

Cochlear implantation step by step



Because
sound
matters



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Introduction

The fundamental research leading to the first cochlear implantations was undertaken during the 50s.

In the late 70s and 80s, the number of clinical tests increased.

Since then, research and development has continued to improve patient outcomes in hearing implant technology with a common objective: to enable people with severe to profound perceptive hearing loss or even total deafness to hear.

Today cochlear implantation is a safe and proven procedure that everyday helps to improve hearing and the quality of life for over 300,000 people around the world.

This booklet has been created to give you an insight into how a cochlear implant works, the medical indications and a step by step description of the road to better hearing.



How hearing works

The outer ear

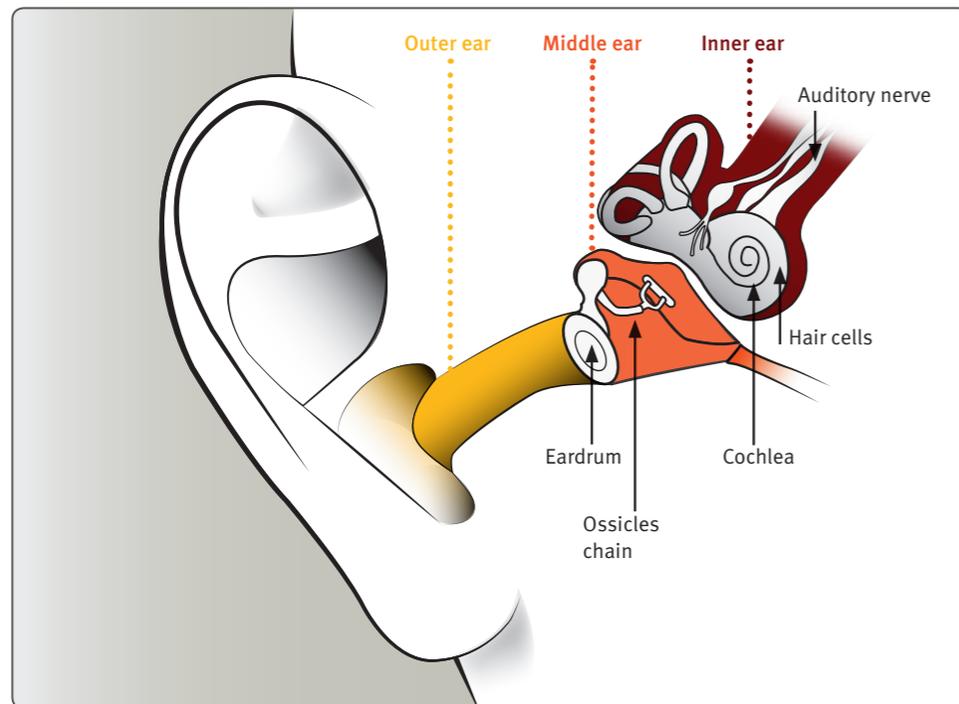
The auricle captures the sound and directs it down the auditory canal.

The middle ear

The tympanic membrane and bones of the middle ear vibrate in response to sound and act as a lever system, forcing the vibrations into the inner ear.

The inner ear

The fluids in the inner ear pick up these vibrations and cause special hair cells to move. The movement of these hair cells ultimately generates the electrical signals in the auditory nerve.



Different types of hearing loss

When any part of the hearing path is damaged, sound information cannot be properly carried to the brain resulting in some degree of hearing loss. Different types of tests measure the degree of hearing loss, ranked as mild to profound, and the type of hearing loss, classified as conductive, perceptive or mixed hearing loss.

