



INERAIDTM
ARTIFICIAL EAR

A PATIENT INFORMATION GUIDE



NOVEMBER 1984

This device is available only for clinical investigation under an Investigational Device Exemption granted by the Food & Drug Administration. It is **not** available for commercial distribution.

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A PROFILE OF SYMBION, INC.

Symbion, Inc. designs, develops and manufactures artificial human organs and related devices. The **JARVIK-7™** artificial heart and the **INERAID™** artificial ear are being developed under exclusive licenses from the University of Utah. The **HEIMES™** heart driver is being developed under a license from the Helmholtz Institute, West Germany. Presently, these products are sold for research purposes only.

The **INERAID** artificial ear is a multichannel cochlear implant designed to restore some hearing to individuals with sensory deafness.

The **JARVIK-7** artificial heart was the first permanent total artificial heart implanted in a human patient. The **HEIMES** heart driver, a portable system about the size of a camera bag, is designed to power the artificial heart and can be easily carried by a patient.

Symbion, Inc., formerly Kolff Medical, Inc., was formed in 1976 by Dr. Willem J. Kolff and other persons associated with the University of Utah Institute for Biomedical Organs of the Department of Surgery.

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INERAIDTM

A R T I F I C I A L E A R

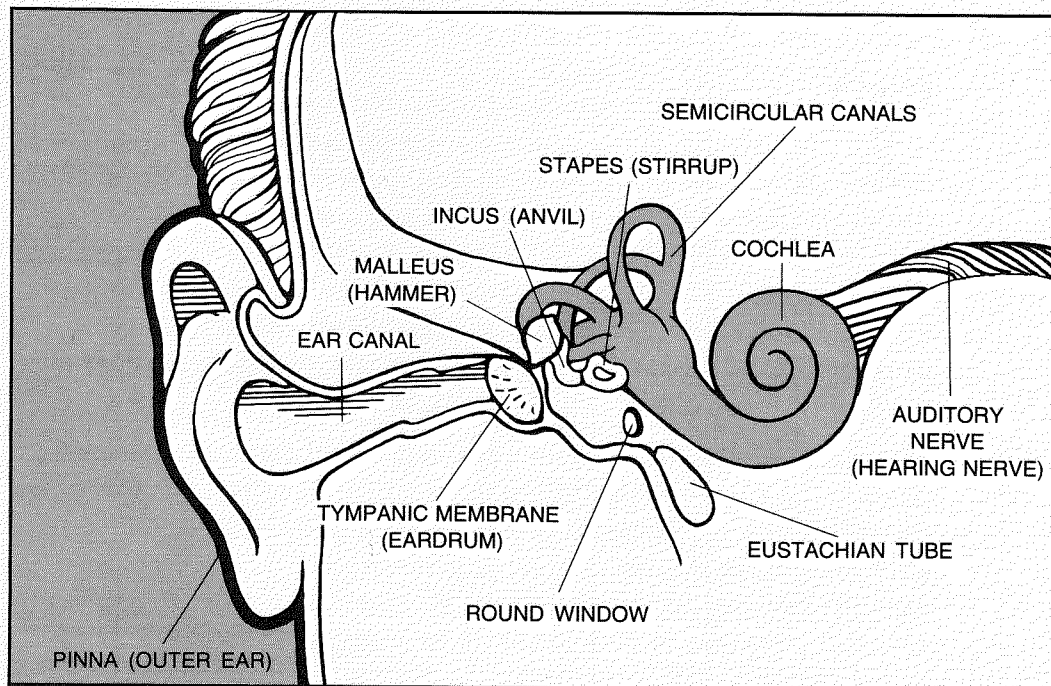
I N T R O D U C T I O N

This guide is intended to familiarize you with the INERAID artificial ear. It contains valuable information concerning hearing and loss of hearing, cochlear implants that attempt to restore hearing, and medical criteria required of INERAID artificial ear implant candidates. It will further inform you concerning probable risks as well as benefits that may be expected from a decision to surgically implant an artificial ear. The final section contains answers to many of the questions you may have.

The INERAID artificial ear is a multichannel cochlear implant designed to restore partial hearing to those suffering from sensorineural deafness. It is an investigational device and, as such, results of its use cannot be guaranteed. You are encouraged to become informed about all aspects of this program and the purpose of this guide is to assist you in that educational process. All information is general and based on the latest product information at the time of publication and should not be interpreted as a promotion or inducement to purchase.

Please read the guide carefully and note any questions you may have. It is our concern that you have a clear understanding when discussing this matter with your physician and family. This will enable you to make the best decision to have, or not to have, an artificial ear implant.

