

MOBILITY AIDS

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Introduction

- Mobility aids are appliances used to help people who have difficulty in walking.
- Each aid gives a varying amount of stability, and accordingly, a varying extent of mobility.
- They enable some of the body weight to be supported by the upper limbs and thus build up the stability and thus indirectly the mobility of a patient.
- Usually the stability of an aid is inversely proportional to the mobility it can help achieve.
- Selection of mobility aid depends upon diagnosis, strength of patients, gait, stability, coordination, vision, psychological factor like enthusiasm to heal, extent of disability, architectural barriers and prognosis of the disease.

Functions

To reduce weight bearing on injured part or extremity

To reduce pain

To compensate for weak musculature

For visually impaired

To give proprioceptive information

To improve balance

Indicate the bystanders of disability

Parallel bars

- Parallel bars are used when the patient is unstable, or to correct a gait pattern.
- They are rigid and support the patient right through the length of the bar.
- A full-length mirror should be placed at one end of the parallel bar.
- In it the patient can observe his movements and thus avoid looking at his feet, a common mistake made when any type of walking aid is used initially.
- The parallel bar is particularly useful in posterior column lesions if the patient has lost proprioception.
- The height of the parallel bar is from the ground to the greater trochanter of that side.



Walking Frames

- Walking frames or walkers are more stable than the others because their bases are quite large and the center of gravity falls within the base.
- They are prescribed for debilitated or elderly people who are usually confined to home, unable to climb stairs, and who have been advised not to venture outdoor.
- A patient is not usually given a walking frame unless he is not able to walk even with walking sticks, or crutches, as the pattern of gait acquired in a walking frame is difficult to change.
- The **standard walking frame** consists of four almost vertical aluminum alloy tubes arranged in a rectangle, and joined together on three sides by upper and lower horizontal tubes.
- The patient stands in the walking frame, lifts and places the frame forward a short distance away and then walks up to the frame still holding the hand grips.

- The vertical tubes, heights of which may be adjusted by means of spring loaded catches have their lower ends fitted with rubber tips (ferrules) to prevent sliding and slipping.
- Handgrips are fitted to the upper horizontal tubes on each side.
- The walker should be light, rigid, stable and easy to use.
- The main structure of the gutter frame is the same as that of the standard walking frame except that the tops of the upper horizontal tubes on each side is modified by the addition of two gutters in which the patient's forearms rest.
- The forearms may be fastened in the gutters with light Velcro straps.
- This type of frame is useful when the patient cannot extend his elbow fully or is unable to take his full weight through his hands due to weakness, deformity of the hands or when there is a plaster cast.
- **Reciprocal walking frame** when the patient cannot lift the walker or needs more stability.
- It is similar to the standard frame but with each side of the frame capable of being moved forward alternately.
- As the frame does not have to be lifted with each step, the patient's stability is increased.

- A **rollator** is a walker with two small casters at the front and two short legs at the back, protected by rubber ferrules.
- The rollator is best suited for children who may find it difficult to lift walker.
- The patient holds the handgrips, lifts the rear legs just off the ground, wheels the rollator forward a short distance, lowers the rear legs on to the ground and then walks forward into the rollator holding the handgrip.



STANDARD WALKING FRAME



ROLLATORS



RECIPROCAL WALKING FRAME



GUTTER WALKING FRAME

Other Mobility Aids

- As the patient becomes more and more confident with his walker and desires more mobility he can migrate to a stick, a quadripod or a tripod.
- These aids are used on one side of the body and help improve weight bearing, enhance proprioception and reduce pain
- If the grip of the upper limb is poor owing to some pathology like rheumatoid arthritis, which prevents the person from using canes and crutches the physiatrist has to prescribe specially designed gait aids.
- The grip of a properly measured cane should be at a height located at the upper border of the greater trochanter
- The grip of the cane should be, with the patient standing erect, at the level of greater trochanter and the distal end placed 6 inches from the lateral border of the foot (during standing)
- It is better to ensure that the elbow is flexed 20-30° to help in shock absorption.

- The patient should be instructed to hold the cane in the hand opposite to the affected limb and to advance it along with the affected leg.
- This is called a three point gait pattern.
- When ascending stairs the good leg is advanced first, but when descending, the order is reversed.
- These aids are most commonly made of hardwood or aluminium telescoping tubes, but can vary in design. The reason they are hollow and telescoping is that they can be adjusted according to the patient's height.
- All of them should be fitted with a deeply grooved 1 to 2 inch wide rubber tip called ferrule for good friction and safety at the lower end, and the clinician should check these regularly for wear and tear.
- The ferrule must have concentric circular depressions radiating inwards, creating a vacuum effect for better floor grip.

