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Everything within Reach!

Myoelectric-controlled Arm Protheses

Quality for life

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Myoelectric-controlled Arm Prostheses

„Family Comes First“

Karl-Heinz Ammon

Family Father with Power

Karl-Heinz Ammon is the father of a family and loves to build things for fun. He likes working in the yard, on the house or romping around with his daughters. His wife is constantly astonished by everything that her husband can do.

Renovating the kitchen in a day, for example, just to surprise his wife, is no problem for Karl-Heinz Ammon and his myoelectrically controlled DynamicArm. Karl-Heinz Ammon lost his left arm in a work accident in March 2001. At that time he was working as a driver and loader for the catering service at the Dusseldorf airport. As he was trying to help his co-workers with a problem, the weight of a loading bridge crashed down on his left arm. The fire department needed almost an hour to release his arm from its position and its amputation could not be avoided.

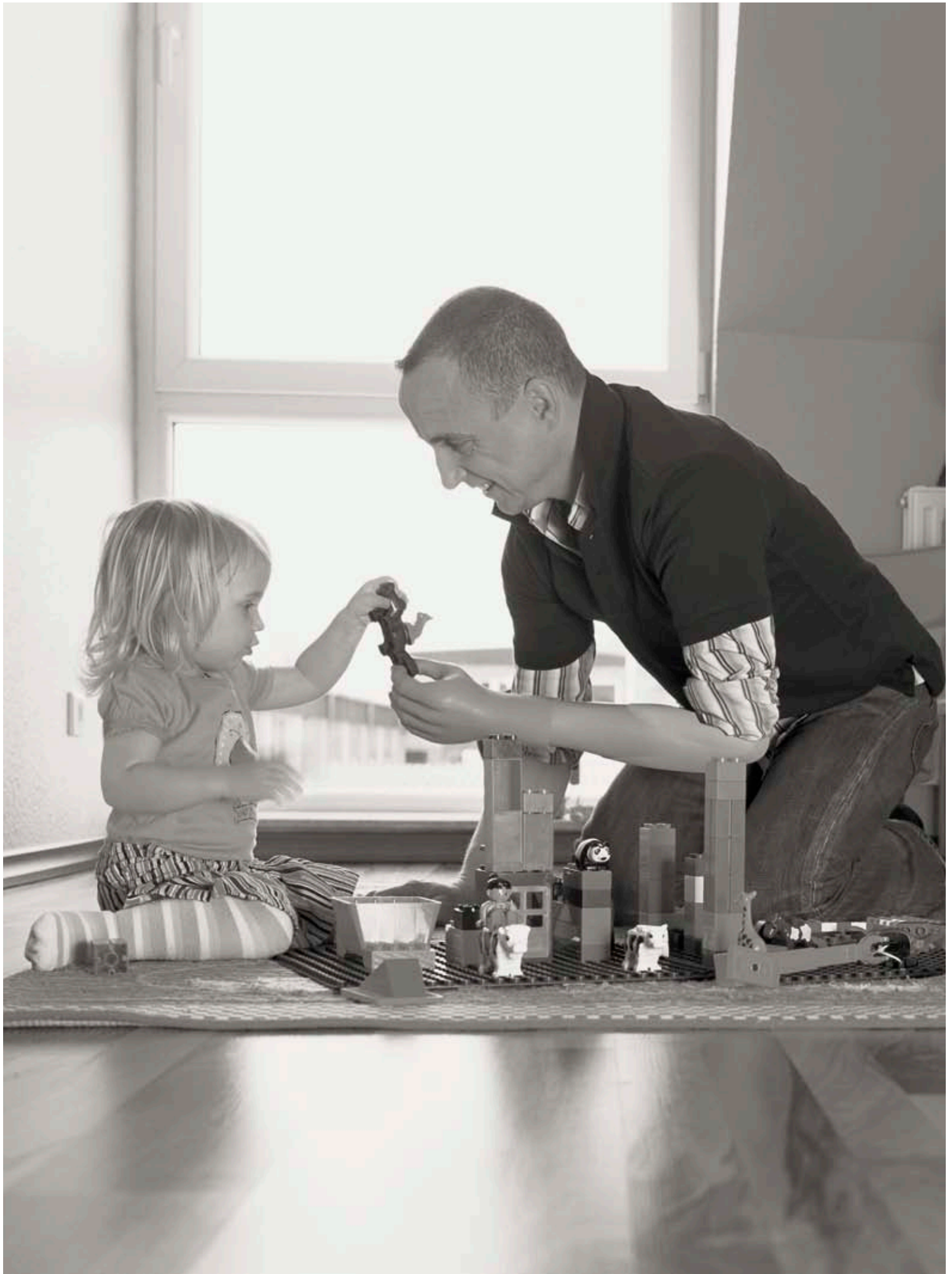
No Limits

Karl-Heinz Ammon did not despair of his situation. True to his philosophy of life: “Everyone’s fate is written on the wall”, he took his life in his own hands. His girlfriend at that time – now his wife – provided him with tremendous support.

Three times she had to ask him – that’s how they’d arranged it – whether he would like to marry her until they both finally agreed to get married. Today the two of them are the proud parents of three girls.

After his accident, Karl-Heinz Ammon’s boss offered him a job that he could do despite his handicap. Karl-Heinz Ammon now works in airport catering and packages perfume, alcohol and cigarettes for duty-free shops.

Karl-Heinz Ammon loves his hobbies. He takes good care of their yard and house, both of which look great. His wife is especially happy that her enthusiastic fisherman is able to stick his worms back on the hook by himself. The only time his prosthesis does not help him, is when he is swimming. But that – Karl-Heinz Ammon admits good-naturedly – was not going so well before the accident either. He wasn’t about to win any world records anyway. He has other plans. “I’d like to learn to dive,” he said, smirking. “I’m definitely going to book a diving course on our next vacation.”



Cable-controlled Arm Prostheses

„Close to Nature and Active“

Peter Wendling

A Passion for Hunting

Peter Wendling is a family man who likes to spend his time outdoors. His passion is hunting. You hear it immediately when he patiently, enthusiastically and intelligently explains even to a layman the difference between a driven hunt and stalking. In the hunting season, he does not mind waking up at the crack of dawn, with the wind howling and rain beating down, and sometimes sitting for hours in the high seat.

His accident in 2000 changed none of this. Peter Wendling lost his right forearm in a straw cutter on October 23rd. Peter Wendling received his first prosthesis in April 2001.