ANATOMY OF THE EAR



HEARING

THE EAR

What we usually refer to as the "ear" is only a portion of this vital sensory organ. The ear consists of three main parts which extend deep into the head: the outer ear, middle ear, and inner ear.

OUTER EAR

The outer ear is made up of the pinna, which is the fleshy curved part we normally call the ear, and the ear canal.

MIDDLE EAR

The middle ear consists of the tympanic membrane (eardrum) and ossicles (three small ear bones) which are called the malleus (hammer), incus (anvil), and stapes (stirrup).

INNER EAR

The major parts of the inner ear are the semicircular canals and the cochlea. The semicircular canals are involved in maintaining posture and balance. The cochlea is the snail-like structure of the inner ear. The sense organ for hearing – the organ of Corti – is located in the cochlea.

The organ of Corti is composed of more than 15,000 microscopic sensory "hair cells." These hair cells contact approximately 30,000 nerve fibers that make up the auditory (hearing) nerve.

NORMAL HEARING

Sound arrives at the outer ear in the form of waves. These waves travel down the ear canal and strike the eardrum, causing it to vibrate. The vibrating eardrum sets the three small ear bones in motion. The movement of the bones creates waves in the fluid within the cochlea. Depending upon the frequency (pitch) of the sound waves, one section of the organ of Corti vibrates more than other sections. The vibrating hair cells transform the wave motion into electrical signals which the auditory nerve transmits to the brain. The brain interprets these signals as speech and other sounds.

HEARING IMPAIRMENT

Hearing impairment can result from a problem in any one of the three parts of the ear. It may be as simple as a build-up of wax in the ear canal or as serious as being born without parts of the ear.

CONDUCTIVE IMPAIRMENT

Problems that disrupt the transmission of sound vibration through the outer and/or middle ears are called conductive losses. These impairments are treated with good success

using modern medical and surgical techniques.

SENSORINEURAL IMPAIRMENT

A person may be diagnosed as having "nerve" deafness when a more accurate classification is "sensorineural" deafness.

There are two forms of sensorineural deafness: *sensory* and *neural*. A sensory loss occurs when the microscopic sensory hair cells are damaged. This means the hair cells are unable to stimulate the auditory nerve fibers to send electrical signals to the brain. In a neural loss the auditory nerve fibers are damaged resulting in irreversible deafness.

Studies indicate that as many as two-thirds of the people suffering from sensorineural deafness could be helped by a cochlear implant because their deafness is due to a *sensory loss*. The cochlear implant is designed to imitate the function of the damaged or destroyed sensory hair cells. At least part of the auditory nerve must be intact for a cochlear implant to work. As a candidate for a cochlear implant you will be tested to determine whether you suffer from sensory or neural deafness.

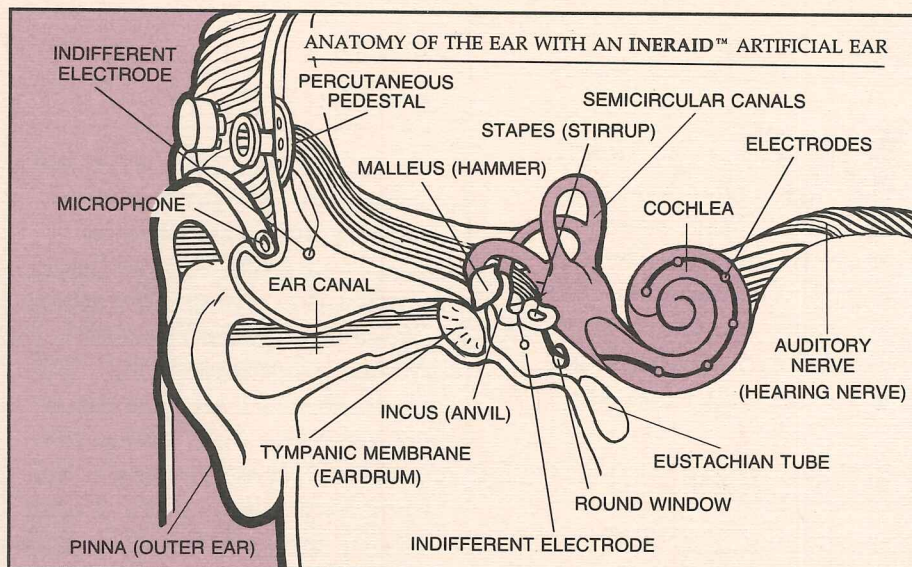
COCHLEAR IMPLANTS

SINGLE-CHANNEL MULTICHANNEL

Basically, there are two types of cochlear implants: single-channel and multichannel. Single-channel implants stimulate all implanted electrodes alike. This means that all of the nerve fibers activated by a single-channel implant will respond essentially the same. Because of this characteristic, single-channel devices offer little hope of producing the complicated neural activity patterns required by the brain to understand speech. However, they do provide recognition of environmental sounds.