Walking Sticks

- Walking sticks take away the body weight from the lower limb during walking and therefore can compensate for muscle weakness and relieve pain in the leg
- The use of a walking stick or sticks can increase the stability and the confidence of a patient



Tripods

- Tripods and quadripods are more stable than cane.
- Tripods have three rubber-tipped legs, which touch the ground at the corners of an equilateral triangle.
- The handgrip lies in the same plane as a line joining any two of the leg.
- The height of the handgrip can be adjusted; the measurements being taken similar to that of the cane.
- The tripod and quadripod walking aids, which may be used single or in pairs, confer more stability than walking sticks or elbow crutches.
- They are usually prescribed for patients suffering from neurological conditions, but they may be used for elderly patients who have degenerative problems like osteoarthritis, and therefore not confident without a stable aid.



Quadruped Walking Aid

- Also known as Quadripod.
- This has four rubber tipped legs. The handgrip lies vertically above the two inner legs, which are more widely spaced than the two outer legs.
- The height of the handgrip is adjustable as given earlier.



CRUTCHES

- A crutch is a staff or support, often used in pairs, by the physically handicapped, as an aid in gait.
- They are used to reduce weight bearing on one or both legs, or to give additional support where strength is inadequate and balance is imperfect.
- The function of crutches is to prevent undue weight-bearing.
- The handgrip must also be tested to see that the patient has sufficient power and mobility to grasp the hand piece
- In case of non-weight bearing on the affected leg; the mobility and strength of the normal lower limb should be assessed, paying particular attention to the hip abductors and extensors, the knee extensors and the plantar flexors of the ankle which must be sufficiently strong to take weight. The patient is taught hip hiking on the non-weight bearing side if required.
- Sitting and standing balance must be tested and trained if necessary.

Axillary Crutches

- They are made of wood or aluminium with an axillary pad, a hand piece and a rubber ferrule. The length and the position of the hand piece are usually adjustable.
- The axillary pad should rest against the chest wall approximately 5 cm below the apex of the axilla and the handgrip should be adjusted to allow the elbow to be slightly flexed to 20° when weight is not being taken.
- Weight is transmitted down the arm to the hand piece. It is inadvisable to take weight through the axillary pad as this could lead to a neuropraxia of the radial nerve or brachial plexus (crutch palsy).

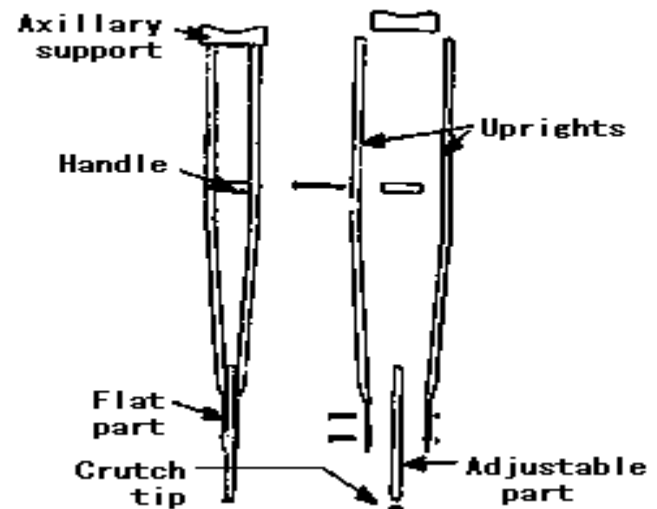
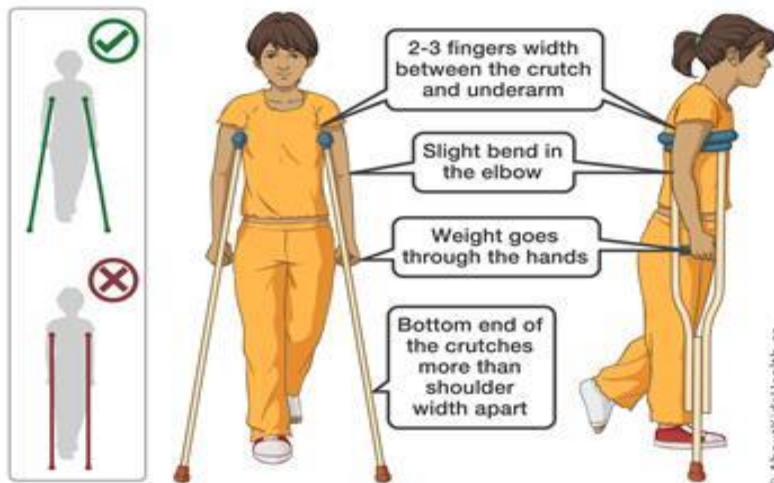


