MEDICINE

Human Bones Replaced

Scientists have found a way to treat animal bones so they can be used to rebuild the human body. This would be priceless if anything were to happen to our bone supply.

By JOHN W. ROBINSON

➤ DAY AFTER DAY, small quantities of a glistening white substance that promises to prevent the disfigurement of thousands of victims of an atomic attack are being prepared in a small laboratory at the Naval Medical Research Institute, Bethesda, Md.

The samples have been sent to all parts of this country and many foreign ones as well, where both surgeons and dentists are giving them exhaustive tests in the human body.

The white material is a new kind of bone, known as anorganic bone. Most of it originally came from cows, but it could just as well have come from pigs, sheep, or almost any other kind of animal. The important thing about it is that special treatment has changed it into a bone that will "take" in the human body the same way that human bone grafts take and become a solid part of their new host.

The great advantage of the new graft material is that it can be had in almost limitless supply. Every stockyard in the U. S. is a potential warehouse for it, and, once prepared, it requires no refrigeration, no sterile handling or any of the other precautions that make human bone grafts so difficult to keep on hand.

The demand for bone grafts will be second only to that of blood if we are ever faced with mass casualties. Then, the supplies of human bone now ready in bone banks would be woefully inadequate. Even if transportation were available, the present stockpile would be wiped out overnight.

In this kind of an emergency the new bone would be lifesaving, says Capt. Fred L. Losee, USN, of the Institute, the man who has been primarily responsible for its development.

The bone is made from animal bones which have been treated with ethylenediamine, an organic solvent that dissolves away all the inside material subject to decay. These organic substances are believed to be the main cause of the reaction that keeps bone grafts from taking when transplanted from one type of animal to another, or from animals to man.

Advantages of the New Bone

The treated bone is very white, easily shaped and extremely porous. Its advantages over natural bone are its freedom from decay and the ease with which it can be sterilized by either boiling or autoclaving.

For human grafting, the anorganic bone is much easier to handle than freeze-dried human bone obtained from a bone bank. This latter type has to be taken from the donor under sterile conditions and kept that way until used. Anorganic bone, on the other hand, can be kept indefinitely in any closed container and then autoclaved immediately before transplanting.

For use, the bone is usually ground up into particles of varying sizes, depending upon the size of the graft area. The particles are packed into the defect and remain there while natural rebuilding begins.

The rebuilding is possible because the treated bone contains thouands of cavities and inter-connecting passageways through its lattice-like structure. Into these are sent tiny new blood vessels that flood the area with a rich supply of blood, a process known as revascularization.

Then, after a good network of blood vessels has been established through and around the chips, new bone cells made by the host's body circulate in the network and attach themselves along the sides of the little canals.

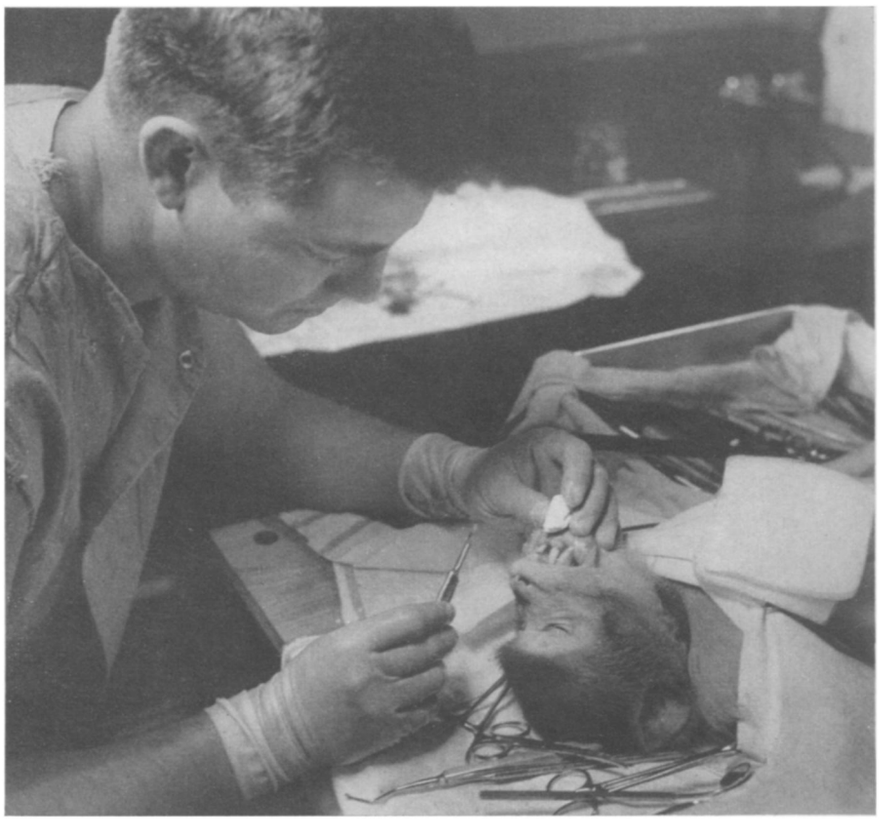
As time goes on, the artificial bone is slowly supplanted by this new bone growth and eventually the grafted material is completely replaced and absorbed by the body. This final stage of repair is known as remodeling.

Dental Applications

Capt. Losee, himself a dental researcher, foresees tremendous possibilities for anorganic bone in the fields of dentistry and oral surgery.