Multichannel implants have a processing channel that is customized for each electrode. Each electrode is stimulated with a different waveform. Thus small segments of the nerve can be individually stimulated, creating more complicated activity patterns than is possible with a single-channel implant.

Present models of cochlear implants may be further divided into percutaneous and transcutaneous systems. A percutaneous system has a pedestal which is attached to the bone behind the ear and projects through the skin. It is connected to the sound processor by a cable. A transcutaneous system has a transmitter outside the body which sends



signals electromagnetically to a receiver implanted under the skin.

THE INERAID ARTIFICIAL EAR

The INERAID artificial ear is a multichannel percutaneous system. It consists of two main parts: the implanted electrode assembly and the external microphone with sound processor.

IMPLANTED ELECTRODE ASSEMBLY

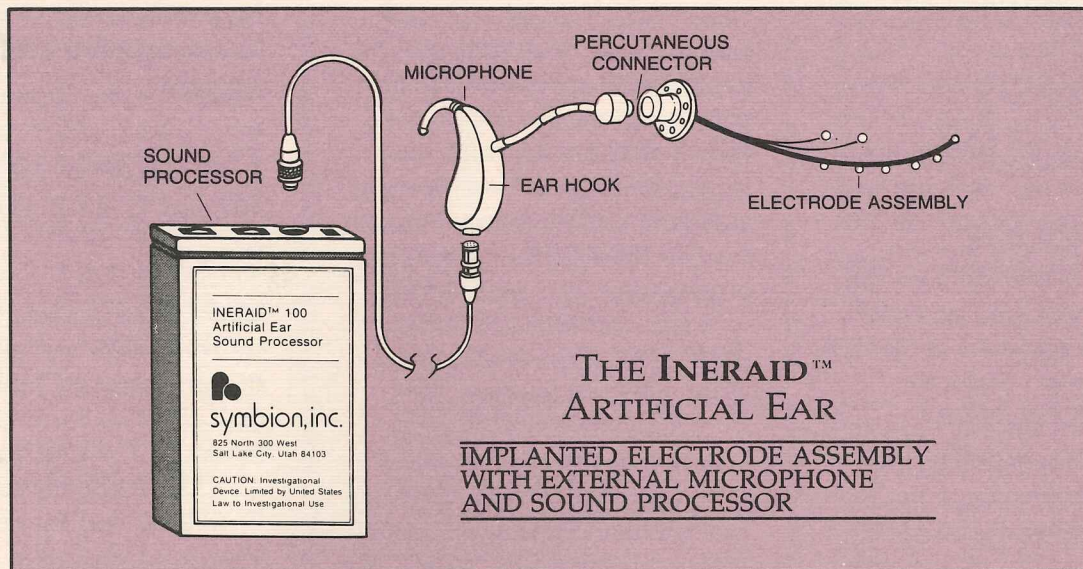
The implanted electrode assembly consists of a percutaneous pedestal and eight electrode wires. Surgery is required to thread the electrodes into the cochlea. They are connected to the pedestal which protrudes through the skin behind the ear. The pedestal

allows the sound processor to be connected to the electrodes.

MICROPHONE AND SOUND PROCESSOR

The ear hook, which looks like a typical hearing aid and is worn on the ear, contains the microphone. It is connected to the sound processor by a cable. The sound processor is a box measuring $4\frac{1}{2}'' \times 2\frac{1}{2}'' \times 1''$. It contains the electronics that convert sounds into electrical stimuli which are sent to the electrodes implanted in the cochlea. The sound processor box is worn in a pocket or on a belt. It may be removed at any time but sound will no longer be heard because the implanted electrodes will not receive electrical energy.

Should the cable become entangled, a break-away safety connector will quickly disconnect the sound processor unit from the pedestal.



HOW THE ARTIFICIAL EAR WORKS

Sounds entering the microphone are relayed through the cable to the sound processor. The sound processing electronics separate the sounds by frequency and direct these signals to the appropriate electrodes implanted in the cochlea. These electrodes are designed to imitate the function of the damaged sensory hair cells. This electrical information is transmitted by the auditory nerve to the brain where the signals are interpreted as meaningful information.

RESULTS

At the time of this printing, the artificial ear enables one patient to recognize from 60% to 80% of random, unpracticed, two-

syllable words without speech reading (lip reading). With speech reading this patient scores from 90% to 100%.

