

AUTOPLASTIC GRAFT OF FIBULA INTO HUMERUS AFTER  
RESECTION FOR CHONDRO-SARCOMA,  
WITH OBSERVATIONS ON BONE-GRAFTING.

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GRAFTING of bone is no new thing, for more than twenty-five years ago Poncet,<sup>1</sup> after resection of the diaphysis of a tibia for infective osteomyelitis, implanted, with satisfactory results, fragments of bone taken from a new-born child dead of asphyxia, and from a recently-killed kid. Of late years the subject has been receiving much attention, and it has been demonstrated clearly that bone may be grafted successfully and that application of the method may be the means of preserving bones and limbs which previously would have been sacrificed.

The possibility of grafting skin has been known for years, but it is only lately that attempts have been made to transplant other organs and tissues. Now there is abundant proof that the method may be applied to fascia,<sup>2</sup> bones, tendons, vessels, and portions of other organs such as the thyroid gland, kidney, and ovaries.<sup>3, 4, 5</sup>

Much attention has been paid to the relationship of the donor of the graft and the recipient; the general conclusions of the different investigators being that autoplasty is most satisfactory, that homoplasty between near relations is the next best, and that heteroplasty is of very little service. There are, however, one or two cases reported in which the bone of an animal has been implanted into man and has survived. It is perhaps open to doubt whether these grafts actually produced new bone or merely acted as a framework for deposition.

The following account is illustrative of an autoplasmic graft:—

**History.**—In September, 1911, a boy, aged 11, was admitted to St. Bartholomew's Hospital on account of a painless swelling in the upper part of the left arm, which had been noticed twelve months previously. There was no history of injury.

**Anatomy.**—Size of the swelling by external measurements—2½ by 1½ inches. Situation—shaft of the left humerus a little above the centre of the bone. The muscles of the left arm were smaller than the right, probably the result of disuse



FIG. 19.—SKIAGRAM OF THE HUMERUS BEFORE OPERATION.

atrophy. There were enlarged glands in the left axilla, which could be accounted for by a sore place on the left elbow. The boy had a congenital cataract, but in all other respects was normal. A skiagram (*Fig. 19*) showed a swelling expanding the bone, and a provisional diagnosis was made of endosteal sarcoma.

**Operation** (Sept. 28, 1911).—The humerus was exposed by a longitudinal incision on the outer side of the arm. The compact bone was so much destroyed that it could be cut into easily with an ordinary scalpel, and a piece was cut out

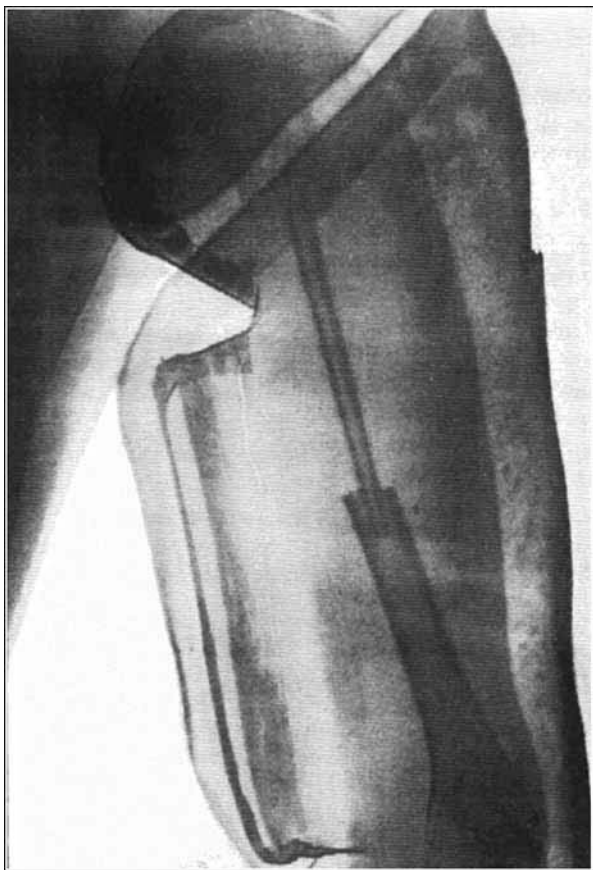


FIG. 20.—SKIAGRAM TAKEN IMMEDIATELY AFTER OPERATION. The bones are somewhat obscured by the poroplastic splint.

for immediate microscopic examination. The report of the section was that it consisted entirely of hyaline cartilage. As there was no appearance of a capsule it was decided to remove the tumour entirely and not to scrape it out, especially as it seemed that such a procedure would weaken the bone in a dangerous manner.