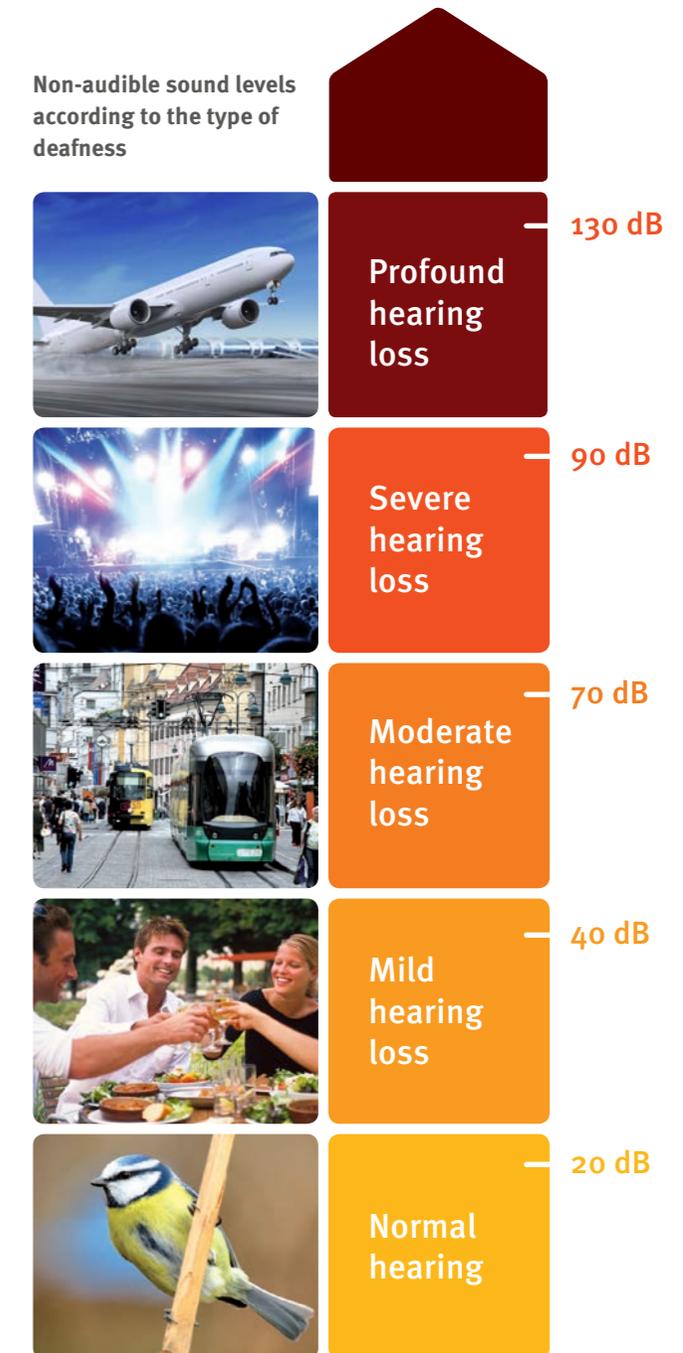
Conductive hearing loss describes hearing loss in the outer or middle ear.

Perceptive or sensorineural hearing loss is caused by problems in the inner ear or the nerve pathways.

Mixed hearing loss is a combination of conductive and sensorineural hearing loss.

Different treatments and solutions are available, depending on the type and degree of hearing loss. These include hearing aids, middle ear implants, bone-anchored hearing solutions and cochlear implant systems.

Non-audible sound levels according to the type of deafness



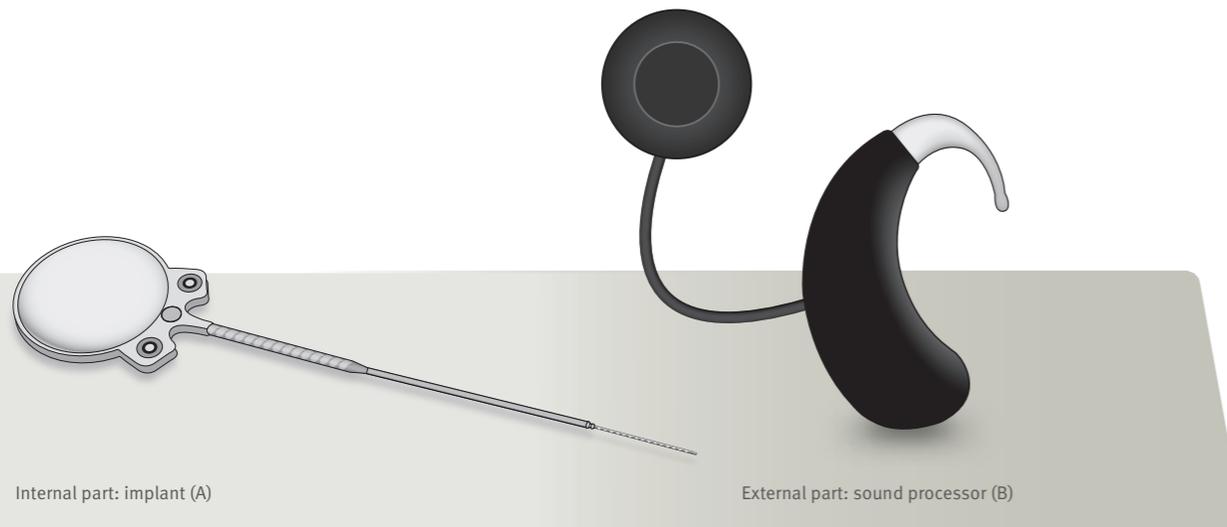
What is a cochlear implant?