Although this patient has done well, there is no guarantee that you will have similar results. The INERAID artificial ear is an investigational device and there is insufficient data to predict results. You may do as well or better than the patient described, or the artificial ear may merely help you identify environmental sounds.

OTHER SOURCES OF COCHLEAR IMPLANTS

You may wish to contact these research groups to learn more about other cochlear implants.

Cochlear Corporation, 101 Inverness Dr. E., Englewood, Colorado 80112.

William F. House, M.D., Otologic Medical Group, Inc., 2122 West Third Street, Los Angeles, California 90057.

Dorcas Kessler, Research Audiologist, Department of Otolaryngology, University of California, San Francisco, U-494, 533 Parnassus Avenue, San Francisco, California 94143.

F. Blair Simmons, M.D., BIOS-TIM INC., Clarksville Road and Everett Drive, P.O. Box 3138, Princeton, New Jersey 08540.

IMPLANT PROTOCOL

PATIENT SCREENING AND TESTING

At this time, participation in the INERAID artificial ear implant program is limited to patients who meet the following requirements:

1. At least 18 years old.
2. Profound hearing loss in both ears (greater than 90 dB bi-laterally) and receiving no benefit from hearing aids.
3. Learned how to speak prior to becoming deaf.

If you meet the above general requirements you will be evaluated by an otologist involved in the program to determine your eligibility. This consists of a series of medical tests which will help the otologist determine if you are likely to benefit from the artificial ear.

OTOLOGIC EXAMINATION

Your otologist will examine your ear to make sure there are no problems which would prohibit implanting the artificial ear.

AUDIOLOGICAL TEST BATTERY

A complete audiological test battery is also necessary. This is designed to determine the

nature and severity of your hearing loss. You will also be evaluated for the use of a high-powered hearing aid. If it is found that one or both ears might be helped by a hearing aid, you will not be a candidate for the INERAID artificial ear implant.

PHYSICAL EXAMINATION

You will receive a complete physical examination. This will rule out the presence of any illnesses which might interfere with your ability to undergo general anesthesia and surgery.

PSYCHOLOGICAL EVALUATION

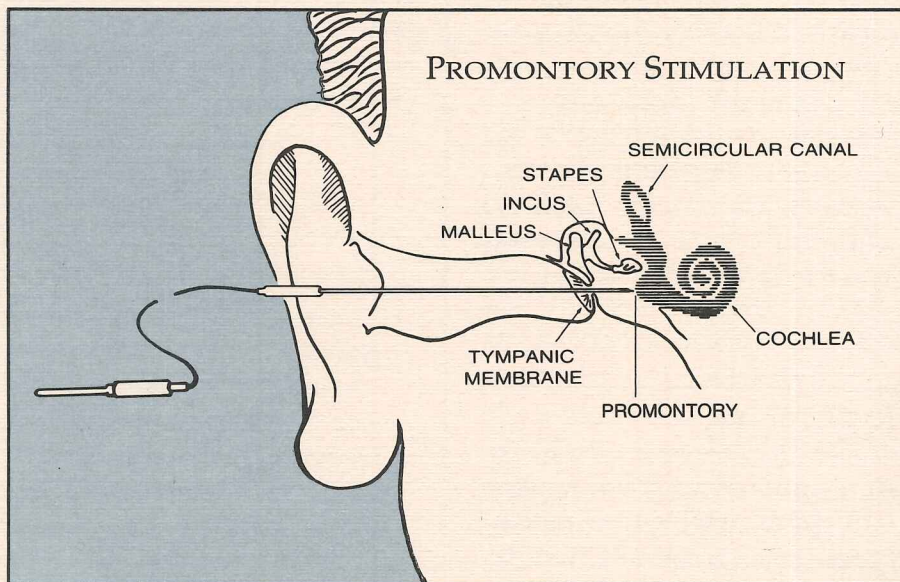
You will undergo a psychological evaluation to make sure your expectations of the artificial ear implant are reasonable. This evaluation will also indicate your ability to make the

necessary psychological adjustments after receiving the implant.

PROMONTORY STIMULATION TEST

Most of the evaluation tests are routine, with the exception of the promontory stimulation test. In order for you to benefit from the INERAID artificial ear, the auditory nerve must be able to conduct electrical signals to the brain. This test uses electrical stimulation to help determine if the auditory nerve fibers are working.

The promontory is an area of bone which forms one of the boundaries between the middle ear and the cochlea. In people with normal hearing, all of the intact auditory nerve fibers terminate at the cochlea. Because some forms of deafness cause degeneration of the auditory nerve fibers, the number



of viable fibers present may range from 0 to 100%.

