LIVING INTRASCLERAL IMPLANTS

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Reprinted from *Transactions of the Ophthalmological Society of Australia*, Volume XXIV, 1965

FURTHER OBSERVATIONS ON INTRASCLERAL CARTILAGE IMPLANTS

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It is with a considerable sense of pride and achievement that I am privileged to give this short paper and pay tribute to my teachers in this city where I began my medical career.

The method of packing the scleral cavity with living diced cartilage is new, and was first described in my paper at the combined scientific meeting of the Ophthalmological Society of Australia in 1962 at Surfers' Paradise.

As with all new procedures, time and experience will prove the validity or otherwise of such treatment after evisceration.

TABLE I.

Case.	Sex.	Age.	Date of Operation.	Type of Graft.	Details.
1. T.A.W.	M	78	17.1.61	Autogenous (mass)	Glaucoma absolutum painful eye (died of coronary disease 10 months later)
2. D.T.	M	9	12.5.61	Homogenous (mass-father)	Hit in left eye with bamboo—perforating wound of cornea and sclera.
3. K.L.	M	6	6.9.62	Autogenous (diced)	Poked in right eye with stick—perforating wound.
4. P.McM.	M	6	10.1.64	Autogenous (diced)	Hit in right eye with stick—perforating wound.
5. I.S.	M	12	31.8.64	Autogenous (diced)	Shot in right eye with air gun pellet—perforating wound.
6. M.J.M.	F	84	4.2.64	Autogenous (diced)	Glaucoma—painful blind eye—some liquefaction of diced cartilage.
7. M.K.	M	6	3.11.64	Autogenous (diced)	Congenital cataract at 3½ yrs., secondary glaucoma – recurrent keratitis and iridocyclitis.
8. F.J.L.	M	51	22.1.65	Autogenous (diced)	Motor accident—lacerated wound with glass and loss of contents of globe.
9. C.R.L.	M	34	22.2.65	Autogenous (diced)	Penetrating wound by screwdriver (left eye).

Certain observations to be given in this short paper will, I think, confirm the desirability of developing the method as a routine procedure.

The "proof of the pudding is in the eating", and only time and progressive observation will supply the necessary details. I shall endeavour to present an honest account of the progress of cases treated by this method over the last four and a half years, and will indicate possible factors which may call for variation or restraint in its application.

Since my first paper I have performed the operation in six new cases, making nine in all (Table I), and from these nine cases, conclusions may be drawn. The patient in the first case in 1961 has since died of coronary disease at the age of 79. In the other two original cases the results are still functionally excellent and no untoward effects have developed.

The nine cases have demonstrated certain principles:

1. There has been no evidence of inflammatory reactions.
2. Free mobility of the scleral ball and prosthesis has been maintained.
3. There has been no evidence of cartilage absorption except in the case of Mrs. M, aged 84, to which I will refer later.
4. The sockets have remained healthy.
5. The method appears to be more physiological and biological than the use of non-living material, and up to the present there are no indications that the implants will be rejected or absorbed.
6. The age of the patient indicates that some variation in the technique may be desirable.
7. There has been absolutely no evidence of sympathetic irritation to the sound eye.

Experience has shown that certain details require consideration.

1. The age of the patient. In extreme old age the poor viability of the cartilage may lead to liquefaction of part of the diced cartilage grafts. A comparison of the two elderly patients on whom I have operated is interesting regarding the survival of cartilage grafts in old age.

The first one, aged 78, had a single solid mass of cartilage graft which lived without any sign of liquefaction. The other one, aged 84, had diced cartilage grafts, which at the operation were yellowish, and it appeared that the life cycle of the cartilage cells was clinically spent. It may be better in these elderly patients to use the single shaped mass as an implant.

2. The extent of the packing of the cavity. One patient, aged 57, had a rather marked proptosis, and in this case I did not fully pack the scleral cavity, so as to ensure that the prosthesis would not be too far forward and the lids be unable to retain the prosthesis. The result was satisfactory. Any deficiency in matching the protrusion of the other eye can be compensated for by varying the thickness of the prosthesis. In children the cavity can be packed fully, even under tension, by using the packing tube.

3. The prosthetic technician, Mr. Schulmeister, has advised me that it is better to have the scleral ball at the slightly deeper position created by excising the cornea, as the prosthesis can then be made thicker and so lose a semi-transparent appearance that occurs if the prosthesis is too thin.

4. The rough anterior surface of the scleral body with projection of cartilage lumps (which act as a key for the prosthesis) is an advantage to avoid slipping and to assist spontaneous movement (Figure I).

Regarding the method of suturing the scleral cavity, I mention that I have used chromic catgut for the mattress sutures, but I think that a white silk continuous suture for the final closure of the sclera is advisable, even if it has to be removed later. This is because, in one case, there was a slight gaping of scleral closure line, which afterwards became filled in with fibrous tissue, but with no actual disadvantage to function.