Figure 1. Crutch Parts



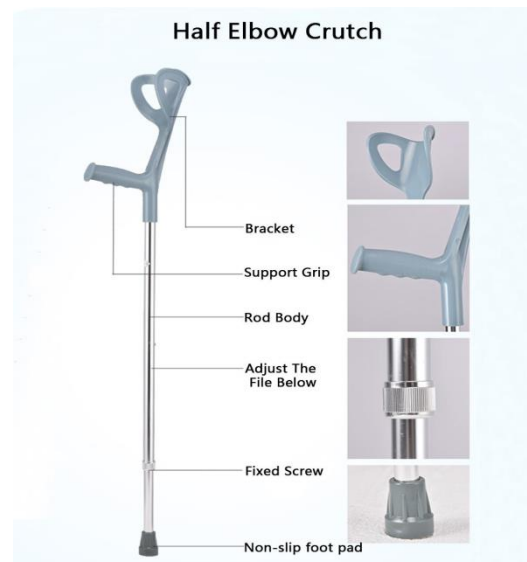
Measurements

- There are many ways of measuring the patient for crutches, usually carried out with the patient in supine,
 - Remove the patient's shoes and measure from the apex of the axilla to the lower margin of the medial malleolus. This is an easy measurement and is practically reliable.
 - From the anterior axillary fold measure 6 cm in front of and lateral to the little toe.
 - Two inches below axilla to 2 inches from the lateral foot and 6 inches anteriorly (during standing). The hand grip adjusted to allow 20-30° elbow flexion.



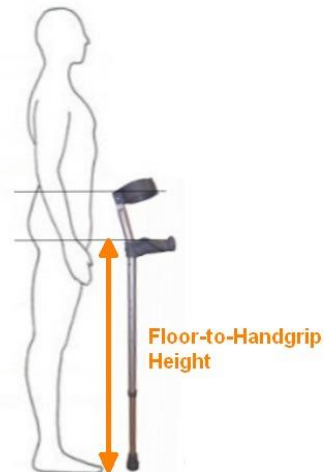
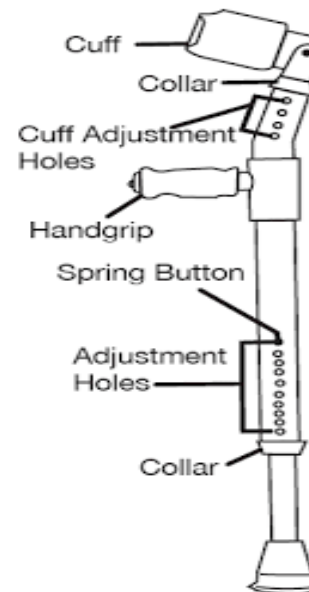
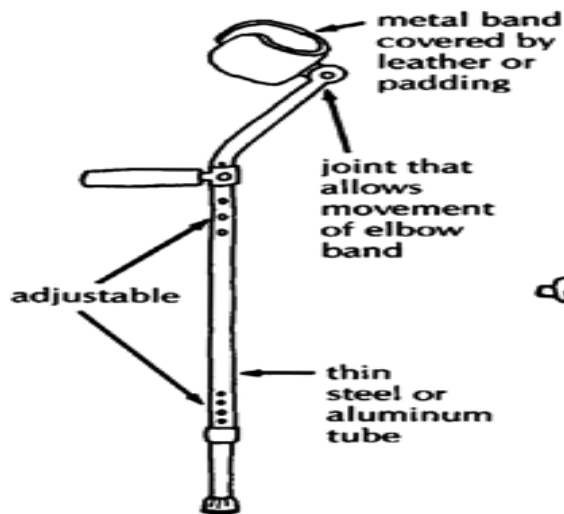
Elbow Crutches

- These are made of metal or plastic and have a band which fastens on to the forearm prevent the crutch from slipping out of ones grip.
- They are usually adjustable in length by means of a press clip or metal button.
- They have a rubber ferrule to afford a good grip.
- These crutches are particularly suitable for patients with good balance and strong arms but in whom the grip is suspect.
- Weight is transmitted in exactly the same way as for axillary crutches.
- Many patients graduate to elbow crutches from axillary crutches.



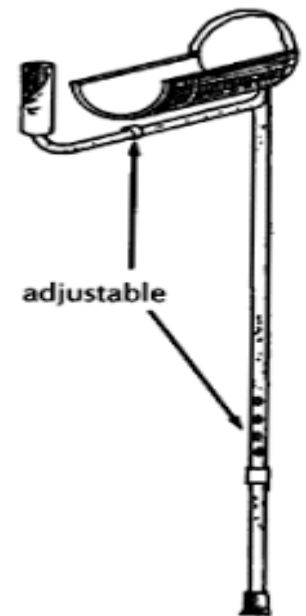
Measurements

- The measurement is usually taken with the patient in the lying position with the shoes on.
- The elbow is slightly flexed (approximately 15 degrees) and the measurement is taken from the ulnar styloid to a point 20 cm lateral to the heel of the shoe.
- Once the patient is standing with the support, the length must be rechecked.