The promontory test is based on the assumption that electrical stimuli, delivered by an electrode placed on the promontory, will activate these nerve fibers. If a portion of the pathways to the brain is intact, you will "hear" something when stimulated.

The actual steps of the promontory test are described as follows:

- **Anesthetize the eardrum** – The eardrum must be anesthetized before the promontory electrode may pass through it onto the promontory bone. This may be done by directly injecting a local anesthetic into the ear canal or by an electrical process. Either method is effective.
- **Insertion of the electrode** – The electrode is inserted through the eardrum and onto the promontory bone. Since your eardrum is anesthetized, insertion of the electrode is rarely painful. You may feel a temporary pinching sensation when the electrode first touches the promontory bone. If this sensation is felt, it typically lasts about two seconds and then fades away.
- **Stimulation** – The electrode is connected to a piece of equipment called a stimulator. This device produces small electric pulses that are delivered to

the electrode. As stimuli are delivered, the doctor will ask if you hear anything. He will be interested in finding the softest sounds you are able to detect and which stimuli produce sounds that are almost uncomfortably loud. Some stimuli may elicit sensations other than hearing, such as tickling, slight dizziness, or pinching.

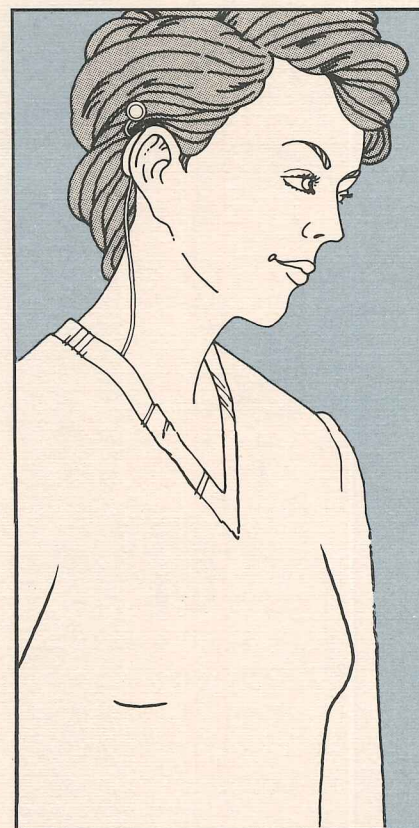
The promontory stimulation test is still an experimental procedure. Although hundreds of patients have been tested with no adverse side effects, it is possible that there are effects we are not aware of. Potential risks that we are able to identify include:

- **Discomfort** – Some discomfort may be experienced when the promontory electrode first makes contact with the bone. None of the patients tested in this program have experienced any severe discomfort.
- **Infection** – It is possible that a middle ear infection might result from the promontory test. Although the likelihood is small, in the event it does occur it will require medical treatment.
- **Perforation** – Though it has not occurred in any patients to date, permanent perforation of the eardrum may result from inserting the electrode through the eardrum and onto the promontory bone.

You should be aware that if you do not consent to the promontory stimulation test, the otologist will be unable to satisfactorily evaluate your hearing loss. As a result, he will not recommend that you receive the INERAID artificial ear.

SURGERY

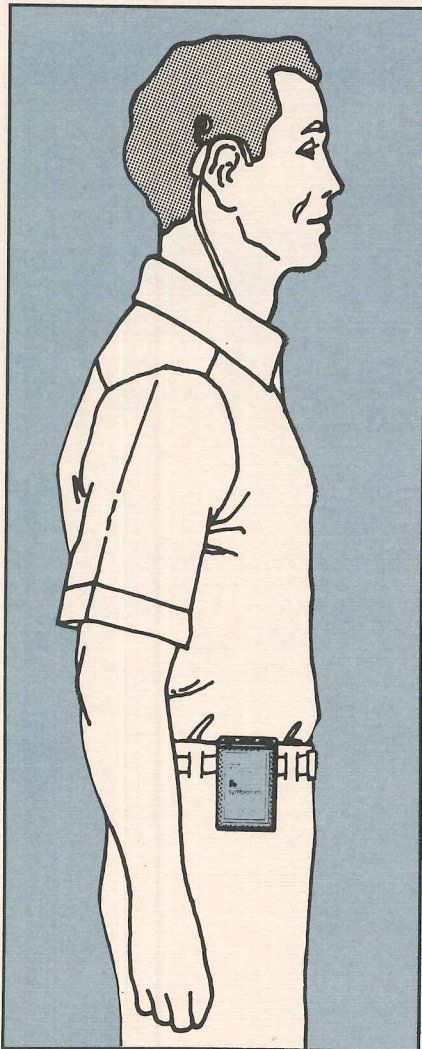
The INERAID artificial ear requires a surgical procedure to implant the electrodes within the cochlea. You will be hospitalized two to four days. The implant surgery will take approximately two months to heal.