The humerus was sawn through transversely half an inch above and below the tumour, and three inches of the bone removed with its periosteum. The left fibula was then exposed, and three and a half inches of the shaft removed with the periosteum complete. All muscular and tendinous attachments were dissected off carefully, and the graft placed in normal saline at a temperature of 104° F., while its bed was being prepared in the humerus. The medullary cavity in each free end of the humerus was now hollowed out with a burr for a distance of half an inch, and then the fibula jammed in the cavity. The muscles were stitched round the bone with catgut, the skin was closed, and a poroplastic splint applied. Primary union took place (*Fig. 20*). Macroscopic examination showed that the humerus contained a solid growth resembling cartilage which occupied the medullary cavity and penetrated to the surface at the side. It had no definite capsule, but was surrounded by somewhat

sclerosed bone. Microscopic examination showed that the tumour consisted of hyaline cartilage. The diagnosis of chondro-sarcoma was based on the fact that the tumour was infiltrating, and on the knowledge that such swellings are often recurrent.

**Subsequent Course.**—The accompanying skiagrams show the later changes. A few weeks later a small amount of growth could be seen from the two ends

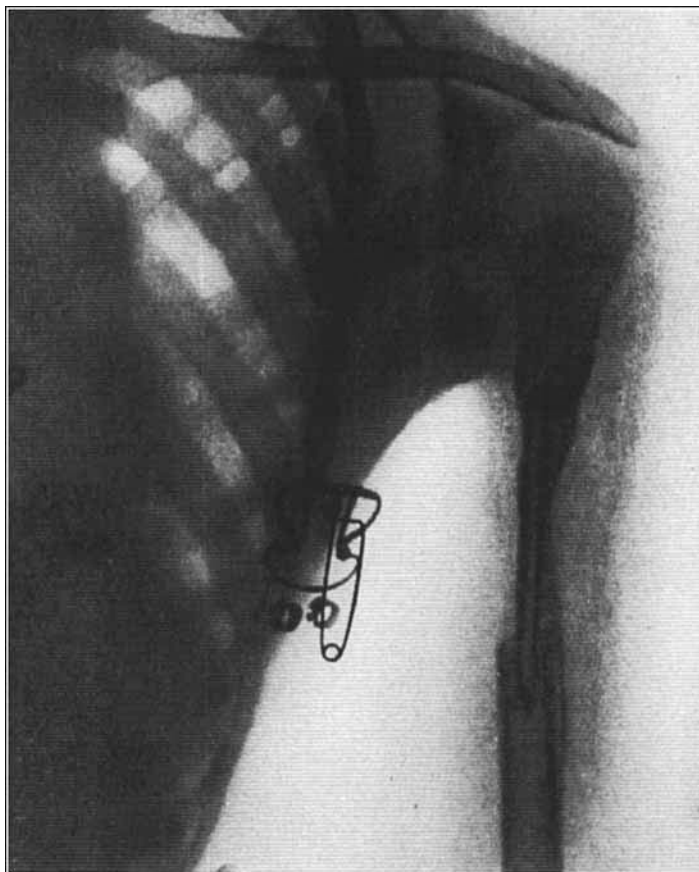


FIG. 21.—SKIAGRAM TAKEN THREE MONTHS AFTER OPERATION.  
New bone can be seen extending along the whole length of the graft, which is now fixed at both ends.

of the humerus, while the graft appeared to remain stationary. Then a faint line of growth was seen along the whole length of the implanted fibula, suggesting development from the periosteum (*Fig. 21*). From that time growth was rapid ; good union had taken place between the fragments by the end of December, 1911, that is, three months after the operation, and in another three months (*Fig. 22*) the skiagram shows that the bone had united solidly and has

increased in thickness. From an early date the boy was encouraged to use his hand and arm in the splint, so that the nutrition of the limb should be maintained.

At the time of writing, seventeen months after the operation, the boy has an arm which to all intents is as good as the other. He goes to school and joins in the ordinary games. The movements are perfect, and he has no sort of pain.



FIG. 22.—SKIAGRAM TAKEN SIX MONTHS AFTER OPERATION.

Much new bone has been deposited, the outline of the fibula being only just visible at the upper end. The bowing is due to the fact that the upper end of the graft slipped out of the humerus. The greater part of the new bone has been deposited on the concave side.

Measurements show that the left humerus is three-eighths of an inch shorter than the right, and the circumference of the limb is a quarter of an inch less. The loss of the fibula is not appreciable; he can walk just as well as ever, and is not weak on that side; in fact, unless told, one would not know that a piece of the fibula had been removed (*Fig. 23*).

*Fig. 24* shows that much new bone has been formed, and it looks as if communication is being established between the medullary cavities of the graft and the humerus.

**Observations on the Technique :—**

1. The portion of humerus was removed, together with its periosteum, and the graft of fibula was inserted with its periosteum intact.