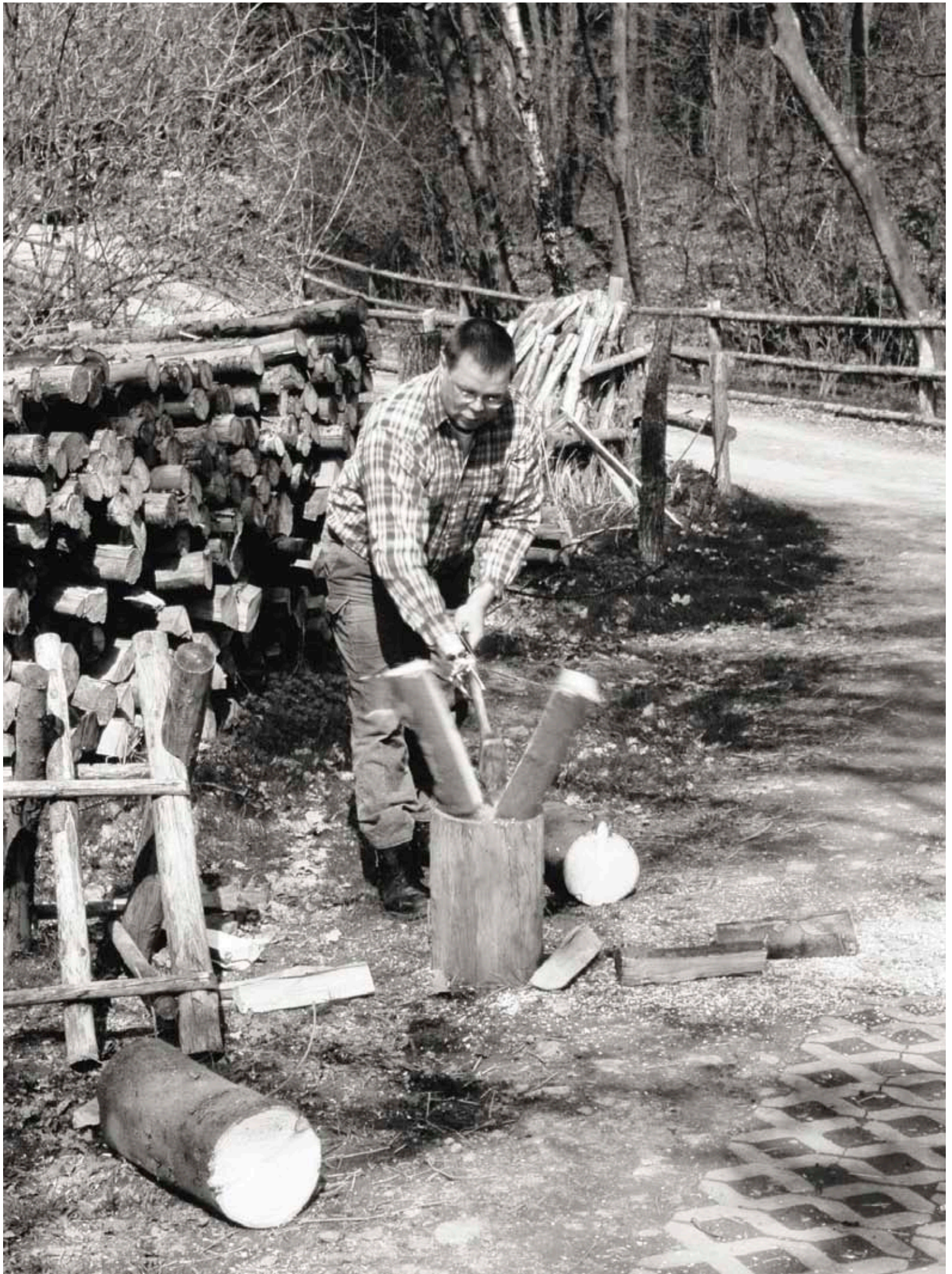
• MovoHook 2Grip with branch lining

The former student of nutritional science works as a cook and trainer in the Bielefeld-Brackwede penitentiary. There he works for a program that is intended to help prisoners find training and employment programs for their re-integration into society and to reduce the risk of recidivism.

Always Active

Peter Wendling is a very active man. Besides his hobby of hunting, he also breeds dogs. This is closely related to his main passion since Peter Wendling breeds German Long-Haired Pointers. This kind of dog is a true hunting dog and needs a lot of physical activity. And they certainly don't get too little with Peter Wendling.

In the winter, Peter Wendling has more to do than usual. He and his family live in an old mill that is completely heated by wood. But the Wendling family does not get their wood pre-chopped into logs. The wood is cut and then Peter Wendling chops it himself, right in his own yard. The strong hook he wears is an excellent solution for this type of work. In the evening, after finishing the work, he can return to his old well-heated mill and have a nice evening with his wife and their three sons and then go hunting with his dogs early the next morning.



Passive Arm Prostheses

„Always on the Go“

Ursula Schlesselmann

Quality of Life is Back

Ursula Schlesselmann proudly shows her upper arm prosthesis. “It looks so deceptively real! My friends are as excited as I am,” laughs Ursula Schlesselmann from Hamburg. The prosthesis has given me back my quality of life, she says today. Ursula Schlesselmann has been wearing a prosthesis since her accident 19 years ago. She is now using a passive arm prosthesis. Its external appearance is more important than what it can do. She is enjoying this summer to the fullest – in short sleeves! She could even paint the fingernails of her new prosthesis with nail polish if she wanted, but she prefers to put a silver arm band around her wrist, because she believes that “it is more in line with my taste.”

If you ask her about sports, Ursula Schlesselmann begins to rave. Being a passionate tennis player and bicycle rider, she is always on the move. She just came back from a 5-day bicycle tour – with 180 more miles on the speedometer. But the 65-year-old does not have time to rest. In a few minutes she’ll be headed to the next tennis match.

Since Ursula Schlesselmann loves nature, she likes to spend every free minute outdoors. She may take a boat ride on the lake or a long walk on a sunny day, and her husband always has the camera ready to catch and preserve the beautiful moments.



Technology for People

For many people, a prosthesis is indispensable in their daily professional life and their free time. The goal of each fitting is to compensate for the loss or limitation of physical functions by providing technical solutions that offer the greatest amount of function while being visually inconspicuous.



Dr. med Hartmut Stinus,
Orthopedist, Northeim

Today a prosthesis lets you undertake many daily and leisure activities without significant limitations. This of course always requires a fitting that meets your individual needs. The best kind of fitting is determined by consultation with a rehabilitation team.

A very wide range of high-quality and technically exceptional prostheses are now available.

Aesthetic and functional solutions that return or contain a high degree of mobility and quality for life are available for almost all areas of application and for nearly every amputation level.

It is particularly in myoelectrics, the area of electric-motor driven prostheses, which has seen great advances in recent years thanks to new micro-

processor-controlled drive systems. The prosthetic gloves, which determine the external appearance of an arm prosthesis, have come to look so deceptively real in the meantime that the prosthesis is hardly noticeable any more.