Gutter Crutches

- These are used for patients who require some form of support but cannot take weight through hands, wrists and elbows because of deformity and/or pain.
- They are usually made of metal or plastic.
- There is a padded forearm support parallel to the ground, on which the forearm is placed and strapped on.
- Velcro fastenings around the forearm keep the crutch in place.
- The hand piece is adjustable to the grip available to the patient.
- The crutch is adjustable in length in the same way as the elbow crutch.
- It should also be adjustable in the length of forearm support.
- The measurement is taken from the elbow flexed at 90°
- to the ground with the patient in stand



Crutch Muscles

**Depressors of Shoulder girdle
(Lattismus Dorsi, Seratus
Anerior, Pectorals,
Trapezius)**

**Adductors of Shoulder girdle
(Pectoralis Major, Lattismus
Dorsi, Teres Major, Triceps,
Coracobrachialis)**

**Flexors of the Shoulder
(Anterior Deltoid,
coracobrachialis, Pectoralis
Major and weakly Biceps)**

**Extensors of the elbow (
Triceps Brachii, Anconeus)**

**Dorsiflexors pf the wrist
(Flexor carpii radialis, Flexor
Carpii Ulnaris, Palmaris
longus)**

**Flexors of the fingers and
thumb (Flexors carpii radialis,
flexor carpii ulnaris, flexor
digitorum profundus, flexor
digitorum superficialis, flexor
pollicis longus, palmaris
longus)**

**Handgrip musculature (Flexor
digitorum profundus, flexor
pollicis longus, extensor
digitorum communis)**

**Cylindrical grip muscles (FDP,
FDS, FPL, Adductor Pollicis,
4th Palmer Interossei,
Adductor Digiti Minimi)**

Before Prescription

Good sense of balance

Correct selection and adjustment of crutches

Appropriate strength of the musculature

Good vision

Proprioception

Correct crutch stance

Proper pattern of gait

Crutch Maintenance

The rubber ferrules must be in good condition

The wood or metal must be strong enough to take the patient's weight

The handgrips and axillary pads must be in good condition

All the adjusting nuts must be tight.

The catches used for height adjustments must be functional

Scooting Board

- The scooting board, or skate board is basically a wooden platform with casters or wheels below and which is a sport very popular amongst kids in the Western world.
- In our country we often see handicapped people with residual polio move around on contraptions similar to the scooting board or skate board, squatting on it and pushing themselves forward with their hands.
- Sometimes it is more popular among housewives who need to sit on the floor and cook with all their utensils spread out around them.
- The concept is not high in technology but is appropriate for Indian homes where furniture is minimal and sitting cross legged on the floor (or ground) for a meal or for studying is quite common.
- A wheelchair would not be useful in such homes as it also occupies space and needs many barriers to be overcome before it can be of use.



Wheelchairs

- A wheelchair is not just a 'chair with wheels'.
- It is a second "home" to the patient, since he spends so much time in it.
- The patient's wheelchair should be designed for comfort and ease of manipulation.
- Wheelchairs differ in design and construction based on the needs of individuals and their disabilities.
- Wheelchairs come in three sizes: adult, child and tiny tot.
- Since many of the disabled individuals live out of wheelchairs it is important to prescribe the most comfortable one for a patient in the given circumstance