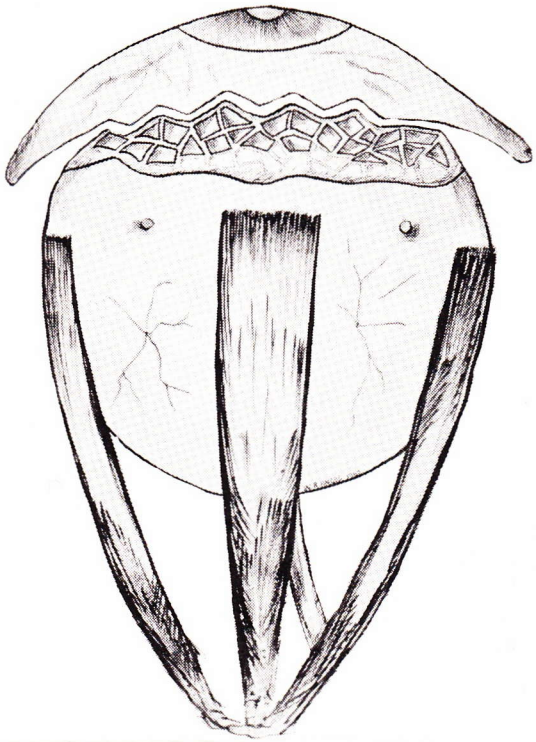

FIGURE I: Diagram showing the "keying" effect between anterior surface of the grafted scleral ball and the posterior surface of the prosthesis.

The best methods of suturing and the most suitable materials are still under trial.

In my opinion, at this stage, the results confirm the validity of the method, and I will welcome criticism or suggestions.

The movie film to follow shows the final cosmetic results and free mobility of the scleral ball in a healthy socket, without any sign of restricted movement caused by fibrosis and adhesions from inflammatory reaction or tenosynovitis of the recti.

SUMMARY

Observations from nine cases treated with intrascleral cartilage implants are described. Case histories are recorded. Suggestions for improvements are made.

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ANGUS, W. R. (1962), "Living Intrascleral Implants", *Trans. Ophthal. Soc. Aust.*, 22: 103.

AUSTRALASIAN MEDICAL PUBLISHING CO. LTD.
SEAMER AND ARUNDEL STS., GLEBE, SYDNEY

Reprinted from *Transactions of the Ophthalmological Society of Australia*, Volume XXII, 1962

LIVING INTRASCLERAL IMPLANTS

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In presenting this preliminary report on living intrascleral cartilage implants, the very paucity of cases and the absence of statistical data, and in fact of any previous report on a similar technique, precludes the formation of definite conclusions; but a review of the interesting details collected, combined with the attempt to establish a technique, opens up a new field for research, application and development. The heritage from one's own personal career as a general surgeon for 25 years before turning to ophthalmic surgery, together with the knowledge, principles and inspirations handed down from the masters, reveals stages in the development of living intrascleral implants which are almost romantic.

As a student I was inspired by Sir James MacKenzie, founder of the James MacKenzie Institute of Clinical Research at St. Andrews, Scotland, in his book on heart affections, dealing with medical research in general practice, and I have always tried to follow his advice to be an investigator and research worker in that field.

Other teachers from whom I have drawn inspiration are Professor Frederic Wood Jones, whose delightful approach to medicine and science was expressed at a public lecture at the Medical Congress in Adelaide in 1937 entitled "The Spirit of Adventure". The impressions received as a student from such men as Professor Archibald Watson and Sir Henry Newland, and from the published works of men like W. E. Gaillie, Sir Harold Gillies and others, have both subconsciously and consciously helped to determine my approach to research in medicine. When Sir Henry Newland returned after World War I from working with Gillies at Sidcup, I assisted him, as his house surgeon, to prepare cartilage rib grafts for stiffening the newly formed noses in rhinoplasty, and some of those grafts would be stored for future use in the subcutaneous fat of the abdominal wall.

In 1928 I began using Gaillie's living suture technique for the repair of ventral or recurrent inguinal herniæ. So, one may say, I was becoming "graft conscious", by direct application of principles and experience. But it was not until I stumbled upon an advertisement for vitallium in the dental unit of 106 Australian General Hospital during the war, that I read of Lyndon Peer's work in the use of vitallium moulds to prepare shapes in plastic surgery for the making of new ears. It was then in 1945

that I conceived the idea that cartilage would be a good material with which to replace the eyeball and to which to affix the recti muscles, and so fill the orbit and give a better movement to the ocular prosthesis and improve the cosmetic result.

I approached the Hodgson-Wirth Laboratories, who are dental micro-casters, in Collins Street, Melbourne, to see if they could prepare a mould in vitallium, but at this time, for various reasons, they preferred that I should have it made in America. By that time I had returned to my practice in Warrnambool, Victoria, as an oculist, and I felt that, with so few cases in the country on which to use such a technique, I would abandon the idea, and this I did for twelve years.