The present brochure is intended to give you a brief overview of the fitting possibilities that are available to you today after amputations or malformations in the area of the arm. We will not only present different prosthetic systems, but also explain medical terminology. We will also explain residual limb care and the right bandaging of the residual limb. Both are essential for making the later prosthetic fitting easier. We will also discuss in more detail the phenomenon of phantom limb sensations which can occur after an amputation. Finally, we will show you how follow-up treatment with hydrotherapy and occupational therapy works and what you should personally pay attention to. You and your therapist will set up a treatment plan that is important and necessary for successful rehabilitation. You will also find some recommendations for rehabilitation at the back of this brochure and can repeat these exercises very easily at home.

I hope that this brochure will provide you with answers to your most pressing questions and that you will find the brochure informative.

Prosthetic Fitting

Myoelectric-controlled Arm Prostheses

Myoelectric-controlled arm prostheses are externally powered prostheses, which means that they are not driven by the muscle strength of the patient, but with the aid of electric power. The word “Myo” is derived from Greek: mys (“muscle”). A biochemical process generates electrical tension in the microvolt range every time a muscle contracts. This tension can be measured on the skin. This also applies to the muscles remaining after an amputation.

With myoelectric arm prostheses, muscle tensions from the residual limb are usually read by two electrodes – small children start with one. The low myoelectrical impulses that lie in the microvolt range are then amplified and forwarded to the electronics of the prosthesis in the form of control signals.

The great functional benefits of this prosthetic system have a decisive influence on rehabilitation results. Because myoelectric prostheses also offer an appealing design as well as wearer comfort, they have become established as the standard.

Cable-controlled Arm Prostheses

Cable-controlled arm prostheses are body-powered prostheses and are also called active prehensile arms. The functions of the prosthesis are controlled with the body power of, for example, the residual limb and/or the shoulder girdle. A cable control system, which usually runs from the prosthetic arm over the back to a loop and around the healthy shoulder, controls the movement of the prosthesis. With a forearm prosthesis, the targeted movement of the healthy shoulder or both shoulders makes it possible to open the prosthetic hand or the hook. A harness in combination with upper arm prostheses also lets you bend your arm and lock your elbow. The harness gives the patient a feeling for the motion by letting him or her personally transfer the movement. Although this sounds easy, in order to smoothly control and coordinate the prosthesis, it actually requires an intensive training period.

The advantages of the body-powered prosthesis include its relatively simple mechanism and relatively inexpensive price. It is also exceptionally well suited for people who do a lot of work with and in water, when appropriate care is taken.

The disadvantages of this kind of prosthesis are the partially unnatural physical movements required to control the functioning of the prosthesis and the harness, which requires some getting used to.

Passive Arm Prostheses

Passive arm prostheses are worn by people who consider their appearance very important. The prosthesis rounds out the image they have of their body. Besides its purely aesthetic function, the prosthesis also helps in daily life. It can support objects and can be used as a counter-support for certain activities.

This type of arm prosthesis is suited for every amputation level, but it is especially well-suited for high amputation levels, since the sacrifice of active functional elements allows it to have a particularly low weight. Despite its relative lightness, it increases balance and helps prevent scoliosis and damage caused by bad posture.



• Myoelectric-controlled forearm prosthesis



• Cable-controlled forearm prosthesis



• Passive forearm prosthesis

System Electric Hands

The Human Hand is the Model

High Functionality

A fitting with a myoelectrically controlled prosthesis means that the function of the prosthetic hand takes priority. The human hand is a very complex gripping organ that constantly reveals the limits of technology despite every kind of technical perfection.

An ideal fitting has to fulfill different requirements. On the one hand it must ensure high functionality, good durability, high grip speed and grip force as well as low susceptibility to disturbances. But it must also fulfil the desire for low weight, low consumption of energy, the ability to control it easily and the most natural appearance possible.

The reasons mentioned above and the fact that a prosthetic hand is primarily used as a counter-support led Ottobock to select the three-finger grip

for the mechanical construction of the system electric hand. This has created very light, reliable mechanisms that are also incredibly strong.

Moisture and dust are kept out by the system inner hand which looks very similar to its natural model thanks to an external prosthetic glove.

This prosthetic glove is available in variations for children, young adults, women as well as men and comes in 18 different skin colors that can be individually colored afterwards with special color pens. The system electric hand is available in different sizes and offers different connection possibilities for providing the mechanical and electrical connections to the socket.





Control Options

Today proportional control concepts are preferred. They make it possible for the prosthesis user to vary the grip speed by raising or lowering the muscle signal. The modern proportional prosthesis control from Ottobock, Dynamic Mode Control (DMC), has the advantage of allowing the user to individually regulate not only the grip speed, but also the grip force of the prosthesis by raising or lowering their muscle signal. This even makes it possible to pick up small and fragile objects.

The Ottobock DMC plus System Electric Hand has integrated not only the previously mentioned DMC control, but also the DMC plus control concept. Starting the hand opening process after a grip with maximum grip force in the DMC plus mode requires a significantly greater muscle signal than is necessary with the conventional DMC mode.

The idea behind this is that small muscle impulses such as those required for using silverware can be generated without the grip of the hand being loosened unintentionally.

The Digital Twin Control combines both the control concepts of digital control and double channel control in one hand. Digital control keeps the grip speed the same even when the strength of the muscle signal fluctuates. The double-channel control is a variation of the digital control, which allows it to open and close the prosthesis with only one single Myo signal.

Short and Sweet

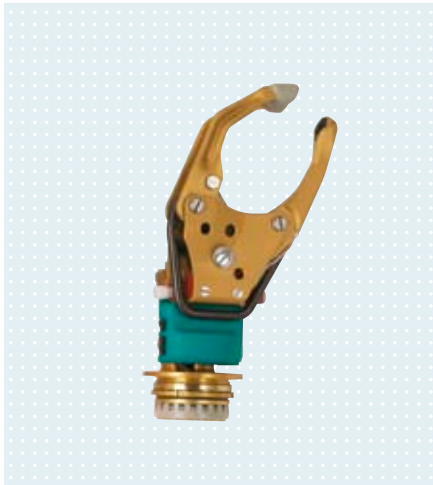
The Transcarpal Hand developed by Ottobock makes a myoelectric prosthetic fitting possible for the first time at mid-hand amputation levels with a length that matches the sound arm. In its development we made sure that the final outcome would allow fittings for those who still had an intact wrist. A state-of-the-art, constructive design was developed which makes the prosthetic hand significantly shorter and roughly thirty percent lighter than the system electric hands.

The Transcarpal Hand is available with the previously mentioned control options DMC plus or Digital Twin.

SensorHand Speed

Speed and Great Precision





- A suitable control option is usually selected through close cooperation between the orthopaedic technician and the prosthesis user. The MyoBoy (see page 21) provides support.