SOUND PROCESSOR FITTING

After healing has completed you will have your initial appointment to be fitted with a sound processor. It may take several visits for the technician to adjust the processor to insure maximum effectiveness.

Patients involved in this phase of the program must return for hearing tests at regular intervals for at least two years.



INFORMED CONSENT FORMS

Informing patients about the important parts of the study and the medical treatment they may receive has become an established part of good medical science. The Federal Government, through the Food and Drug Administration (FDA), oversees certain types of research with the help of Institutional Review Boards (IRB). These special committees are active in hospitals or universities conducting medical research.

IRBs are legally required to insure that persons undergoing experimental research receive adequate information about

the project. This practice promotes informed analysis about the value of certain medical research testing and enables an individual to make the best decision about participating.

It will be necessary for you to sign consent forms for the promontory stimulation test and the implant surgery. You are encouraged to take your time and think about the information contained in the consent form. You may wish to discuss areas of concern with relatives or counselors. You should never feel pressured into making your decision. It is important for you to realize that no informed consent form, nor any statement given to you by the research directors or scientists, may include any language which waives your legal rights.

RISKS AND BENEFITS

A THOROUGH UNDERSTANDING

The INERAID artificial ear is an investigational device. It is essential that you have a thorough understanding of the potential risks and benefits of the artificial ear before you become a patient. Although there are some risks to implanting an artificial ear the possibility of developing a serious complication is remote. Please ask your otologist to answer any questions you may have after reading the following summary.

POTENTIAL RISKS

SURGERY

There are standard risks associated with all surgeries. This includes the risks of being under general anesthesia and the possibility of experiencing discomfort after surgery. You may also have temporary vertigo (dizziness) and nausea.

Implanting the electrodes requires surgery on the temporal bone. The facial nerves are located in this area. Surgery near the facial nerves always involves the risk of facial paralysis. The surgical staff is well trained in such procedures; therefore, the risk of complication is minimal.

The cochlea could be traumatized when the electrode is inserted and this dam-

age may lead to auditory nerve degeneration. However, this nerve doesn't function in the sensory deaf except with electrical stimulation.

INFECTION

There is the potential for infection in the area of the percutaneous pedestal just as there is for any permanent implant penetrating the skin. You will be trained in the proper maintenance hygiene to reduce the risk of infection.

Although it is unlikely, meningitis may result from an infection of the pedestal or of the electrodes implanted in the cochlea. It could be caused by a serious infection of the inner ear fluids since these fluids communicate with the fluids in the brain and spinal column. Please report any suspected infection, regardless of how minor, to your otologist immediately. He will see that it is cleared up before it becomes a serious problem.

ELECTRICAL STIMULATION

Electrical stimulation has caused bone formation around cochlear electrodes in experimental animals. However, patients with cochlear implants have not reported a decrease in their hearing ability attributed to bone formation.

Nerve degeneration due to electrical stimulation of the implanted cochlear electrode has not been observed nor measured, yet remains a theoretical risk.

Vertigo or ataxia (failure of muscular coordination) have been reported in less than 1% of the single-channel cochlear implant patients when the electrodes were stimulated. None of the volunteers in the earlier University of Utah multichannel series reported this condition.

ELECTRICAL DISCHARGE

Risk of electrical discharge by the INERAID artificial ear has been minimized by circuit design. Many electrical components would have to fail simultaneously. Even in such an event, the risk of permanent damage to you or to the implant is remote as you would hear a loud sound and could quickly pull the break-away connector to disconnect the sound processor.

PSYCHOLOGICAL REACTIONS

The INERAID artificial ear may fail to perform to your initial expectations. To minimize the risk of disappointment you will receive careful evaluation and counseling before surgery.

OBSOLESCENCE

Transcutaneous stimulation of multiple electrodes with the INERAID artificial ear is expected to become possible in the future. If you receive the percutaneous system now you may not be able to have this unit converted to a transcutaneous system.

TINNITUS

Electrode insertion and stimulation may cause inner ear trauma which could result in tinnitus (ringing in the ears). No INERAID artificial ear patients have experienced this to date. You may already have tinnitus. Although it is doubtful that the artificial ear will cure it; it is also unlikely to make it worse.

DAMAGE TO PERCUTANEOUS PEDESTAL

There is the possibility that a sharp blow to your head may break the pedestal. A broken pedestal may need to be surgically removed.