A cochlear implant is an electronic medical device developed for people with severe to profound perceptive hearing loss who have limited benefits from appropriately fitted hearing aids.

Hearing aids capture sound, amplify it and send it through the normal auditory channel. They are designed for people with slight to moderately severe perceptive hearing loss.

In cases of severe to profound hearing loss, hearing aids are not powerful enough. If the ear damage is too severe, amplifying sound using a traditional hearing aid will have no effect. The cochlear implant overcomes this by sending the signal directly to the auditory nerve. Unlike traditional hearing aids, cochlear implants bypass the damaged areas of the ear. They capture the sound, process it and electrically stimulate the auditory nerve.

Example of a cochlear implant system



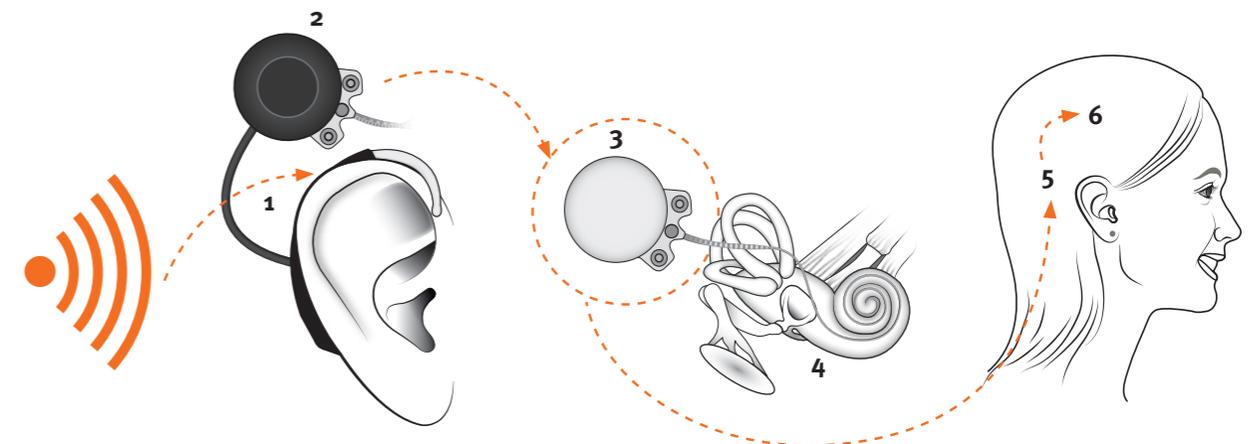
The cochlear implant system consists of two parts:

- The internal part (A) is a receiver surgically implanted in the temporal bone underneath the skin, and an electrode array placed in the cochlea.
- The external part (B) is a behind-the-ear sound processor and a lead connecting the processor to the antenna. The antenna is magnetically attached to the skin over the internal part.

How does a cochlear implant work?

1. The sound processor captures and digitises sound.
2. The antenna is magnetically attached to the skin. It transmits the digitised sound from the sound processor to the implant receiver.
3. The magnetic implant receiver is fitted under the skin directly under the antenna. It transforms the digital information into an electronic signal sent to the cochlea.
4. The electrode array is inserted in the cochlea. Each electrode on the array corresponds to a signal frequency.
5. The auditory nerve is stimulated when the encoded signal is transmitted to the corresponding electrode.
6. The brain receives the sound transmitted via the auditory nerve.

The sound processor is activated using fitting software that creates custom programs for each user.



What to expect from a cochlear implant?

Cochlear implants have been shown to improve the quality of life for thousands of people around the world.