Three Times as Fast

The Ottobock SensorHand Speed offers a significant advance in prosthetic fittings. It opens and closes almost three times as fast as other electric hands. This is achieved by a new high-performance drive, an intelligent software solution and an improvement in signal processing. A grip stabilizing system was also integrated. The SUVA Sensor Technology, which was developed together with the Schweizerische Unfallversicherungs Anstalt, SUVA (Swiss Insurance Agency), offers even more gripping security in everyday life. It increases its grip force automatically in a few hundredths of a second, if an object that it is holding is in danger of slipping out of the hand, until the object is once again in a stable position. The SensorHand Speed is also equipped with a FlexiGrip function. The elasticity of the grip is similar to that of a real hand. This means that the prosthetic user can change the position of an object in his or her hand without having to open or close the hand with an electrode signal in advance. A range of different control options that are based on the previously mentioned Ottobock DMC control principle are integrated into the hand and permit its adaptation to the individual needs of its user.

Very Easy for its User

The control mode called the VarioDual is unique and therefore especially worth mentioning: If the muscle which was flexed to open the SensorHand Speed is relaxed again, the hand immediately begins to close. The grip speed is proportional to the speed of muscle relaxation. The grip force is in turn proportional to the signal strength on the second myoelectrode.

At first, this sounds relatively complicated, but it is very easy for the user to learn, since the process corresponds to the one used for a natural hand. If the muscles used to open the hand are relaxed, the hand closes up to a neutral position. Grip force also follows a more natural process, and is increased by contracting the muscles that are responsible for closing the hand.

The unique single-electrode control called the VarioControl functions in a similar way. The speed at which the prosthetic hand closes here is controlled in proportion to the relaxing of the muscles, as it is with the VarioDual. The grip force is preset within a defined range. The actual application of grip force is undertaken by the Auto-Grasp SUVA-Sensor Technology. The prosthetist and the prosthesis user usually work closely together to select the right control option. The MyoBoy (see page 21) will help with this process.

System Electric Greifers A Must for Craftsmen



The System Electric Greifer lets you do precise work while providing a strong grip, which helps users do detailed work and also handle heavy objects! Its features together with its extremely robust construction make the electric greifer an indispensable addition to the system electric hand, especially for people who do handiwork.

Its integrated quick-disconnect wrist lets the patient exchange the hand and greifer on his or her own. This makes it possible to adapt the prosthesis quickly for the respective needs of its user. Since the greifer can be controlled in the same way as a system electric hand, switching from one to the other is not difficult.

The electric greifer can be flexed 45° in both directions about the joint so that unnatural compensatory movements with the shoulder girdle are largely avoided. Different fingertips (wide, thin, with or without rubber coating) are available as an option and can be individually adapted to the requirements of the respective activity.

The integrated finger wheel also makes it possible to open and close the myoelectrically controlled electric greifer manually. At the same time, the continually revolving finger wheel can be monitored visually during the gripping process. If it is necessary to open or close the greifer very quickly, this is possible with an easy to reach lever.



- Easy change from the System Electric Hand to a System Electric Greifer and vice versa



- Wrist joint with flexion of approx. 45°



- Finger wheel for opening the System Electric Greifer manually

Individual Combination and Adaptation

Each prosthesis can be set up with different components, depending on the user's situation and needs.

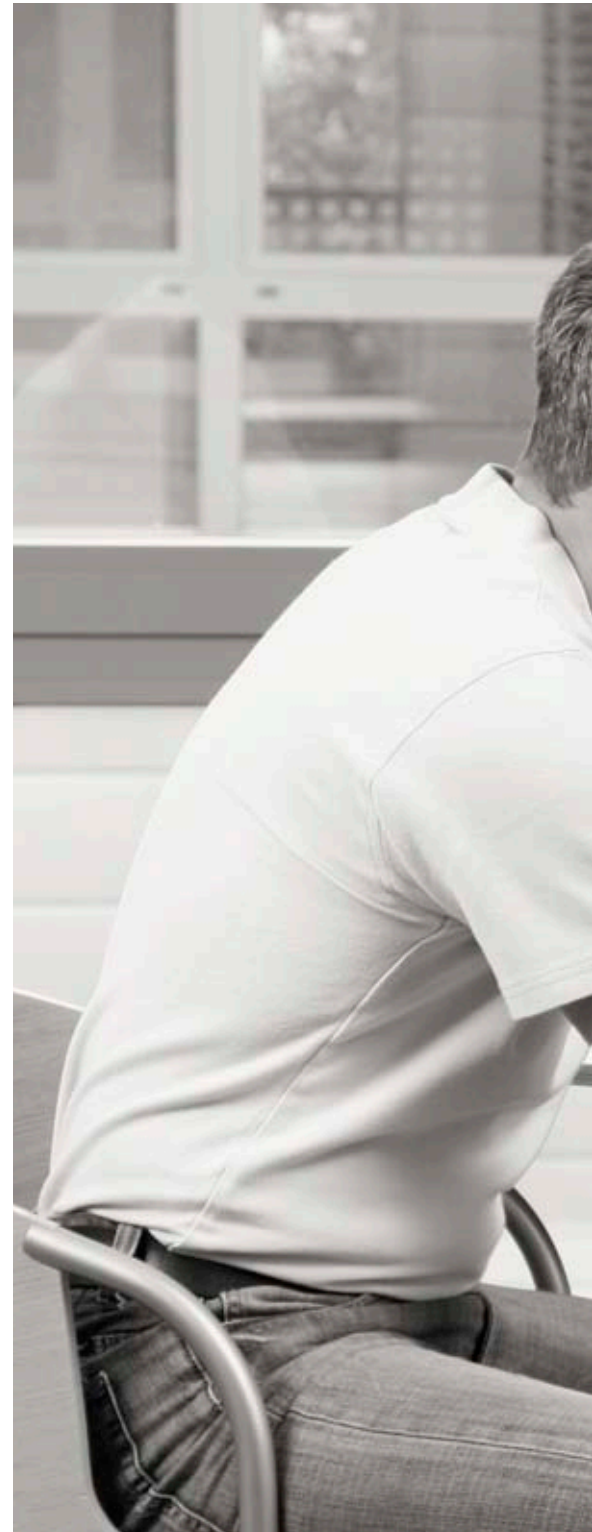
The use of sophisticated technology is very important. If and how the patient manages to learn this technology and integrate the prosthesis into his or her self-image is however critical.

A myoelectrically controlled prosthesis includes not only an individually prepared socket, but also many other components that the prosthetist assembles.

Targeted Muscle Training

Ottobock developed the MyoBoy to facilitate targeted muscle training for the patient. An integrated computer game helps the patient learn to master his or her myoelectric prosthesis and have fun doing it.