IMPLANTED MATERIALS

The materials used in the implanted portion of the INERAID artificial ear have been used in implants for years. Tests in laboratory animals have demonstrated their lack of toxic (poisonous) reactions and their resistance to corrosion. However, potential effects of the long-term implantation of these materials represent an unknown risk.

UNKNOWN FACTORS

Although the known risks can be defined and minimized, there is always the possibility that unanticipated risks will develop during the course of the program.

POTENTIAL BENEFITS

You need to evaluate the benefits for yourself and discuss them with your otologist. For your convenience some of the potential benefits are summarized here.

SPEECH RECOGNITION AND IMPROVED SOCIAL INTERACTION

The most obvious benefit is that the artificial ear may allow recognition of speech and environmental sounds. This will enable you to monitor the volume and pitch of your own voice as well as improve your enunciation. This capability will aid your daily communication and may increase your opportunity for social interaction.

NO KNOWN ELECTRONIC INTERFERENCE

Patients with some single-channel transcutaneous implants have reported the unpleasant side effect of receiving stray radio signals through the implanted antenna. To date, INERAID artificial ear patients have not reported any interference problems.

NO IMPLANTED ELECTRONICS

The current INERAID artificial ear model does not require implanted electronics. The

long-term implantation stability of electronic packaging for artificial hearing devices has not been established. Keeping the electronic components outside the body may be beneficial until more information can be obtained. Since the electronic components are housed in the sound processor they can be upgraded non-surgically as improvements are developed.

PARTICIPATION IN RESEARCH TO AID OTHER DEAF INDIVIDUALS

Experience with volunteers who participate in this program will be used to develop superior artificial hearing devices which may aid other deaf persons in the future.

THE ALTERNATIVE OF WAITING

After reviewing the risks and benefits you may decide to wait before receiving the artificial ear. Cochlear implants are experimental and the potential benefits cannot be predicted with certainty.

You may be integrated into a social structure of deaf friends you feel comfortable with. This may be preferable to a situation where you will have to form new relationships in the hearing world. This is especially true when one considers that cochlear implants do not provide normal speech recognition without speech reading.

ANSWERS TO YOUR QUESTIONS

Q. My doctor told me I have nerve deafness. Can I be helped by an INERAID artificial ear?

A. Most patients diagnosed with nerve deafness actually have sensorineural deafness. In two out of three patients the auditory nerve is still functional (or partially functional) but the sensory hair cells in the cochlea are damaged or destroyed. It is these patients who will most likely be helped.

Q. Why do you prefer participants who lost their hearing after learning to speak?

A. Patients who learned to speak before they lost their hearing are necessary to program objectives. They assist the researchers in determining how well the artificial ear helps them understand speech as they remember it sounding and how well they can adapt to the artificial sound. With this information researchers are able to improve the quality of sound produced by the artificial ear.

Q. Will the program ever include participants who were born deaf or lost their hearing at an early age?

A. One of the goals is to work with these patients in the future.

Q. If I am pregnant can I participate?

A. The approved protocol excludes women who are pregnant due to risk of anesthesia during surgery.

Q. How much will an INERAID artificial ear cost?

A. The cost for the pre-surgical evaluation, surgical fee, hospitalization, etc., is approximately \$6,000. The cost of the cochlear implant is \$1,000 and the cost of the sound processor is \$10,000. Some insurance companies have indicated that they would cover a portion of the costs associated with the INERAID artificial ear. This will vary among insurance companies.

Q. Do I have to pay my own travel costs? What about missing time from work?

A. You are responsible for your travel expenses and will not be compensated by the program for time lost from work.

Q. What if I am a qualified candidate for an INERAID artificial ear and want to be in the program yet can't afford it?

A. Symbion, Inc. will provide information on alternative financial arrangements and will assist you in determining what costs will be covered by your insurance company.

Q. Is the INERAID artificial ear a complicated device to use?

A. No, it is no more complicated to use than a powerful hearing aid.

Q. What powers the sound processor unit?

A. A nine volt transistor battery which will last four to six days and will not be rechargeable.

Q. What type of sound does the artificial ear produce?

A. One volunteer described the sound as being clear yet seeming far away. We expect the sound quality to vary from one patient to another.

Q. How fast can I make progress in understanding sounds?

A. It is difficult to say. Previous patients have recognized some sounds immediately; other sounds they have had to re-learn. It is likely that you will recognize more sounds with time.

Q. Will the INERAID artificial ear interfere with playing golf or tennis or doing my lawn work?

A. No, it may help you during these activities.

Q. Can I swim, bathe or shower after receiving the INERAID artificial ear?

A. You may bathe as you usually do after disconnecting the sound processor unit. Swimming is discouraged – particularly in salt water.