Parts of a Wheelchair

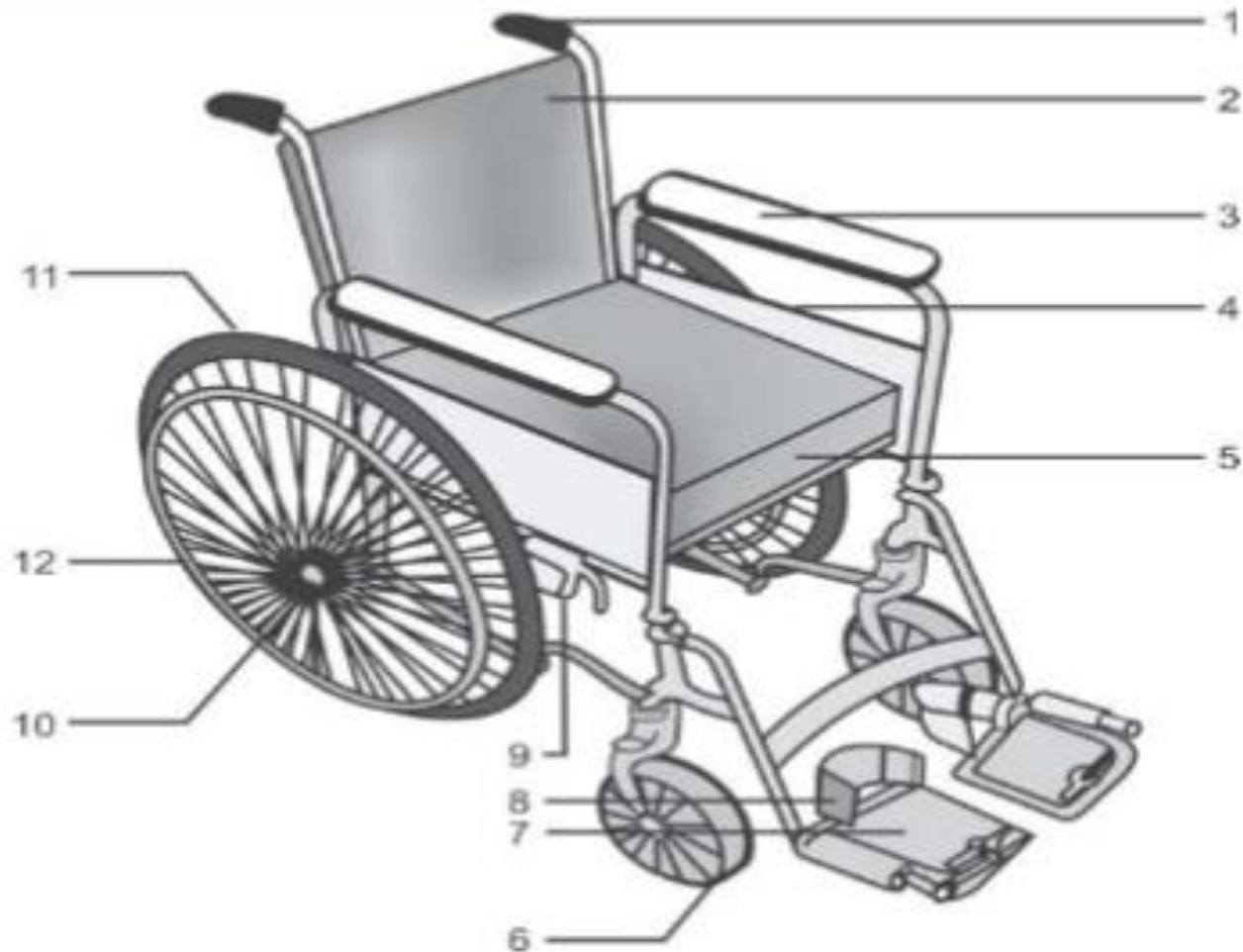


Figure 9.10: The wheelchair and its parts: (1) Handgrip (2) Backrest (3) Armrest (4) Clothes guard (5) Seat (6) Footrest (7) Casters (8) Heel-loop (9) Brake (10) Axle/anti-tip bar (11) Handrim (12) Wheel and tyre

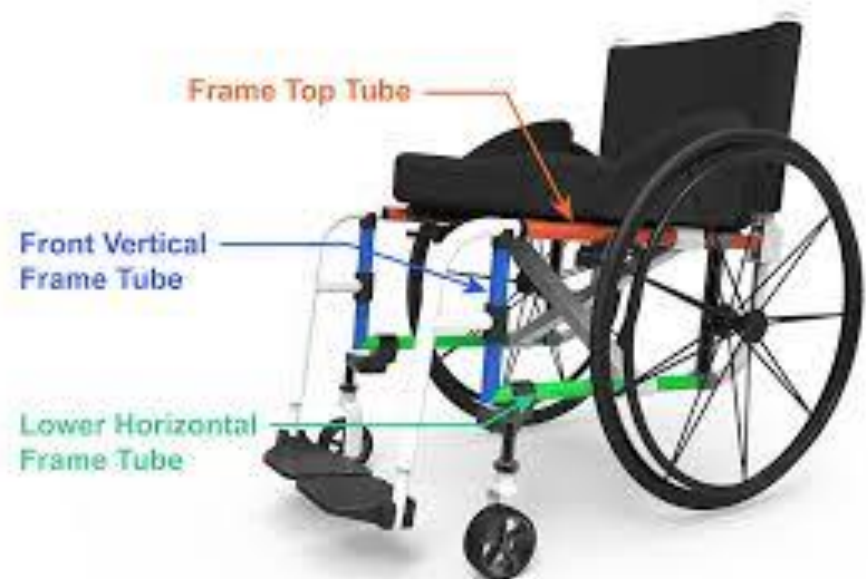
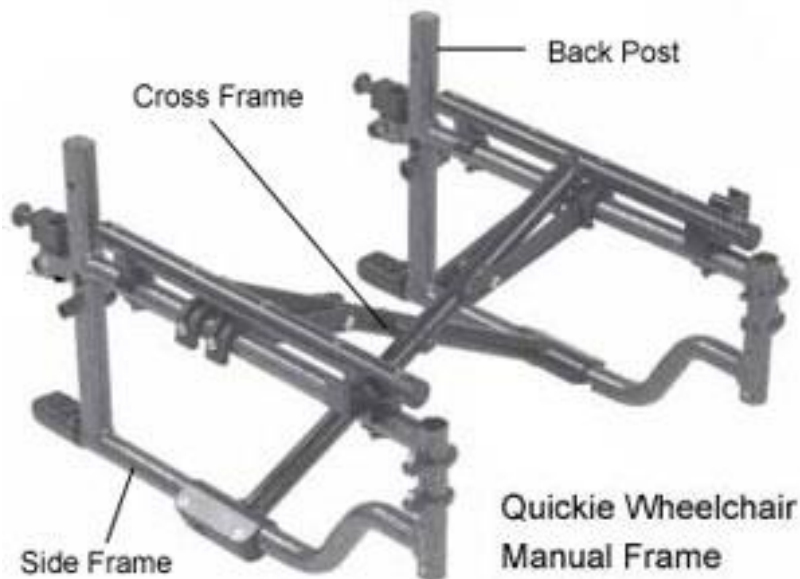