The MyoBoy also helps the technician locate and analyze the electrical tension on the skin of the patient. The obtained data make it easier to determine the best control system for the individual fitting. Furthermore, the data can be edited and printed out for documentation.





Upper Arm Prostheses - DynamicArm Armed for Action



Amputations in the upper arm area place special demands on an ideal fitting, since not only the function of the hand, but also that of the elbow joint must be replaced.

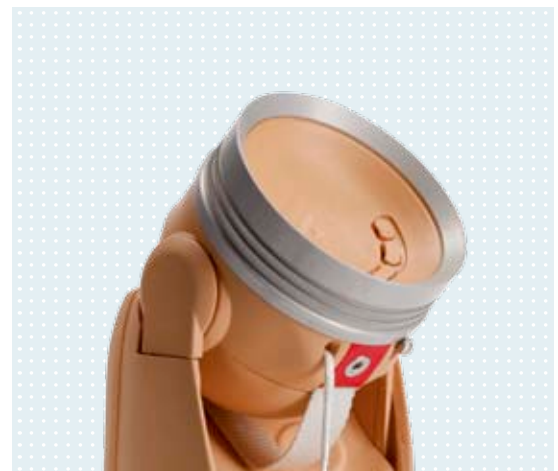
A successful fitting must provide the most suitable replacement for the lost bodily functions and ensure the affected person's inconspicuous integration into his or her environment. Accordingly, the prosthesis should come as close as possible to its natural model, not only aesthetically, but also in terms of its movement. A prosthesis, even the most cosmetically perfect one, will draw attention to itself as long as it does not move naturally.



• AFB finger wheel for adjusting the flexion aid



• Adjustable friction of humeral rotation



• Interior cable routing through the Easy Plug system

The DynamicArm can be positioned quickly and also allows users to actively lift up to six kilograms.

Ottobock had a particular goal in mind when developing the DynamicArm. The DynamicArm was intended to be not only the most functional prosthetic elbow in the world, but also the one that comes closest to replicating the movement of the human arm. More than 40,000 hours of development are behind this innovative high-tech solution for the prosthetic fitting of the upper arm.

The DynamicArm is an electronically controlled elbow joint that is powered by an electric motor. The integrated, extremely quiet Vario transmission continuously and gradually adapts the transmission to the patient's respective operating state and load as well as his or her Myo signal. The especially strong drive motor and a control mechanism, which keeps the acceleration of the DynamicArm under control at the beginning of its movement and brakes it gently at the end, combine to produce dynamic movement that for the first time is similar to that of a human arm.

A number of sensors continually monitor the movement and the load of the system, forwarding this information to the electronic control 100

times per second. The electronic control evaluates these signals continuously and also considers the control signals of the prosthesis user in the process. This causes the speed, acceleration and force to be continuously adapted independently of the weight, flexion angle and control signals of the patient.

The electronically controlled AFB mechanism (Automatic Forearm Balance) supports flexion and thus reduces the energy requirements of the system. It also reduces the oscillation of the forearm during free swinging and consequently helps to produce natural-looking movement.

The automatic disconnection of the drive lets the DynamicArm move almost silently in the free swing phase.

The DynamicArm offers new possibilities for those who have undergone amputation surgery on one side, but it is particularly helpful for those who have undergone upper arm amputations on both sides. Its functional advantages and its inconspicuous, dynamic movement make it a prosthesis that can be integrated into both professional and social daily life.





Making Exploration Fun

For the Children's Hand 2000 we didn't just make the mechanism smaller – we created a completely new one, intended especially for children. The unique grip kinematics open the door to many new applications. For example, a child can more easily view an object that is held in the hand, and fewer compensatory movements are required of the shoulder.

Different control options are also available for the children's hand system. The exchange of a small coding plug makes it possible to change the control mode and thus easily adapt the system to the needs and abilities of the child. Even long residual limbs and wrist disarticulations can be well fitted passive and functionally.

For the earliest possible fitting, starting at the age of 2, there is not only a digital and DMC control, but also an especially simple control option: The EVO (Electronic Voluntary Opening) is controlled by one electrode that is used for opening the hand. As soon as there is no muscle signal, the motor automatically closes the hand. This lets the child get used to the prosthesis early on and he or she can integrate it into his or her self image.





Children's Hand 2000

„The Little Whirlwind“

Celina Pflugmacher





Self-confident and Lively

Celina is a little whirlwind. Little, however, is not the right word, since, at four years, she's already quite big. Just like her twin brother Luka, who does not like it at all when Celina is not at his side. The two of them usually come together. Even in kindergarten. When Celina is sick, Lukas would rather not go to kindergarten. Then he sometimes has some problems with mom – but not for long. Celina, a self-confident and outgoing girl, likes going to kindergarten, since, after all, her friends are there.

Fun and Games

Celina was born with dysmelia. When she was six months old, she received her first prosthesis, a so-called plastic hand. This allowed her to support herself. The weight of the hand helped Celina to avoid damage caused by incorrect posture. After the plastic hand, Celina received a passive prosthesis and then she was fitted with a single-electrode myoelectric prosthesis. Early on, Celina learned a physiologically good posture and the correct way of using the prosthesis in ergotherapy.

All this helped Celina integrate the prosthesis quickly and completely into her body image. She presently wears her two-electrode prosthesis from morning to night, just as she did with her last prosthesis. She'll continue to use it unless, as she grows, it's necessary to fabricate a new socket.

In kindergarten it is her liveliness, if anything, that catches people's attention. Best of all she likes putting together the coolest things. Moreover, she cannot ride bikes enough – though still with training wheels – and loves to travel through the neighborhood on her scooter. When she is playing outside with her brother or the neighbors' children, Celina and Lukas often lose track of time and only go home now and then to see if mom is still there – and of course to have a snack.

When they are both at home, however, Mrs. Pflugmacher has her hands full trying to keep the mischief-makers in line. They both love to play tag in the house – especially around the dinner table – and guess who wins most of the time?

Post-operative Therapy Measures after Amputation



Daniela Wüstefeld, Occupational Therapist,
Competence Center Ottobock Duderstadt

Many experienced ergotherapists believe that far too little attention is paid to the residual limb. Physicians, therapists, technicians and patients must however take the post-operative phase of an amputation very seriously, since taking the right measures at the right time can often prevent complications and limitations later. The question of how quickly one can begin with a prosthetic fitting after an amputation and the success of this fitting primarily depends on the early involvement of all participants.

Edema

The development of edema is a problem that is frequently underestimated in the post-operative fitting. This develops on account of the fact that lymph liquid, which was previously carried out via the healthy lymph system, now collects in tissue openings. An edema is normally an unavoidable reaction to an operative, traumatic event and usually recedes after about a week.

