



The Association for Children with Hand or Arm Deficiency

Patron: Laura Hamilton

A Guide to Artificial Arms

by Mark Broomfield The National Centre for Training and Education in Prosthetics and Orthotics, University of Strathclyde



Upper Limb Deficiency

The loss of all or part of an arm in a child whether caused by congenital reasons or trauma, gives rise to many worries by the child's parents. In general the child with a traumatic loss will have a harder time than his or her congenital colleague, as he or she has experienced the use of normal limbs as well as the anguish of the amputation. Most parents wish their child to be fitted with a prosthesis that will enable them to maintain as normal a life as possible, and for most children this is possible.



This booklet will attempt to explain the possible prosthetic replacements available for the hand and arm. It should be emphasised that this is only a guide, and that treatment regimes may vary in different parts of the country, in addition it must be borne in mind that not every child wishes nor needs a prosthesis.

Children with a single sided upper limb congenital deficiency will cope well in most situations without any prosthesis at all. They will use their good hand for most activities, and often use their deficient arm (short arm) as a steadying arm. With babies it is the parents who may wish them to wear a prosthesis, but as they get older, then the child will very soon decide whether or not to wear a prosthesis. This can sometimes cause conflict when the child's wishes are different to the parents wishes, but it is important to respect your child's wishes here. Often as children get older, they may only wear prostheses for specific activities such as sports or social events.

In addition to the above factors, the fact that the deficient arm weighs less than the sound arm will cause uneven loading of the growing spine. This may cause postural problems as the child grows, possibly leading to back pain. Parents should keep an eye on their child's posture, and if they are worried contact their prosthetic centre or physiotherapist for further advice.

Congenital Limb Deficiency

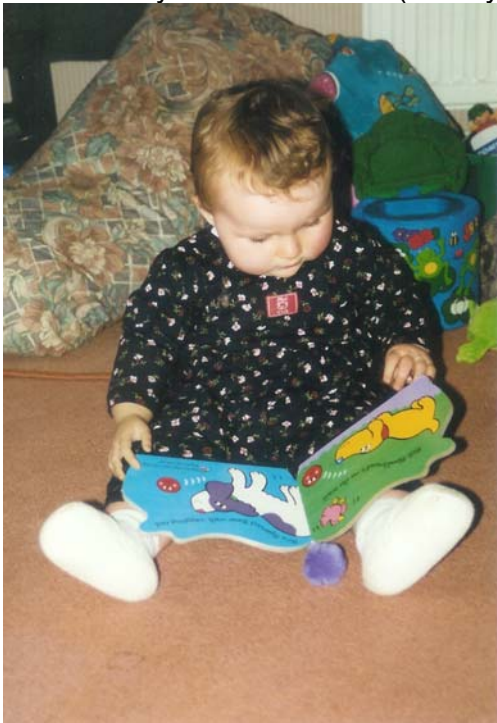
Throughout history there have been babies born with upper limb deficiencies, as there are today. It is hard to obtain reliable statistics, but as a rough guide about 60 babies per year will be born in the UK who will need a prosthesis. This number has remained constant for many years, and for the vast majority of these babies there is no known cause for their deficiency. Occasionally genetic factors can cause the arm deficiency, and genetic testing can be carried out where this may be the case. Normally, parents can go on to have further children with extremely little chance of the same deficiency recurring.



Although the deficiency can range from the partial loss of a finger, to the complete loss of both arms, the majority of affected children, that are seen in a prosthetic clinic, are born with one hand and 2/3rds of their fore-arm missing. In a right handed world, it is perhaps fortuitous that about 66% of these children have lost their left hands and forearms. From the Prosthetist's (artificial limb specialist) point of view, this level of deficiency is the easiest to fit successfully. Children with longer deficient arms, may find that they can manage better without a prosthesis for the simple reason that it is much more satisfactory to feel objects with their own skin.