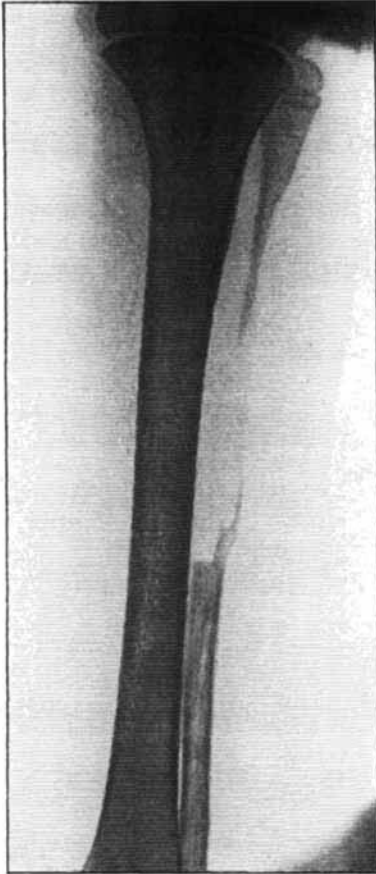


FIG. 23.—SKIAGRAM TAKEN THREE MONTHS AFTER OPERATION.

This shows the gap left after removal of the piece of fibula, and new bone being formed from the two ends.

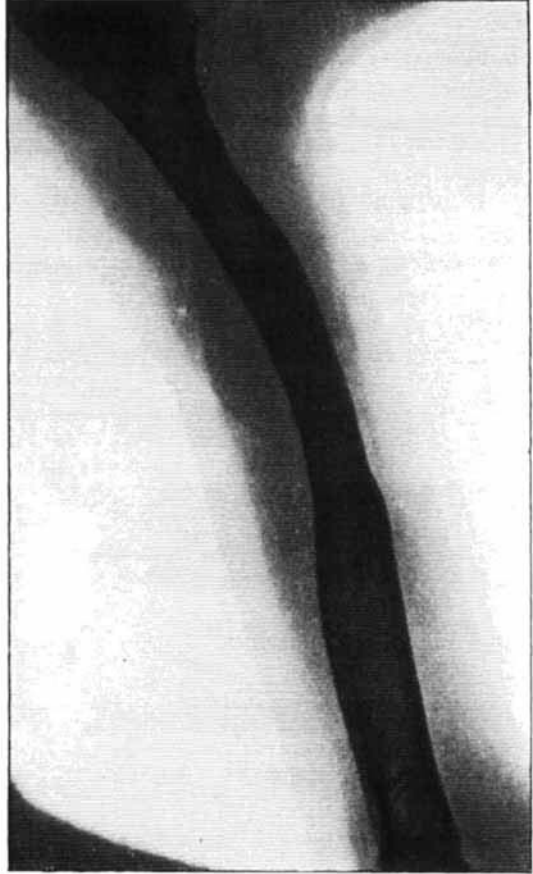


FIG. 24.—SKIAGRAM TAKEN SEVENTEEN AND A HALF MONTHS AFTER OPERATION.

The graft is now part of the humerus: there is indication that the medullary cavities are communicating. The bowing previously noted persists.

2. No holes were drilled into the graft with the idea some surgeons have of allowing access of blood to the bone—it would appear that this is unnecessary.
3. All muscular and tendinous attachments to the fibula were dissected off with scrupulous care. It seems desirable that this should be done, seeing that such fragments would inevitably perish and might prejudice healing.

4. The bones were not secured in position by any foreign body, such as a screw, peg, or plate; this has its advantages and disadvantages. In the above case the upper end of the graft slipped out of the socket in the humerus, and this accident accounts for the bowing of the bone as seen in the skiagram. Cases are reported in which screws have been used with success, and probably some such device would be of great assistance.

#### CONCLUSIONS.

1. An autograft of bone taken under favourable conditions (youth of the individual is a favourable factor) will live and grow. It will certainly grow in thickness, though whether it will grow in length, and at the same pace as the corresponding bone of the opposite arm, remains to be proved.

2. The periosteum of the graft is of service to the bone, whether as a limiting membrane only, or as an active factor in the deposition of new bone.

3. There is evidence to show that bone without its periosteum will grow, and that even the marrow alone will survive and deposit new bone, but until we know more it is better, when possible, to employ bone with its periosteum.

4. Transplantation of bone from an animal to man and the use of bone from dead bodies is merely in the experimental stage, and for the present sufficient material may be obtained from the tibia, fibula, and ribs.

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#### REFERENCES.

<sup>1</sup> PONCET, *Rev. de Chir.*, xlv.

<sup>2</sup> DAVIS, *Johns Hop. Hosp. Bull.*, 1911.

<sup>3</sup> TUFFIER, *Rev. de Chir.*, xlv.

<sup>4</sup> LEXER, *Archiv. klin. Chir.*, xcv., pt. 4.

<sup>5</sup> MACEWEN, *The Growth of Bone.*