There are however post-operative cases where longer, non-receding edemas develop that lead to delays in the next stage of the prosthetic fitting. A problem-free healing of the wound in the post-operative phase requires measures that prevent the continuation of edema or at least limit it. This includes not only systematic medical monitoring of the healing process after the operation, but also the correct handling of the residual limb.

The lymph liquid, for example, will drain well if the residual limb is elevated above the height of the heart. Additionally, specially trained therapists should drain off the lymph liquid daily in the post-operative phase. To determine the success of the treatment process and to increase motivation, residual limb measurements should be continuously taken and the results written down on measurement forms.

Physicians, physiotherapists and ergotherapists receive recommendations on atraumatic treatment methods suited for edematous tissue.

Aggressive, manual stretching of the tissue on the residual limb should be avoided under all circumstances in edema therapy. This can lead to microtraumas that can in turn cause edema. Adequate pain therapy is also important to prevent the patient from thinking that a prosthetic fitting will not be possible for fear of more pain.



Other Treatment Steps

Other treatments besides edema prophylaxis are also important in the post-operative phase. Of central importance is wound and scar care. Then comes the sensitization of the residual limb and the desensitization of the scar tissue. Furthermore, it is important that the joints adjacent to the amputation level are mobilized early on. Soon after the amputation, the patient should begin to practice using his or her remaining limbs for performing daily activities, particularly cleaning the body, so that he or she can manage without the prosthesis in emergency situations. Please ask your therapist to work out an individual exercise program which will help

you train at home! Compression bandages must be used to shape the residual limb after removing the stitches. The therapist will perform the wrapping with elastic bandages for every residual limb length. Later this can be done by the patient him/herself after prior instruction.

If a patient is not capable of doing the wrapping alone and no one else is present who can do this, an individual or ready-made silicone liner can also be used instead.

Residual Limb Pain and Phantom Pain Physiotherapy and Ergotherapy for Good Treatment





The risk of healing disorders and infections is high in the period of time following amputation operations. That is why it is very important to monitor the wound daily. If the skin around the residual limb turns red or pain is felt, something must be done immediately. Bandaging the residual limb to generate a certain compression is also very important. Physical therapy, physiotherapy and ergotherapy should begin right after the operation if possible. Since the body is suddenly no longer complete after an amputation, the patient may have to make internal adjustments as well. In many cases, a confidential conversation between the physician and the patient can help; sometimes including a psychologist may also make sense.

The differentiation has to be between phantom pain and phantom sensation. Phantom pain is sudden pain in the area of the extremity that no longer exists. The phantom fingers can then claw, burn or itch, for example. Phantom pain can emerge from time to time or repeatedly.

The phantom sensation, on the other hand, is viewed as something completely normal. Phantom sensation, for example, may involve the patient still feeling the fingers from his amputated limb. One perceives that they are still able to move it. With their eyes closed, patients can also describe how they are holding their hand at the moment.

Only some patients suffer from phantom pain in the long term. If the patient feels such pain, there are different treatment possibilities. Quite often one finds nerve ends that are too long and “ride” on the bone especially in cases involving traumatically amputated patients. Such problems can often be eliminated in an operative correction of the residual limb by shortening the nerves and vessels. Other possibilities – immediately after an operation – include local pain blockage as well as medication with calcitonin infusions. The correct wrapping of the residual limb with mild pressure can also bring about a significant reduction in phantom pain. Phantom pain can usually be treated well by undergoing special physiotherapy and ergotherapy. Physical therapy has also been shown to have a good effect. Finally, wearing a prosthesis can also contribute to the alleviation of pain.

Especially the intensive use of myoelectric prostheses helps the brain adapt to the altered situation.

Dr. med Hartmut Stinus,
Orthopedist, Northeim

The Socket Decides

The Prosthetist: Your Partner!

Early Fitting

The fitting with an arm prosthesis should be done as early as possible. The sooner the prosthesis can be integrated into the self-image that the user has of his or her body, the easier it will be accepted. It is precisely this aspect that plays an especially important role with children. A prosthesis is not only advantageous for optical or functional reasons. It also compensates for the loss of weight following the amputation. This improves body posture and prevents things like crooked shoulders, which can have a negative impact on the body's alignment. This often can help prevent permanent, painful spinal curvatures as a result of too much stress on one side.

A Prosthetist's Work

Critical for the quality of an arm prosthesis is the work of the prosthetist, since a correct, individualized fit for the residual limb is the basis for a high-quality and functional prosthesis. The uniqueness of the residual limb must be considered and the joints' freedom of movement must be retained. The bone protrusions of the residual limb should be protected and simultaneously used as suspension points. Attention must also be paid to scars, skin defects and other irregularities.

Fabrication of the Socket

First the prosthetist prepares an exact plaster cast with the aid of bandages soaked in plaster: A so-called plaster negative. This is then filled with liquid plaster and thus becomes a plaster positive. The plaster positive is then modified, which means that extra plaster is applied to sensi-

tive spots on the residual limb to provide relief in these areas later, while plaster is systematically removed from other places to achieve a better-fitting finished socket.

The completely modified plaster positive then serves as the basis for the production of the socket, that is, the part of the prosthesis that fits onto the residual limb. Lamination resins used to be the material of choice for sockets.

Today thermoplastic materials are preferred. They do not cause any allergic reactions, are comfortable to wear and maintain the necessary linkage. If increased comfort or especially strong linkage are required, constructions with so-called liners are often used. Liners are usually made of silicone, which cushions bony prominences, and are secured by an inner socket made of thermoplastic or lamination resins.

With myoelectric prostheses, the electrodes must also be attached to the inner socket in the best possible positions which are determined in advance with the MyoBoy (see page 21).

The finished arm prosthesis consists of inner socket, also known as the bedding for the residual limb, the outer socket, which is the shell that gives it shape, and the system components such as the system electric hand, elbow component, battery, etc.





Pay Attention to Yourself!

Like your body, a prosthesis also needs a little care every day





Putting on and Taking off the Prosthesis

When you put on a prosthesis, it is best if you pull a so-called donning sheath over the residual limb. A length of the stockinette should extend beyond the residual limb, and this is used to pull the residual limb into the socket.

With myoelectrically controlled arm prostheses, it is recommended that the skin in the area of the electrodes be moistened a little with water beforehand. This reduces skin resistance and improves conductivity. This makes it easier for the amplifying electrodes to read myoelectric signals on the surface of the skin.