Types of Prostheses

The type of prosthesis that is given to a child depends on many factors that will be assessed by the Clinic Team (usually, a Doctor, Prosthetist and an Occupational



Therapist) at your local limb centre. Broadly speaking there are two main types of prosthesis that may be considered for prescription, cosmetic prostheses and functional prostheses.

As the name implies a cosmetic prosthesis designed to look as natural as possible. It will be as lightweight as possible and will not usually contain any moving parts. Despite the lack of a moving hand, a cosmetic prosthesis can be extremely useful, as the child can support objects with his or her prosthetic hand.

A functional prosthesis contains a moving hand or hook which may be opened by the child through the use of a simple harness, or by the use of electricity. The functional prosthesis is heavier than a cosmetic prosthesis, will need more maintenance, but with suitable training will allow a greater degree of personal independence.

Training in the use of artificial arms is carried out by specialist occupational therapists who work closely with the prosthetists.

Prostheses are constructed from a combination of custom made and commercially available components. The most important part is the socket which transmits the various forces to the deficient arm and often prevents the prosthesis from falling off. If the socket is not comfortable, then even the most sophisticated prosthesis in the world will be unusable.

The socket is made from a plaster of Paris bandage cast of your child's deficient arm together with various measures. The position that it is cast in is crucial to the success of the prosthesis. The prosthetist then fills the female cast with plaster, strips off the bandages and is then left with a model of the deficient arm. This model is rectified (adjusted) in order to help with force transmission, comfort and suspension. Once the prosthetist is happy with the plaster cast, he or she hands it to the prosthetic technician who then builds the prosthesis to the prosthetist's instructions.

Prosthetic Clinics

In order for your child to be fitted with a prosthesis, he or she must be referred to your nearest prosthetic clinic, which will be situated in most large towns and cities. They may be known as Disablement Services Centres (DSC's), Limb Fitting Centres (LFC's), or Artificial Limb and Appliance Centres (ALAC's).

It is often thought that early fitting of a prosthesis is of great benefit to the child, and as a result of this many children attend the prosthetic clinic at an early stage (about 3-8 months). The reasons for this early prosthetic fitting are often as follows:

- Gets the child used to wearing a prosthesis
- Helps develop two handed activities
- Helps develop eye/prosthetic hand contact
- Can help with crawling
- Helps avoid unwelcome comments from strangers
- Parental wishes

Because of the small number of children involved, there is probably no definitive proof as to whether this is the best prescription option and other children are fitted successfully at a later age. It is impossible to provide a complete replacement for the human hand, and it may be beneficial to think of a prosthesis as a simple tool. If the prosthesis supplies a benefit to the child (or parents at a very early age) then it will get used, if only occasionally for certain activities. The usual benefits are function, where the child can hold or operate something; or cosmesis where the prosthesis looks similar to the missing hand.

Even if you think that your child would not benefit from a prosthesis. It may be that a simple orthosis (splint) is all that is needed to help with holding cutlery or a pencil, or that suitable training is needed from the Occupational Therapist to help with toileting and dressing. In any event meeting other parents with similar children can often be of great benefit in itself, and your child's needs will change as they get older.



Partial Hand Deficiency

A partial hand deficiency covers every thing from a missing finger, to virtually all of the hand missing. The functional loss to the child may range from the trivial to the serious.



However we do not only consider our hands to be functional bits of anatomy, they are permanently on display and are used for a variety of tasks including touch, gripping and gesticulation. In general, prosthetists and doctors will be very reluctant to consider a prosthesis for a partial hand deficiency. The length of the deficient arm means that a prosthesis would look too long, and the child misses out on the important sense of touch. Despite the length discrepancy a few children may feel happier with a functional prosthesis of some sort. It may be that a simple device is considered which aids grip or enables a spoon or pencil to be held.

Some older children may feel more comfortable with a light weight cosmetic prosthesis on social occasions.

Often the biggest problems arise when the child wishes to take part in sport or other activity, and it is here that the Prosthetist can design a specialised sports prosthesis which will enable ordinary sports equipment to be used.