MANUAL WHEELCHAIR PARTS



Frames of a Wheelchair

- Wheelchair frames are either rigid or folding.
- A folding frame is heavier and requires more effort to maneuver but is more convenient for storage in the home and for placing into the car while travelling since it occupies much less space.
- A rigid frame in one solid piece is lighter and used more for sports and other rugged activities.



Tyres

- The selection of tyres depends on the use of the chair.
- Tyres made with solid, hard polyurethane and having a smooth tread are designed for indoor use, allowing for easy maneuverability on smooth surfaces.
- If used outdoors these tyres offer no shock absorption or traction.
- Pneumatic (air filled) tyres provide for shock absorption and a smooth ride, particularly outdoors on uneven or rough terrain.
- These tyres require more effort to maneuver and add slightly to the overall width of the chair.
- Greater tread depth and lower tyre pressure provide more traction but require more effort to propel the chair



Wheels

- Two types of wheels are available: solid magnesium and with spoke.
- Solid magnesium wheels never lose their shape or need adjustments.
- Spoked wheels are lighter and therefore easier to manoeuvre.
- The disadvantage of spoked wheels is that the spokes are easily broken and will cause the wheel to lose its shape. They must therefore be tightened frequently.
- Wheel sizes may vary depending on the size and weight of the user. There are two sizes- 12" and 18" diameter.
- A smaller wheel size requires more pushing strokes than a larger wheel size to propel the chair over the same distance.
- A small wheel reduces height to the wheelchair during transfers.



Brakes

- There is a separate brake for each wheel of the chair.
- Brakes must be put on when stopping the chair, whenever the person is being transferred in or out of the chair, or whenever a procedure like standing up in the wheelchair, or eating from a tray placed on it is contemplated.



Casters

- There are 2 casters in front of the wheels.
- They are different from wheels in that they can revolve in all directions, and allow for better front end maneuverability on smooth surfaces.
- Casters are pneumatic, semi pneumatic, or solid.
- The semi pneumatic type is better on uneven terrain.
- Pneumatic casters provide for greater shock absorption; however, there is an increased drag during propulsion if not filled with air properly.
- This increases the expenditure of energy.
- Solid casters are good on smooth terrain. Casters may also have lock



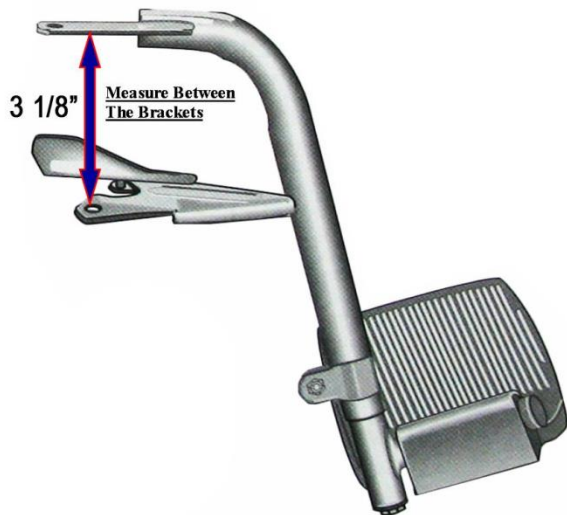
Push Rims

- The type of push rim depends on the user's grip. There are basically three types:
 - Standard metal rims,
 - Friction rims, and
 - Rims with projections.
- Standard metal rims are used when grip is not a problem. Friction rims are standard rims covered with friction tape or foam tubing to provide additional grip on the rim surface.
- Projection rims are used by people with limited reach and grip, like quadriplegics.
- These knobs are placed at intervals to give the user better grip and leverage for propulsion.
- The greater the number of knobs the greater is the facilitation for movement.
- Projection knobs may be either at an oblique angle or vertical.
- However, they may hit against the sides of the wall or furniture and add to the overall width
- The chair used by a hemiplegic has two hand rims on the same (unaffected) side and the user propels it using the same hand. To negotiate turns he uses either one of the hand rim



Footrests

- Footrests maintain the feet in neutral and prevent deformities like equinus.
- They are either fixed or movable.
- Swing away footrests are more convenient but increase the length of the chair, which affects turning and maneuverability.
- These lack toughness and require frequent repair.
- Heel loops or leg straps can be added to the footplate.
- Either or both of these accessories add length to the wheelchair.