Taking Care of the Prosthesis

It is easy to take care of arm prostheses. Usually it is enough just to clean the inner socket with a moist towel every day after wearing the prosthesis. This daily cleaning is nevertheless important, since it not only reduces odors, but also protects prostheses, particularly myoelectric ones, from damage due to sweat. A prosthetic glove creates the outer finish of the prosthesis, and looks decep-

tively similar to a human hand. Durability and strength as well as elasticity are also important to avoid limiting the function of the electric hand. In addition, the glove together with the inner hand protects the sensitive mechanism of the electric hand from dirt and humidity. For this reason it is important to replace the prosthetic glove as soon as any damage is noticed. The prosthetic glove is to be cleaned with soap and water if it gets dirty. A special cleaner from Ottobock can be used if the dirt is hard to remove. Users of a myoelectric arm prosthesis should remove the battery if they take off the prosthesis for a long time. If the prosthesis is going to be worn for a long time, a fully charged battery should be used. If the electric hand is not being used, the fingers should not be closed completely. Otherwise this will place a longterm strain on them, which unnecessarily increases the wear on the mechanical components.

It Really Works!

Occupational therapy helps you master everyday tasks

The Quality of a Fitting

Rehabilitation is not over with the completion of the healing process and the prosthetic fitting. The fitting should – if it follows an operation or a congenital malformation – recreate the body image as closely as possible. Comfort is not the only factor however; it should also come down to how the prosthesis will actually be used helpfully in daily life and what practical advantages it offers. This is the place for occupational therapy that should be prescribed by the attending physician.

The goal of occupational therapy is the retention, restoration or replacement of important movements. This enables the patient to do everyday activities like eating, dressing and washing largely on his own and independently.

Regular Hygiene

The cleaning and induration of the residual limb is especially important at the beginning. The hygienic measures for the residual limb are just as important after the wound has healed. The residual limb should be washed daily, ideally in the evening after wearing the prosthesis, using lots of

lukewarm water and a little gentle soap. The inner socket of the prosthesis should also be wiped off with a slightly moist towel. This significantly reduces the risk of skin diseases and fungus infections, which can emerge as a result of sweating.

Regular washing and rubbing down with a hand towel increase the resilience of the skin. This is required for the hygiene of the residual limb and for the wearing of the prosthesis. Other materials for rubbing down the skin, such as beans, corn or sand can also be used.

Functional Training of the Residual Limb

Targeted exercises will mobilize and improve the remaining joints' ability to move, while the muscles will also be strengthened and the residual limb will get used to holding the prosthesis in place. Exercises for the residual limb include games with light balls or a balloon.





Practice Makes Perfect

Training with and without the Prosthesis





Additional requirements are placed on the remaining hand in the event of amputations or malformations on one side. One-handed training is especially important if the later prosthesis will only be a holding hand and not a replacement for the dominant – usually right – hand. Children with a congenital abnormal development are especially creative with these exercises, since they do not have to first “retrain” themselves. It is easy to understand that a righty, for example, whose right arm had to be amputated, initially has difficulties training the left side to perform the functions of the formerly dominant right side equally well.

Residual Limb Exercises

This training is intended to help normalize muscle strength (muscle tone). Exercises that require the training of both arms simultaneously are especially important. With phantom pain, for example, bringing both arms into the same position and tensing them can be helpful. As opposed to congenital abnormal developments, the residual limb is bandaged after amputations. It must be tightly wrapped diagonally and conically without cutting into the skin.

An alternative for the patient is to put on a liner by him/herself to keep the residual limb in a conical form and support the desired venous backflow.

Prosthetic training can begin after one-handed training and the described residual limb exercises. Using an arm prosthesis must be practiced: Putting on a prosthesis and taking it off, using its functions and, last but not least, its cleaning and care, must be learned to take advantage of all its benefits in efficient manner.

The Right Position

Positioning is practiced by doing special exercises: The prosthesis must be brought into the best-possible starting position for it to grip ideally, since poor positioning can be the fundamental reason for imprecise or insecure gripping. Initial training with the prosthesis takes place in front of a mirror. This lets the patient check him/herself and simultaneously see the positive influence of the prosthetic fitting on his or her entire body posture.

Targeted Training

Training the prosthesis to function with objects includes working with the prosthesis while sitting and also standing. Targeted, secure gripping as well as targeted releasing are practiced with objects and tasks from daily life. Users are taught to handle pegs and cubes made out of wood and other materials, for example, using different degrees of strength and firmness.

If the patient is able to use the prosthesis with enough confidence, he or she can train the controlled use of muscles for gripping. In the process he or she must watch him/herself carefully, since the prosthetic hand cannot replace the lost sense of touch.

Objects such as foam rubber, straws, paper cups and tubes of all kinds will help the patient learn the effect of different amounts of pressure on various materials and rigidity.

The Earlier, the Better ...

Special Children Have Special Needs

Congenital abnormal development requires an appropriate fitting when the infant reaches 6 months. This is very important for the development of the infant. The earliest possible fitting has two advantages: On the one hand the symmetry of the body is retained through compensation; on the other hand the small child needs both arms and hands as supports for crawling and discovering the world. A child up to the age of two is in a sensorimotor phase and is developing his or her senses and movement functions. In this respect, a child benefits immensely from the fitting of a prosthesis at this time.

After an initial fitting with a Physolino Babyhand, a cable-controlled or myoelectrically controlled prosthesis can be used.

It is easy to learn to control the gripping function of the body-powered prosthesis. Many parents however reject this type of fitting on aesthetic grounds. An passive, functional and high-quality alternative

is offered after the child has reached the age of 2, when they can be fit with a myoelectrically controlled arm prosthesis. Small children under the age of 4 best learn how to use the prosthesis playing games. Everyday life, hobbies, dexterity games and reaction training can be used playfully to induce older children to do occupational therapy.

Two-handed activities are especially important for movement. Weaving, sewing on buttons, tying shoes, throwing rings and sandbags, letting go of rope and gripping towels are only a few examples of exercises suited for children.

