TRANSPLANTATION OF CARTILAGE*

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The past twenty years has witnessed an awakening of interest in the transplantation of normal tissues of the body and our knowledge and skill in this department of surgery have made unprecedented progress.

Experimental research has shown that practically all the body tissues and sometimes even whole organs can be successfully removed from their normal habitat and under favorable conditions as successfully reimplanted in other parts of the body, often without change either in their form or function, and surgery has been quick to profit by the work done in the laboratory.

It is only in the past eight years and more particularly in the last four that very much attention has been given to the transplantation of cartilage. At Cecis' Clinic in Pisa, Italy, during the Turco-Italian War, the process came first prominently into notice.

In war wounds of the face, where loss of the underlying hard parts rendered the deformity more pronounced, resort was had to cartilage implantation for the purpose of overcoming the skeletal defects.

Morestin, of Paris, claimed that he had been using the method for similar purposes for over twenty years, but it was not until the recent war that much notice was given to it in France or elsewhere. It is to Morestin undoubtedly that we are most indebted for its now widespread use. His brilliant and well published experiences have been very largely responsible for exciting genuine surgical interest in the process.

Cartilage lends itself most readily to transplantation. It is easy of access. The supply furnished by the individual himself is practically unlimited. Its removal does not impair his function nor leave disfiguring or mayhap dangerous scar or deformity. It is easily worked into the desired

form. It requires no elaborate mechanical device for its removal or reimplantation and as far as we are yet able to determine, it continues to live and retain its shape and size, and lastly, it must be mentioned that it is not so susceptible to the action of pyogenic organisms as are other grafts. It often heals in firmly, even after prolonged suppuration of the wound.

As with the other tissues of the body, grafts of cartilage grow best when taken from the patient himself, although those taken from others of the same species in the great majority of cases survive and endure.

Heteroplastic grafts do not long survive, but are absorbed and their place is taken by scar tissue. This has been shown by Imbert and others.

A great deal has been said about the periosteum of transplanted bone. Nothing approaching such discussion is likely to take place regarding the perichondrium in transplanted cartilage. J. S. Davis, in a series of experiments, concluded that even without any perichondrium the graft remained unabsorbed. I have a case in which three small pieces of cartilage were transplanted into the skin of the forehead three years ago. They are still there as large as when first inserted. One has no perichondrium and two have it on one side.

Bone requires, when transplanted, to be placed in contact with living bone and to be made to functionate, otherwise it is either absorbed or atrophies. Cartilage, imbedded anywhere in the tissues, retains its form and strength apparently indefinitely, unless subjected to greater stress of weight than that which it formerly carried.

I have observed a case in which three years ago I transplanted a costal cartilage for saddle nose according to the method, I think, of Skillern. At present it seems to me the cartilage is not so thick as it was at first.

My greatest satisfaction has been derived from its use in the upper part of the face and head. But as its function in the facial repair is merely that of filling up bony depressions for cosmetic effect, chiefly its greatest real benefit in my hands

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has been its protective action in repairing bony losses in the skull.

In France, following the lead of Morestin, almost all the surgeons incline very favorably toward its use for this purpose and the method illustrated here is that which I saw both in Morestin's and Chutro's clinics.

For transplantation into the skull in cranioplasty one should be certain to have the transplanted portion thick enough. A thin piece can not afford very much protection. I remove the whole thickness of a costal cartilage as long as is necessary and then I split it in coronal plane into two halves. I never try to remove the perichondrium, but to remove the cartilage with its perichondrium intact. This is not because I fear that the graft will not grow without its perichondrium, but because when split the piece curves with its perichondral surface concave. It does this better when the perichondrium is attached. This curving is often of advantage, always so in cranioplasty, for then the concave surface is placed toward the brain and so the cartilage conforms more to the contour of the skull.

There has never been any accident in getting the cartilage, either with bleeding or opening of the pleura or suppuration, or lung or chest complications.

The patient never is obliged to stay in bed because of the chest wound. In fact, in all the cases in which I have obtained it for purpose other than cranioplasty, the patient was not confined to bed at all.

When cartilage is used for cranioplasty it is to be remembered that the cartilage rests on the outer aspect of the skull. The periosteum is reflected back for a half an inch all around the margin and the pieces are beveled at the expense of their outer surfaces and fastened to the periosteum with catgut. The periosteal flap is thus sutured on to the outer aspect of the cartilage.

It has been said that the cartilage unites with the bone as it does in life. I have not seen this occur, but I have elsewhere found the cartilage firmly adherent through fibrous tissue. I have never known a piece of cartilage to slip from its moorings nor to fracture.

I have never drained after a transplantation, but I always establish as nearly per-

fect hemostasis as I can, and only the minimal amount of ligature and suture material and that always quickly absorbable, is buried in the wound.

Around the mouth, nose and eyes suppuration is very hard to avoid, and in using free bone grafts aseptic healing is almost imperative. With free cartilage, however, my experience is in accord with that of many others. Even though the wound suppurates, free pieces of cartilage often surprisingly large, heal in the course of five to eight weeks if good drainage is maintained.

I have not used it to take the place of a loss of an entire segment of the lower jaw. Morestin at first claimed success with cartilage in overcoming such defects. He later, however, was not overenthusiastic for it. Almost everywhere else about the head I have used it always with the greatest satisfaction.