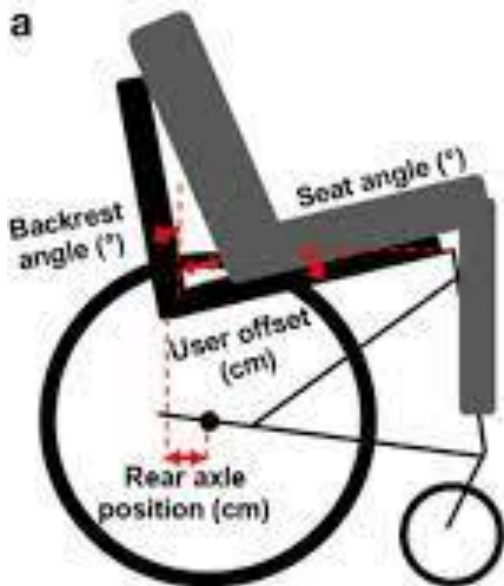
Tilt Bars

- Tilt bars, which project from the back of frame, usually 2 to 3 inches above the floor, are used by the individual who is pushing the wheelchair.
- By placing the foot on the tilt bar and pushing down with the foot, the person can tilt the wheelchair back, allowing the casters to rise off the surface, thus enabling them to clear a doorstep or kerb.
- This can also be done by doing what is called a 'wheelie', which is the same action as above, done by the wheelchair user himself.



Backrests

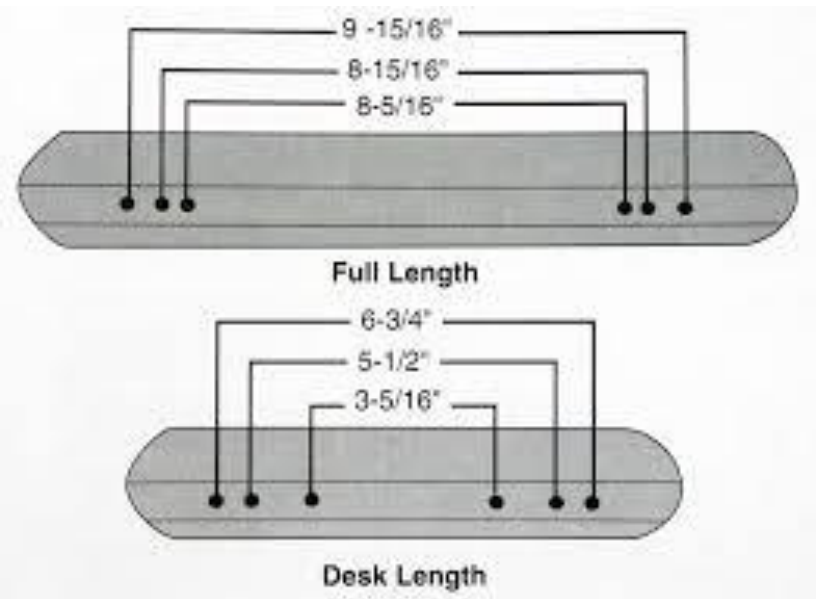
- High wheelchair backs provide trunk support and are ideal for a high level quadriplegic or a child with cerebral palsy with poor sitting balance.
- Low chair backs provide a greater freedom for movement and are preferred by individuals with low level spinal cord lesions and by those who participate in sporting activities.
- The angle of chair backs can be changed and many wheelchairs have their backrests detachable, permitting a back transfer.
- Chest straps are provided to the back rest when sitting balance is poor.