Occasionally it may be that surgery will increase your child's function, your doctor will be able to advise you further on this. Examples of this are toe-transfers and turning a finger into a thumb (pollicisation).



Transverse Radial Deficiency

This is the absence of the arm at any level from below the elbow to above the wrist. Most children present with a short forearm of a few centimetres in length. Because of this shortness in comparison with a partial hand deficiency, it is more difficult to use the limb effectively, and a prosthesis can be beneficial.

Most prosthetic clinics like to fit babies at about 3 - 8 months with a cosmetic "doll's hand" prosthesis. It is held on by an elasticised sleeve. Whilst the cosmetic prosthesis may be seen as non-functional, this is often the most important stage in your child's prosthetic "career". The prosthesis gets your baby used to wearing a prosthesis, and introduces him or her to two handed activities such as clapping. It encourages a two handed body image to develop, and may help prevent strangers from making unwelcome remarks about your baby. However it should be borne in mind that it is not the child who wishes the prosthesis at this age, but the parents.

Babies who have worn their prostheses during this stage can often accept future functional limbs more readily than a baby who has never worn a prosthesis, but there are many exceptions as everyone is different.

As your baby grows, new prostheses will be made. It is important to let the prosthetic clinic know if your baby's prosthesis is no longer fitting, rather than wait for your next appointment. Often appointments are made at three monthly intervals.

Between about 12 and 24 months, it is likely that a functional prosthesis will be prescribed. This may be a split hook, which is operated through a simple strap across the child's shoulder. The split hook is a very functional device and enables the child to carry out fine tasks such as threading beads, as well as coarse tasks such as holding a book. The hook is attached to the rest of the prosthesis by a wrist mechanism. This enables the hook to be manually rotated, and removed, when it can be replaced with a cosmetic hand. The prosthesis is now held on entirely by the shape of the socket which must be a close fit to be effective.



Because some parents and children do not like the look of the split hook, efforts have been made to make the basic design more acceptable, and to this end some centres fit a variant known as the CAPP (Child's Amputee Prosthetic Project) device which looks rather like a small crocodile's jaw. However these devices are often compromises and are not accepted by all parents.

It is possible to get small mechanical hands which open by means of the strap, and close by an internal spring, but due to their size they are prone to be very inefficient, and some children may have difficulty in opening them easily.

Children are given regular arm training by the occupational therapist in order to ensure that the prosthesis and hook is used efficiently. Once your child is about 3 or 4 years old, he or she may then be assessed for a myo-electric prosthesis.

Other centres may dispense with the split hook stage and fit your child with a very small electric hand which is powered by a small rechargeable battery, and controlled by a skin contact electrode in the socket, or by a simple strap. This is known as a myoelectric prosthesis. Several prosthetic centres have found that children respond very favourably to the early fitting of an electric prosthesis, and often do better than with a conventional body-powered prosthesis.

One major advantage is that the myoelectric prosthesis can be made as a self contained unit with no straps, so that the child can put it on and take it off themselves. In addition a higher grip strength is achievable. With modern components the extra weight of an electric arm is not such a problem as it was in the past. It is important to ensure that your child always has a charged battery in the arm at all times. The prosthesis can safely be worn during all activities with the exception of rough contact sports, water and sand play. Normally a cosmetic arm or no prosthesis will be used for these activities.

By the time your child goes to school, you will be aware of his or her preferences regarding their prosthesis, they will prefer one type of prosthesis, or even no prosthesis at all. It is important to keep reviewing them in case they wish a different type of prosthesis. It is possible to design special prostheses or attachments for music, sport or hobbies. The use of silicone sleeve suspension may be useful in sporting situations and your child's Prosthetist will be able to advise you further.

Remember that the prosthesis is there to be used, do not worry unduly about breakages, your prosthetic clinic will repair them quickly, and nothing delights a Prosthetist more than seeing that one of their patients is using their prosthesis as much as possible.

Transverse Humeral Deficiency

This is an absence of the arm at any level from below the shoulder to just above the elbow. It is much rarer than a radial deficiency, and gives the child different problems.