Over the past 30 years, research and developments in the field of cochlear implantation have made remarkable progress. When cochlear implants were first introduced they merely enabled sounds to be perceived. Later, they improved speech understanding in quiet environments. This has been followed by huge improvements in the sound quality of the signal, enabling users to better understand speech in difficult listening environments and listen to music.

Today's cochlear implants are designed to offer speech understanding in all types of sound environments depending on the person's own ability. Users report being able to hear a variety of sounds in their daily lives – from children's laughter to the sounds of nature. Many sounds that they never thought they would be able to hear again.

In general, cochlear implants help users to manage everyday life:

- Better understand speech
- Watch television
- Use the telephone
- Take part in conversation during a meal

For children, cochlear implantation enables speech development and social integration hereby giving children the opportunity to take part in regular schooling and continue on to further education. As children with cochlear implants develop language skills, they grown in confidence and can enjoy greater independence.

However results may vary upon several factors, such as:

- the cause of hearing loss and its potential physiological consequences
- the duration of hearing loss
- the effort of the person and those close to them to educate or rehabilitate the brain to receive sound signals

It is important to note that success with a cochlear implant depends upon one's commitment to the fitting and rehabilitation sessions, as well as their patience, effort and motivation.



Each person is unique



Who can benefit from cochlear implantation?

Cochlear implants are designed for people with severe to profound perceptive hearing loss, who experience limited benefits from appropriately fitted hearing aids.

Generally, people consult a specialist Ear Nose & Throat (ENT) doctor when they experience difficulties in hearing or following a conversation despite using a hearing aid. Often they are exhausted by the effort required to communicate, or even feel the need to lip-read in order to understand a conversation.

The ENT doctor can do the first evaluation and give advice. If a cochlear implant is considered as an appropriate solution, the ENT doctor refers them to a cochlear implant centre. The implantation centre's multi-disciplinary medical team carries out the necessary tests before making any decision on implantation.

Is there an ideal age for a cochlear implant?

For children, especially for pre-lingual deaf children, early cochlear implantation at around 12-18 months is recommended as hearing enables the development of language skills. Early implantation also gives the best chance of attending school and following the general education system.



For adults there is no upper age limit for cochlear implantation, although a preliminary psycho-cognitive evaluation is essential for the elderly. For these candidates, the main benefit of cochlear implantation is to maintain autonomy and social interaction.

As reimbursement indications may change or be country-specific, please consult a cochlear implantation centre for further information.

When is cochlear implantation not suitable?

Despite cochlear implantation being a hearing rehabilitation solution, in certain cases the implantation centre may consider it inappropriate.

In addition to the medical indications of cochlear implantation, the following may rule out this solution:

- If the results obtained with conventional hearing aids are considered sufficient for speech understanding.
- If the auditory nerve is too damaged or non-existent, or if the cochlea is ossified or is not the main cause of hearing loss, other solutions may be proposed (for example, a brainstem implant).
- If the patient's health does not allow them to undergo a surgery.
- If the patient's motivation or the family's support are thought to be inadequate.

What are the factors for success?

It is essential that candidates try to imagine their “post-implantation” life. Maintaining realistic expectations will contribute to implantation success. They must be aware that cochlear implants are a solution for hearing rehabilitation, and that they will not restore natural hearing, despite advances in this technology.

Rehabilitation and fitting adjustments require the user to make a personal effort to optimise their hearing potential. Children should be well supported by their family to motivate them to develop speech and language skills.

Before deciding on implantation, it can be helpful to talk with other cochlear implant users. They can be contacted through cochlear implant users’ associations, which also play a key role in informing and supporting candidates and their families.

Bilateral implantation

A second implant improves the ability to locate a sound, aids speech understanding in noisy environments, and allows the stereo perception of sound. Both sides can be implanted in the same operation. However, the majority of bilateral implantations take place over two sessions, with the second implantation taking place months, even years, after the first. Patients with one implant could be candidates for bilateral implantation, subject to the evaluation at the implant centre.

Please note that bilateral implantation is not reimbursed in all countries. Please contact a cochlear implant centre in your country for more details.