Armrests

- Removable armrests are convenient, provide support, and make transferring easier when detached.
- Armrests can also be fixed or adjustable in height and may be partial length or full length.
- However, they restrict movement during propulsion.
- Environment control units, keyboards, books or trays can be placed on these armrests

Life Benefits of Standing-Tilt



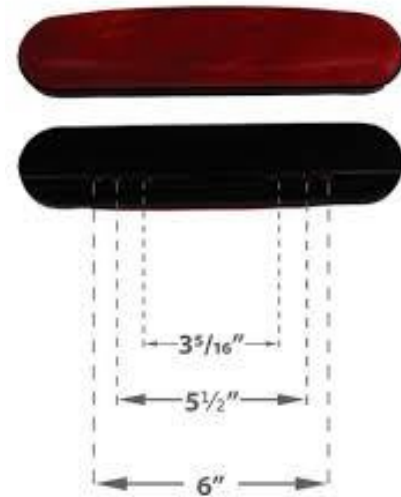
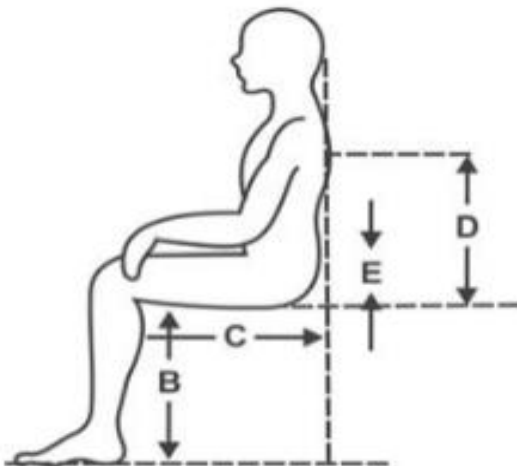
Cushions

- Cushions are used to achieve the most comfortable and supportive position possible and sometimes can make all the difference in the prevention of a secondary disability like pressure sore.
- Seat cushions may be air-filled, gel-insert, contour foam, or gel filled.
- Some have individual inflatable air cells, which are available in varying thicknesses and can be customized for posture control and pressure relief.



Seats

- Patients come in all sizes and it makes sense to take the measurements for the seat, so that he is most comfortable.
- The dimensions to be taken into consideration are the seat height, depth and width.
- Seat width: 1 inch wider than the width of the widest part of the buttocks (A)
- Seat height: 2 inches higher than the distance from the bottom of the heel to the popliteal area (B)
- Seat depth: 1 to 2 inches longer than the distance from the popliteal area to the back of the buttocks (C)
- Backrest height: 2 inches less (may vary) than the distance from the inferior angle of the scapulae to the sitting surface (D)
- Armrest height: Distance from bottom of buttocks-to-elbow (E)



Wheelchair Training

- The patient is taught basic movements within the wheelchair.
- He learns to use the brakes, remove and replace the arm back and footrests.
- In the maneuvering of the wheelchair, he practices to lift his buttocks in the chair, perform a wheelie, to push on a flat surface or slope, and to turn it.
- Objects which he can use on the chair like a tray or computer keyboard are also given to him during the practice session.

Wheelchair Maintenance

The wheelchair should be cleaned regularly. Soap water and wax should be used on the painted surfaces.

- One should check whether the wheels run parallel in a straight line.
- Oil may be used for all movable parts except bearings for lubrication.
- Nuts and bolts must be tightened.
- Metal parts should be sprayed and wiped clean, followed by application of polish.
- The upholstery should be cleaned.
- Telescoping parts like footrests should be polished.
- Tyre pressure should be checked; Low pressure in the tyres will damage rims and make the chair more difficult to propel.
- As spokes keep the wheel shape patent, they should be tightened periodically and replaced immediately if broken.
- Bearings in the wheel and caster should be checked for freedom of spin and smoothness.
- Once every 6 months, the wheelchair should have a complete overhaul by the manufacturer, particularly if used outdoors.

Hemiplegic Wheelchair

- Also known as the one arm drive wheelchair.
- The one arm drive wheelchair is propelled and steered by one upper limb.
- This type of wheelchair is designed for those who cannot walk, and cannot use one upper limb, e.g. hemiplegia.
- This chair allows control of both wheels on one side of the wheelchair.
- The chair has two rims on that propelling side, one rim activating each wheel.
- Using the two rims simultaneously, the individual can move the chair in a straight line.
- The outside hand rim is smaller than the inner and controls the opposite wheel.
- Propulsion using the outer rim turns the wheelchair towards that side and propulsion of the inside or standard rim turns it in the opposite direction. This helps the user steer with one hand.



Growing Wheelchair

- This model is designed to grow with children ranging in age from 6 to 12 years.
- When the child outgrows the chair, a simple conversion of upholstery and footrest extensions can be made



Powered Wheelchairs

- It can be used outdoors, for longer distances, propelled by a motor system.
- Have salient features like power seat adjustment, Power tilt adjustment to avoid constant pressure over one region and Power adjustable leg-rest and backrest.
- Joystick Power Seating System: This allows the user to push the joystick and thereby control up to six different seat positions.



Tricycles

- A tricycle as the name suggests has three wheels fitted with pneumatic tyres, and propelled by hand.
- An advantage is that tricycles are made with indigenous technology and are easily serviced when there is a problem.
- In many parts of rural India, patients need to travel distances on poor roads to do odd jobs, or to go to school or college, and public transport where available is often not disabled-friendly.

