their choices guided by their own ideas of the judgement of others. Most disabled people think that their image is better in a more compact chair, sign of a lesser degree of disability.

It would seem to us that the degree of disability has little to do with the image we give others. Someone with little use of their arms in a standard wheelchair who smiles and has a kindly attentive presence will give a very positive image. Conversely, a rude physically toned person in a very lightweight sporty wheelchair will not be as well viewed.

If our worth decreased with our level of disability, all disabled people would be worth less than the able bodied, whereas we have been claiming the opposite for decades.

To sum it up, the wheelchair that will give you the best image is the one best suited to you; one in which you will feel a good sense of wellbeing and ease.