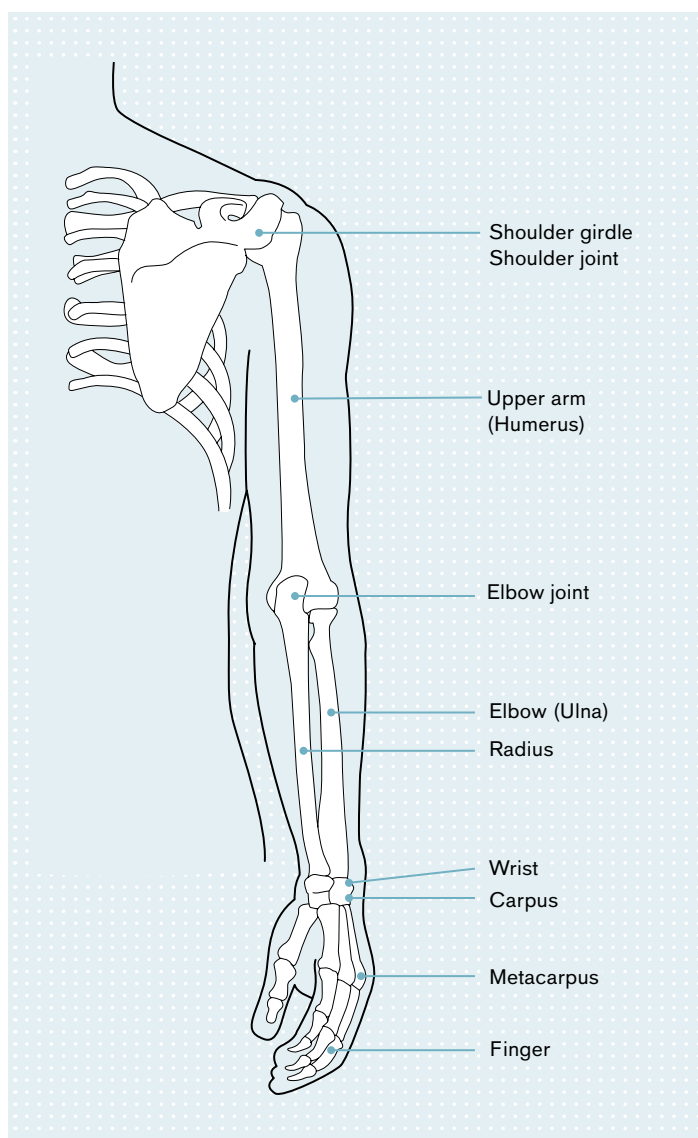
Popular, everyday children's games can also be used in a therapeutically sensible way. The inventiveness of the occupational therapist knows no limits. Everything that is fun for children can be included.



Anatomy and Nomenclature

Amputations and Congenitally Deformed Limbs

Nomenclature



Amputations

The most common causes of upper extremity amputations are injuries and tumors. One must differentiate between cutting injuries, sawing/milling injuries, perforation injuries, wreckage injuries as well as biting injuries, explosion trauma, high voltage burns and frostbite.

The most common tumors that require amputation are bone tumors in young people and bone metastases in older people.

Every fifth case of vascular disease requires amputation surgery. Other causes include venous and lymphatic circulation disorders, infections or even paralysis.

Amputations are also categorized according to their level: forequarter (interscapular transthoracic), shoulder disarticulation, upper arm, elbow, forearm, wrist, hand/finger.

Congenitally Deformed Limbs

Medical research has identified the following causes as possible reasons for congenitally deformed limbs: Chromosome changes (change in genes) or damage to the embryo in the first three months of pregnancy, particularly due to a lack of oxygen, poisoning, ionizing radiation, viral metabolic diseases, blood group incompatibility and strangulation by amniotic bands.

Transversal malformations

Old European terminology. **Amelia;** **phocomelia;** **ectromelia;** **peromelia**

Under no circumstances is giving birth to a child with a malformation a “punishment from God”. Such a child is just as capable of living and can enjoy life just as much as any other; it just needs a little support in some areas.

Internationally, congenital abnormal development is classified according to **transversal** (horizontal) and **longitudinal** (vertical) malformations. Other factors used for differentiation include:

2. **Right or left**
3. **Missing or malformed bones**
4. **Total or partial** malformation
5. **Humerus** (upper arm bone), **ulna** or **radius**

Clinics continue to use the old European categories. Transversal malformations are differentiated in the following ways:

1 **Amelie**

Complete absence of an arm

2 **Phocomelia**

The hand – or part of it – is directly connected to the shoulder

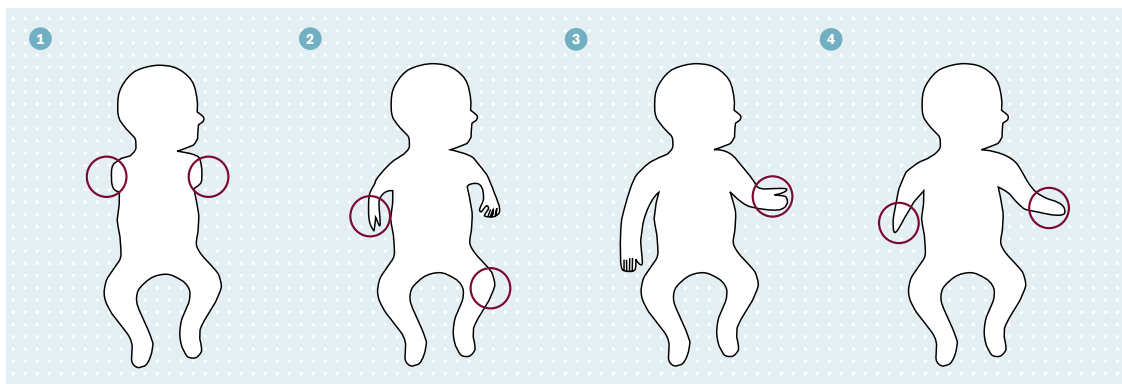
3 **Electromelia**

An intermediate piece from the length of a tubular bone is missing, while the hand is retained

4 **Peromelia**

The arm is partially missing

- The generic term for congenital abnormal development is **dysmelia**.



• Fig. from: Baumgartner, René; Botta, Pierre: Amputation and Prosthetic Fitting of Upper Extremities. Stuttgart: Ferdinand Enke, 1997

Human Beings Are the Measure of All Things





With top-quality and technologically superior products and services Ottobock helps people maintain or regain their freedom of motion. We hold true to the vision of our company: Giving people the greatest degree of mobility and independence possible

Our innovations have their scientific base in the field of Orthobionic, which studies the natural movements of the body down to the last detail. The products that have emerged from this knowledge have made Ottobock a world leader.

The speed of developments has rapidly accelerated as a result of new technologies. At the same time, every new product takes shape on the basis of decades of experience in the successful story of a company that began in 1919. Progress and tradition are not a contradiction for us, but rather a cohesive unit. From the past we have learned a valuable lesson that will help guide us in our future research and development: Human beings are the measure of all things.

Our daily challenge is to see the world through the eyes of those people whom we try to help improve their quality of life with our products, expertise and service.

Quality for Life

Extensive expertise and experience in processing materials such as titanium and carbon fiber supplement our expertise as an industrial manufacturer. Finally, Ottobock is happy to share this knowledge and experience in practice-oriented rehabilitation at its seminars and training sessions for orthopedic technicians. This has proven to be an important element in ensuring that end users receive the best possible prosthetic fitting.

Duderstadt in the Eichsfeld region of Germany is not only the largest of our development and production facility, but also the headquarters of Ottobock HealthCare. It is here that we coordinate our international activities. Motivated, well trained employees as well as efficient knowledge management will make it possible to reach technological milestones such as the DynamicArm in the future, too. Today, continuous training is a firmly established part of the company's global organization.