DISCUSSION

Dr. Thomas C. Davidson, Atlanta, Ga.—The Doctor is to be complimented and criticised for his paper, and I shall take the privilege of doing both. In the first place, I do not think that cartilage is an ideal tissue for repairing tissue in the cranium when we have such excellent material as the osteoperiosteal tissue to use for repairing these defects. The cartilage may repair the defect, but it is not bone. It is cartilage after all.

We do know that we can get an osteoperiosteal graft from the cranium or from the tibia in sufficient quantity by taking off the periosteum and a very small amount of bone tissue, and by suturing this over the defect we get a real repair which is permanent. The cartilage does not give much protection. I have had considerable experience in cartilage grafting in face work and plastic work on the boys overseas and in the hospital in Washington, where I was for five months, and we found that the autogenous graft was best, that substances taken from other patients did not last. We found that the cartilage must be in contact with live bone. If it is not it will last only a short time.

I remember one boy who came back who had had some repair work with cartilage and it had not lasted. His nose had been shot away and the cartilage which had been used to repair the defect had been completely absorbed in six months. Whenever we took cartilage from the rib and put it into the nose or face we were particular to put it in contact with live bone, and we had no trouble whatever. The perichondrium is not necessary and in removing the cartilage from the ribs the perichondrium was left. In the osteoperiosteal work we got good results which were permanent. I do not believe that cartilage will replace bone, although it may give temporary bridge work.

Dr. Fred L. Koontz, Louisville, Ky.—I should like to know what the Doctor's experience is in regard to incision in the cartilaginous transplants to the bridge of the nose, where he makes the incision, and also how he takes care of the pug nose effect in these saddle-nose cases; how he turns them down and what principle he depends upon to overcome that defect.

Dr. Coughlin (closing).—I am very enthusiastic about osteoperiosteal bone grafting. I like it well when there is not a large defect. No special apparatus is needed and altogether it is very useful.

The statement of the Doctor that free cartilage transplant quickly undergoes absorption is not in accordance with my observation. In a patient whom I have just shown you on the screen there are three pieces of cartilage in the forehead. They have been there three years. We intended to make him a nose, but another disease has prevented further surgery. These pieces of cartilage are apparently as large now as when transplanted. At the same time as when they were inserted a piece of his scapula, taken from the lower angle with its periosteum on both sides, was inserted in his left arm with the idea of making from it a septum for the new nose. This piece of bone has entirely disappeared.

Again, I showed you a face wherein I had transplanted cartilage to take the place of the lower margin of the orbit, zygoma and the anterior wall of the antrum. That boy came to me in France, in 1918, and I made a repair of the bony losses by osteoperiosteal transplantation taken from the tibia. The case was illustrated in an article in the *Medical Record* May 1, 1920. The pictures were taken some months after the bone and fat transplantation. The result looked perfect, as can be seen by referring to the article. Two years afterward he came again to me with the eye displaced downward and the cheek fallen in. This time I did a cartilage transplant, and it is interesting to note that nothing remains of my osteoperiosteal bone graft but fibrous tissue, as demonstrated at the second operation. The fat, too, had disappeared. I was led to believe that osteoperiosteal flaps always increase in size when placed in contact at the ends with living bone.

I emphasized the fact that the cartilage for cranioplasty must be thick. I have seen Chutro use a very thin piece of cartilage, but in that case the defect was quite small. For the repair of saddle nose, cartilage transplant is the best thing I know.

There is no doubt that a thin layer of bone can be used for replacing a lost part of the skull. There is no certainty that it will endure. If the defect is very large, I do not think it is advisable to remove a corresponding portion of the outer table. Cartilage is more easily procured. One patient shown you had been operated upon twice before. A surgeon had considered the opening too large to close by bone transplant and had closed it with fascia and muscle.

It is more difficult to get the bone than to get the cartilage and so far as I know at present the cartilage does just as well as the bone. Generally, if suppuration occurs, bone graft is lost. This is not true of cartilage transplant, as we have seen in the boy whose face I showed you.

The cartilage healed in, although suppuration occurred. Suppuration was due, I think, to passing a needle into the lacrimal sac.

Replying to Dr. Koontz, for that particular condition the ala should be separated from the bony margin of the nasal opening in the skull; and then through the incision made between the eyebrows a piece of cartilage and bone is inserted and pushed on down toward the tip of the nose. The nose should be pushed down farther than is necessary, as there will be some shrinking. A piece of cartilage *only* in this shrinking process will ride backward and upward on the skull, but if the bit of rib is left attached to the cartilage and this end placed in contact with the skull, or, better, counter-sunk in the same, bony union will occur, and no backward slipping will be possible. I do not recall who first advised this operation, but am proud to say he was an American.

THE IMPORTANCE OF EARLY DIAGNOSIS IN ACUTE ABDOMINAL CONDITIONS*

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The acute abdomen has been for more than ten years a favorite medical topic. The literature is monumental, and there must be some valid excuse for reopening so hackneyed a topic. My excuse is that despite the enormous literature, despite the plain teaching of the standard textbooks, men are still to be found in every community who, either through carelessness or ignorance, fail to accept the modern teaching. In medicine, which still is an art rather than an exact science, there is always room for individuality of thought and action. There are, however, certain cases in which the way is clear and the road lost only by the inexperienced or careless traveler.

We all acknowledge that in diphtheria, or even suspected diphtheria, the administration of antitoxin means the saving of life. I think you will agree with me that the man who stubbornly refuses to give antitoxin commits a crime against medicine and a greater crime against humanity. I feel that a man who allows a frank appendicitis to rupture before operation commits the same crime. During the war

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