By losing the elbow the child now needs a prosthetic elbow joint in order to position their prosthetic hand. Children with long deficient arms will suffer from the fact that the prosthetic elbow will look too long or be very bulky. In addition in order to flex and lock the elbow, the child usually uses a relatively complex harness.

There is not much choice available in commercial child's elbow mechanisms, and there are probably four main elbow designs available:

- Use no moving elbow at all – normally only suitable for very young children
- Use a friction elbow, where the good hand pushes it into position.
- Use a hand operated locking elbow, where the good hand pushes it into position and presses a button to lock it in position.
- Use a body powered elbow where a body harness bends and locks the elbow. This is often very difficult for children to operate

As a result of the weight and difficulties inherent in operating an elbow mechanism, many children with this level of deficiency wear a cosmetic prosthesis, which may have a simple friction elbow, or even just have it fixed in a natural position. The types of hands and hooks that are fitted are the same as for the transverse radial deficient.

During the past few years the introduction of flexible silicone liners has meant that it is possible to hold on a trans-humeral prosthesis without the need for a body harness. This can cause problems for operating a functional prosthesis, but is generally much more comfortable and the child has a more natural walk because their shoulder can swing normally.



Shoulder Disarticulation and Above

This is the loss of the entire arm from or about the shoulder joint. The shoulder girdle (shoulder blade and collar bone) may also be missing.

Because of the difficulties in controlling a prosthesis due to the lack of any deficient arm to move, most, but not all, children use a simple lightweight cosmetic prosthesis. However some well motivated children can use a complex prosthesis complete with an electric hand.

Bilateral Deficiencies



This is the absence or partial absence of both arms. Children who have lost one arm use their prostheses as a holding and steadying device for their sound hand, and can compete normally with their peers in most situations, whereas children who have lost both hands will rely more on their prostheses or even their feet. There are no hard and fast rules as to what is the best prosthetic approach as each child presents different problems. If your child relies totally on his or her prostheses, then it is important that a spare set is made as well in order that breakages and repairs do not cause major problems.

Prosthesis and Deficient Arm Care

Always check your child's deficient arm regularly in order to stop small problems becoming big ones. Red marks generally mean that the socket is too tight, and needs adjusting or renewing. Do not wait until the prosthesis no longer fits, because it may take your prosthetist a few weeks to supply a new one.

A skin rash may be caused by sweating, or an allergy to the socket materials. Your Prosthetist can ventilate the socket or construct it from a different material in order to remove the problem.

If worn, make sure that your child has a clean prosthetic sock daily, and at bedtime clean out the socket with a damp flannel or a baby wipe, be careful not to get water on any myo-electric components.

The cosmetic glove which covers the prosthetic hand may be made of PVC or silicone. Silicone does not stain, but tears easily. Once a glove is torn, it lets dirt and water into the hand mechanism. Instead of returning to the prosthetic clinic in order to change the glove, you may wish to be given your own supply which you can change yourself at home. Your prosthetist will show you how to do this – initially it is tricky, but it gets easier with practice! Stains on PVC gloves are a problem, and no amount of regular cleaning will keep them at bay- change the glove as soon as it looks unacceptable.

Conclusion

As mentioned before your child will only wear a prosthesis regularly if it provides him or her with tangible benefits. It is important that any problems are cured as soon as is possible, and that your child should enjoy using the prosthesis. Sometimes for various reasons, some children decide not to wear their prosthesis. Whilst this may cause you



some concern, it is important not to use more than gentle persuasion in order to make him or her wear it. The chances are that if a child is forced to wear the prosthesis, then they may well rebel against wearing it for any occasion. Many children will stop wearing a prosthesis for a few years hen may return as and when they wish or need one.



It is not possible to cover all aspects of prosthetics in this booklet, should you have any more questions, please contact Reach who will be able to put you in contact with the relevant people.



Reach would like to express thanks to Mark Broomfield for the preparation of this booklet and to the parents who have allowed us to use photographs of their children.