Q. What happens when improvements are made in the artificial ear?

A. Since the electronics are housed in the sound processor they can simply be replaced whenever upgraded. This is one of the advantages to housing the

electronics in a box outside the body.

There is the possibility that implanted electrodes could not be replaced with more advanced electrodes. Studies have revealed some bone growth around stimulated electrodes implanted in the cochlea; however, some patients with single-channel implants have had these implants removed and replaced with other electrodes. The otologist would look at each case individually to determine the potential success of this procedure. Even if the electrodes could not be removed you could receive the improved electrodes in the other ear. This is one reason why the artificial ear is only implanted in one ear.

Q. What if I have problems with the sound processor or the percutaneous pedestal between regular visits?

A. If the sound processor fails to function at any time, please contact:

Symbion, Inc. 825 North
300 West Salt Lake City,
Utah 84103

Phone: (801) 531-7022
TDD: (801) 359-1656
during normal business
hours.

You will be told whether to return for further evaluation or if you may send the sound processor unit to Symbion, Inc. for repair.

Q. What do I do if I believe that I have been harmed by the research or medical procedure?

A. Contact your otologist. If it is an emergency and he is not available, contact your regular physician and explain that you are involved in this program. Either you or your regular physician should contact your otologist as soon as possible.

Q. May I quit the program any time?

A. Yes, you may withdraw at any time. If you withdraw from the program after you receive the percutaneous pedestal you should return to your otologist. He may recommend that you have the pedestal surgically removed.

Q. Will my medical records and my participation in this program be kept confidential?

A. Yes, all records will be confidentially maintained. However, records of your test results will be made available to qualified investigators and the Food and Drug Administration. Your rights to privacy will be maintained except by explicit permission from you or your authorized representative.

When friends and associates learn that you have the INERAID artificial ear it is possible that the local media will be informed. Because of the publicity the program

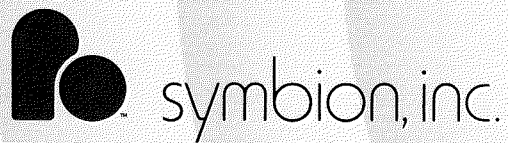
has received the press may request an interview. It is up to you to decide if you want to participate in these interviews.

Q. How can I contribute to the research efforts?

A. Of course you will be contributing when you cooperate with those involved in the program. Another way to further research is to authorize a donation of your temporal bones to the program. It isn't an obligation yet we would like you to discuss this with your otologist.

GLOSSARY

- AUDITORY NERVE* _____ Hearing nerve, the nerve which conducts impulses from the inner ear to the brain.
- COCHLEA* _____ Snail-like structure of the inner ear which contains the organ of Corti.
- COCHLEAR IMPLANT* _____ Device which uses small amounts of electrical current to stimulate the auditory nerve. The brain interprets these signals as sound.
- HAIR CELLS* _____ Microscopic sensory cells located on the organ of Corti in the cochlea. Motion of these cells causes auditory nerve activity in normal hearing.
- INCUS* _____ The middle of the three ossicles of the ear, also known as the "anvil".
- MALLEUS* _____ The ossicle attached to the tympanic membrane, also known as the "hammer".
- MENINGITIS* _____ Inflammation and infection of the membranes that envelop the brain and spinal cord.
- ORGAN OF CORTI* _____ The organ of hearing in the cochlea.
- OSSICLE* _____ A small bone. The three ossicles of the middle ear conduct vibrations from the tympanic membrane to the inner ear.
- OTOLOGIST* _____ A physician who specializes in medical treatment and surgery of the ear.
- PERCUTANEOUS* _____ Protrudes through the skin.
- PINNA* _____ The fleshy projecting part of the ear lying outside of the head.
- PROMONTORY* _____ Area of bone which forms one of the boundaries between the middle ear and the cochlea.
- PROMONTORY STIMULATION TEST* _____ A medical test used to determine if the auditory nerve is functioning.
- SEMICIRCULAR CANALS* _____ Organs involved in maintaining posture and balance.
- SENSORINEURAL DEAFNESS* _____ Deafness as a result of damaged sensory hair cells or damaged auditory nerve fibers.
- SPEECH READING* _____ Lip reading.
- STAPES* _____ The innermost auditory ossicle, also known as the "stirrup".
- TINNITUS* _____ A noise in the ears (ringing, buzzing, roaring, clicking, etc.) that is heard even in quiet.
- TRANSCUTANEOUS* _____ Across the skin.
- TYMPANIC MEMBRANE* _____ Eardrum.
- VERTIGO* _____ Dizziness



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