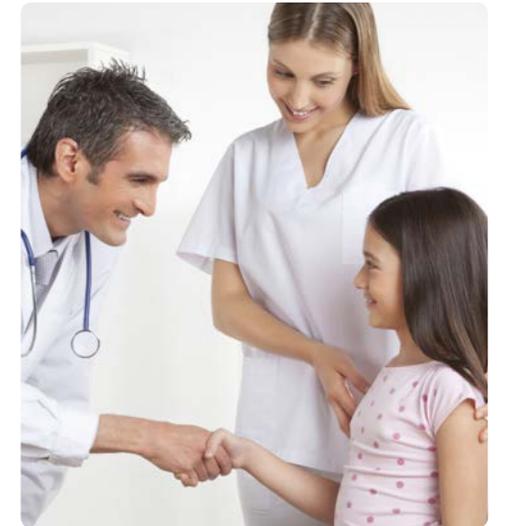


Step by step cochlear implantation

1. Appointment at a cochlear implantation centre

The general practitioner, ENT doctor or audiologist refers the patient to a cochlear implantation centre with a multidisciplinary implantation team consisting of:

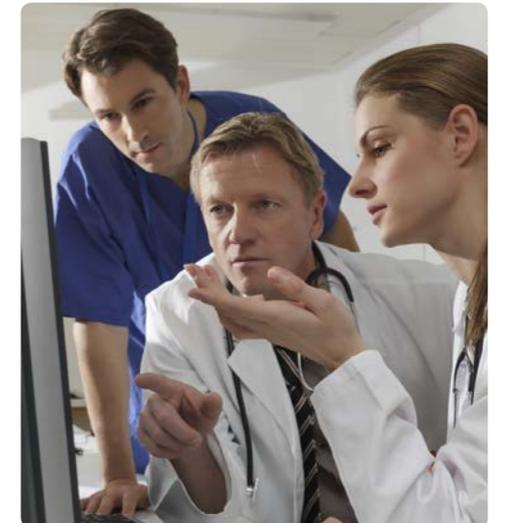
- A surgeon experienced in otologic surgery
- An ENT doctor
- An audiologist or technical audiologist, responsible for the audiometric evaluations and sound processor fitting
- A speech therapist, responsible for language evaluation, follow-up and rehabilitation
- A psychologist, responsible for evaluating the patient’s psychological suitability for cochlear implantation



2. Evaluations

A series of tests and assessments are carried out by the implantation team to evaluate whether a cochlear implant system is indicated for the patient. These include:

- Detailed audiology assessment of the auditory capacities and auditory nerve function
- Various medical examinations to check the patient’s general state of health
- CT scan and/or an MRI of the inner ear
- Psychological assessment of the patient’s and/or family’s motivation for implantation and expectations
- Speech and language assessment to measure the patient’s language aptitude and ability to lip-read



3. Surgical intervention

Surgery is required to insert the internal part of the implant system.

Like all surgery, insertion of a cochlear implant carries risks, mainly connected to the anaesthetic. However, cochlear implantation is a safe and proven procedure, normally lasting around 2 hours.

After general or local anaesthetic, the surgeon makes an incision behind the ear and inserts the cochlear implant under the skin.

Depending on the type of implant, different surgical techniques fix the implant's receiver. An opening is made in the cochlea to carefully insert the electrode array.

The surgeon checks the proper functioning of the implant before closing the incision and completing the operation.



4. Recovery

After the operation, the patient only needs to stay in hospital for a few days.

The healing period lasts around 3 to 5 weeks until only a small scar behind the ear remains, which will be hidden by hair. During this time, most patients can generally resume normal activities. However, they still will be unable to hear.



5. Activation and the first sounds

After the recovery period, the patient receives the sound processor. To be able to hear the first sounds, the fitting audiologist must adapt the sound processor to the physiology of the user.

Using dedicated fitting software, the audiologist creates a “sound map”. This determines the individual limits for each electrode to make hearing as clear and comfortable as possible.

Each experience of activation is unique but it generally takes some time for the brain to adapt to this new type of stimulation.



6. Fittings and rehabilitation

After cochlear implantation, improvements in hearing are linked to the efforts made by the user and the family. Speech therapy and rehabilitation programs and attending all sound processor fitting sessions are therefore highly recommended.

Initially, fitting sessions are scheduled frequently, but they become less frequent once settings are optimised. Later an annual visit is required to monitor progress and continue fine tuning.