For oral surgery the bone chips can be used to pack holes in the jaw bone left after tooth extractions. The edges of these holes tend to round off slowly with time, a process that can be eliminated by rebuilding the area with the chips and thereby saving the denture wearer a sizable amount of his own bone.

Another use may be in rebuilding tooth dentin. When deep cavities are prepared for fillings, sometimes the drilling must cut away so much of the dentin that the underlying pulp of the tooth is exposed. It may be possible to sprinkle anorganic dentin "dust" over the area and have it create a solid new dentin coating for the tooth.



TEETH FROM COW BONE—A lucky monkey at the Naval Medical Research Institute, Bethesda, Md., gets a new front tooth. It will be fused in place with chips from the piece of chalk-like anorganic bone that Cdr. Harvey Lyons of the Institute holds in his left hand. The new type bone has now proved to be successful in rebuilding human bone.

Dental uses for the anorganic bone chips have already been extensively tested in monkeys by Lt. Cdr. Philip J. Boyne and Cdr. Harvey Lyons at the Institute. This has led naturally to human trials, and successful use of the bone in humans has been reported by Drs. Boyne and Losee.

Capt. Donald Cooksey, an oral surgeon at the Naval Dental School, Bethesda, Md., is also using it in selected human cases.

For orthopedic bone surgery the first use of the bone in humans probably took place in September, 1956, when it was used to repair a crushed heel bone.

But the new bone is not a direct replacement for banked human bone grafts, Capt. Losee emphasizes. It should be considered only as a supplement to the human bone that is available, he believes.

One reason for this is that anorganic bone loses some of its tensile strength in the treatment process. The chemical solvent removes the collagen fibers of the bone, necessary to give it strength. In applications where a large area of strong bone is needed, anorganic bone would not work as well as a human graft.

One way to improve the strength of the bone may be to treat it incompletely with the solvent, Dr. Boyne explained. In this way, the exposed surfaces become anorganic but the core does not, and the entire graft remains much stronger. This possibility is now being tested.

Grafts Take Faster

An important advantage of anorganic bone is that it can be revascularized faster than freeze-dried human bone. Since all the organic debris has been removed from the bone's lattice-work, blood vessel growth can begin immediately. With human graft material, however, the body must clear out the organic material before the new blood supply can be established. Thus the synthetic bone actually saves the body time in accomplishing the same result.

Also, with freeze-dried bone, there is always the possibility that the graft may contain a virus, such as hepatitis virus. This might become reactivated in the new host, Capt. Losee believes.

The development of the bone was an unexpected offshoot of basic research done on the cause of tooth decay. Capt. Losee has been studying the differences between healthy teeth and decaying ones for more than 20 years and developed the bone to see what composes both the organic and inorganic parts of bone.

He devised the ethylenediamine process to obtain samples of a non-organic type of bone which he decided to call anorganic. Shortly afterwards, a reserve medical officer at the Institute, Dr. Lloyd Hurley, now at Presbyterian Hospital, New York, mentioned the difficulties in having bone grafts from one species of animal to take in a different species. Capt. Losee casually mentioned his treated bone and the work began.

The first bits of anorganic bone were transplanted in animals in the spring of 1955 at the Institute by Dr. Hurley with excellent results. The grafts took and prospered, with no sign of any foreign body reaction.

Then its use was picked up by another reserve medical officer, Dr. Hugh Rosomoff, a neurosurgeon now at Presbyterian Hospital, New York, who experimented with putting anorganic bone plugs in dogs' skulls.

Since then extensive animal trials and now human tests have proved the value of the new material.

At present Capt. Losee's lab is the country's only supplier of the bone and he has sent nearly 75 samples of it to researchers throughout the world. A large meat packing company has also become interested in the process and plans to make available bone from various types of animals.

Nature's Anorganic Bone

The age of the original bone is no barrier to its use for grafting, Capt. Losee has discovered. Dramatic proof of this came from experiments with bone brought back to him by Capt. Merrill Wheatcroft of the Naval Dental School from an Egyptian burial ground dating back between the 4th and 5th Dynasties.

"Nature had already removed all the organic material from the bone and we grafted it into the hind leg of a dog," Capt. Losee recalls.

The graft took as well as ethylenediamine treated bone and the dog became the first one in history to have leg bone nearly 7,000 years old.

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TECHNOLOGY

Blasting Noise Tests Jet, Missile Components

➤ ELECTRONIC components for jets and guided missiles are being tested by exposing them to high-intensity sound, A. R. Hopkins, a Radio Corporation of America executive, has revealed.

To give engineers ideas on how to design better components that will withstand the terrific sound vibration in jets and missiles, "white sound," or pure sound of wide frequency range, with intensities up to 145 decibels, is beamed on components placed in a sound chamber.

A decibel, db, is a measure of sound power. When you whisper, your voice has an intensity of about 20 db. When you shout, you are generating sounds between 50 and 60 db. Human beings can tolerate only about 140 db.

Two models of the noise-machine, 36 by 18 by 72 inches, and 9 by 9 by 24 inches, generating sound with a range of 20 to 10,000 cycles per second, have been developed by acoustics engineers of RCA's theater and industrial products department.

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"QUOTES"

"Your magazine (SNL) is enjoyed equally by my engineering associates, and our ten year old son!"

—New York