The importance of speech therapy rehabilitation

Speech therapy rehabilitation is extremely important to achieve the best results from a cochlear implant. Its duration varies depending on the user's type of hearing loss, their age and individual motivation.

For an adult with post-lingual hearing loss, rehabilitation lasts on average between 6 months and a year, whilst some users may need a longer period of speech therapy. Rehabilitation can be more challenging if users have suffered from auditory deprivation for a long period.

For children with pre-lingual hearing loss who have received an implant at a young age, language acquisition and comprehension may take many years to achieve. For children with post-lingual hearing loss (for example, following meningitis), positive results are often quickly achieved if the implantation is carried out promptly after the loss of hearing.

Teenagers or adults who have had pre-lingual hearing loss for many years will generally feel more confident and have a greater understanding of speech following the rehabilitation sessions, which may last a few years. However, they might still need to revert to lip reading in certain situations.



Living with a cochlear implant

The cochlear implant system helps people discover or rediscover a better quality of life through improved hearing. Most people with a sound processor find that it quickly becomes a natural part of their life and that they can easily communicate on the phone, watch television, listen to music and have an active lifestyle.

The cochlear implant system also comes with a wide range of accessories to aid daily comfort, maintenance and wireless communication.

Communicating

With the fast development of communication networks, many cochlear implant users want to access modern communication devices for greater autonomy and independence. Being able to use the telephone again is often high on the list of things people expect from cochlear implantation. Nowadays, accessories or bluetooth can directly connect the cochlear implant system to devices, such as the telephone or television.

Travelling

Cochlear implants do not prevent general travel by land, sea or air. It is advised that the external part of the implant system is switched off during plane take-off and landing. Users should always follow the manufacturer's recommended care instructions, especially in different climates. Manufacturers generally offer a loaner sound processor for increased peace of mind. It is also recommended that users carry their implant identification card and present it at airport security controls or at any medical examination.

Sports

Sports activities are generally allowed for cochlear implants users but the implant and the sound processor must be protected from impact and humidity. Sports with a high risk of head impact should be avoided. The implantation centre can provide advice on participation in sports activity, the implant system and specific precautions to take. Manufacturers can also provide useful advice related to special features of their products.

Medical examinations and treatments

Most medical examinations are still possible but users may have to remove the external part of the implant system. In spite of the few medical restrictions, cochlear implant users are still strongly advised to contact the implantation centre before any surgical intervention or medical examination, for example an MRI.



How to select a cochlear implant?

Choosing a cochlear implant system is a decision with a lifelong impact. Before deciding, you should consider the reliability of the implant and its sound processor, as well as different aspects of the services provided, such as manufacturer support, after-sales service and the cost of any accessories.

Implant considerations

- Impact resistance and general reliability
- Type of surgery for your ear structure: fixation system, size and type of the implant
- Compatibility with future technological advancements of the sound processor and signal processing

Sound processor considerations

- Performance, sound quality and compatibility with modern communication systems, e.g. wireless communication with mobile phones and TVs, direct auxiliary jacks and setting adjustment options for different noise levels
- Ease of use in handling and maintenance, e.g. battery replacement
- Comfort and aesthetics

Manufacturer considerations

The manufacturer of the cochlear implant plays a lifelong role in the user's daily challenges. Their solutions need to be high quality and compatible with future generations of products so that cochlear implant users have access to the best technology. This makes quality of service and the after-sales organization important considerations for meeting users' and professionals' expectations.

Need further information?

This brochure is intended to provide an overview of cochlear implantation. Should you require further information, please consult an implantation centre, a cochlear implant users' association or your local Oticon Medical office or distributor.

More information can be found on www.oticonmedical.com.



Because sound matters

Oticon Medical is a global company in implantable hearing solutions, dedicated to bringing the magical world of sound to people at every stage of life. As a member of one of the world's largest groups of hearing health care companies, we share a close link with Oticon and direct access to the latest advancements in hearing research and technologies. Our competencies span more than a century of innovations in sound processing and decades of pioneering experience in hearing implant technology.

By working collaboratively with patients, physicians and hearing care professionals, we ensure that every solution we create is designed with user needs in mind. We share an unwavering commitment to provide innovative solutions and support that enhance quality of life for people wherever life may take them. Because we know how much sound matters.



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