As time moved on, antibiotics, corticosteroids and improved technique had removed the dread of sympathetic ophthalmia, and the operation of enucleation was being replaced by evisceration, with plastic implants giving excellent results. It was in January, 1961, when I was about to eviscerate a painful right eye for glaucoma absolutum in a man aged 78, that I asked him if he would permit me to fill the scleral cavity with a cartilage graft. He agreed, and I removed a solid mass from his costal cartilage with a three-quarter inch cranial trephine, fashioned it and buried it in the scleral cavity. It lived without any untoward effects and produced a good stump with fairly good movement. Unfortunately this patient was very nervous about city traffic and the strain of the metropolis, so he would not go to Melbourne to have a prosthesis fitted, but his orbit without a prosthesis was reasonably filled and the graft was firmly in place.

I then revived my old concept of making a cartilage ball in a vitallium mould to fill the scleral cavity, and again approached Hodgson-Wirth Laboratories. We designed a two-piece vitallium mould, which could be packed with cartilage chips and buried after the technique of Lyndon Peer.

This would mean that a plastic ball implant would have to be inserted into the scleral cavity at the time of the evisceration, and the mould would have to be packed and allowed to grow into shape in the subcutaneous tissues of the abdominal wall for four months, finally replacing the plastic ball at a second operation.

This brings me to the second case, that of a boy, aged nine years, who had his left scleral cavity ripped through the superior rectus to within 1 cm. of the optic nerve. After evisceration, I repaired the scleral cavity and attempted to fill it with cartilage by the same technique described, only to realize that a boy's ribs, at that age, are unable to supply such a mass without risk to the surrounding structure; the trephine method was abandoned, and I inserted a plastic ball, which was rejected two and a half weeks later. This gave me time to prepare a cartilage cast taken from the boy's father, who acted as a donor. At the second operation, I trephined a disc of cartilage with a three-quarter inch trephine, fashioned it by hand and sutured it directly into the somewhat deformed cavity. At the same time I packed the vitallium mould with cartilage chips from the father and buried it in the boy's abdominal wall for future use if required. The direct graft apparently lived, and therefore the cast from the vitallium mould was not needed. The final result in this boy was satisfactory, giving adequate filling of the orbit, but only about 15% of lateral mobility with 80% vertical. I feel that a better result could be obtained with improved technique.

After fourteen months I removed the mould—or "tin-hat", as the boy had named it. The appearance of the cartilage at the operation and after removal is shown in Figure I.

When I cut down on the mould there was a firm "ectocyst" or capsule around it. Passing through every perforation were strong fibro-vascular bands. The mould itself *in situ* appeared to cause no inflammatory or painful signs or symptoms, and was certainly no trouble to the boy, who during that period won a school swimming event, and at no time complained of any inconvenience.

As the living cast had now become a biological curiosity, I gave it to the Lions Research Unit at the Victorian Eye and Ear Hospital.

Dr. Hugh Greer reported that:

Sections show irregular fragments of hyaline cartilage encased in dense fibrous tissue with sparse perivascular lymphocytic aggregations,

cytoplasmic shrinkage and vacuolation with nuclear pyknosis and fragmentation.

Some healthy chondrocytes were present with granular calcification appearing in some areas of cartaliginous matrix. The whole picture suggests that while the matrix has survived the chondrocytes are slowly dying out.

Although these findings confirm those of Lyndon Peer and others in regard to the fate of homogenous grafts, the fact that autogenous grafts survive in a healthy state for years is generally accepted.

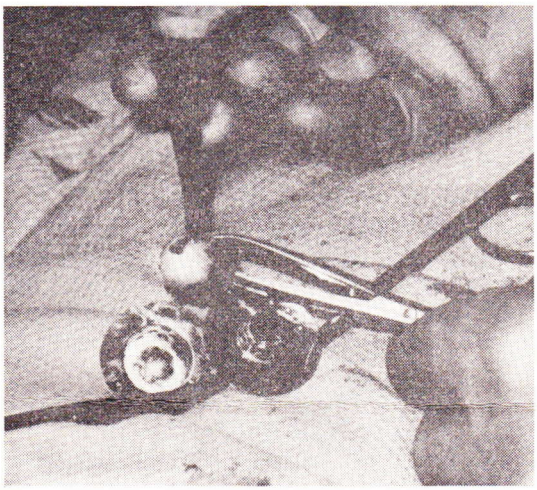

FIGURE I: Photograph showing removal of cartilage cast and vitallium mould after 14 months.

I would like to refer to a personal communication from Dr. Lyndon Peer at this point. I quote from his letter: "I see no reason why autogenous cartilage chips should not be packed within the scleral cavity. As you know, various plastics are used by different men and seem to be tolerated quite well. However, autogenous cartilage is the patient's own tissue."

In developing an improved technique, the greatest need would be the elimination of the second operation. As the eviscerated globe is itself a limiting mould for diced cartilage, it seemed that the intermediate stage of a vitallium mould was unnecessary, and having considered the findings of these two cases, I was stimulated to develop an improved technique, using direct autogenous grafts, which brings me to the third case, that of a boy, aged six years, with a penetrating wound of the right eye necessitating evisceration.

The details of the operation, performed in this case on September 3, 1962, are as follows (Figure II): Under intratracheal anæsthesia the conjunctiva was cut around the cornea 1 mm. behind the limbus and undermined for about 10 mm. Four scleral sutures, to act as guy ropes,

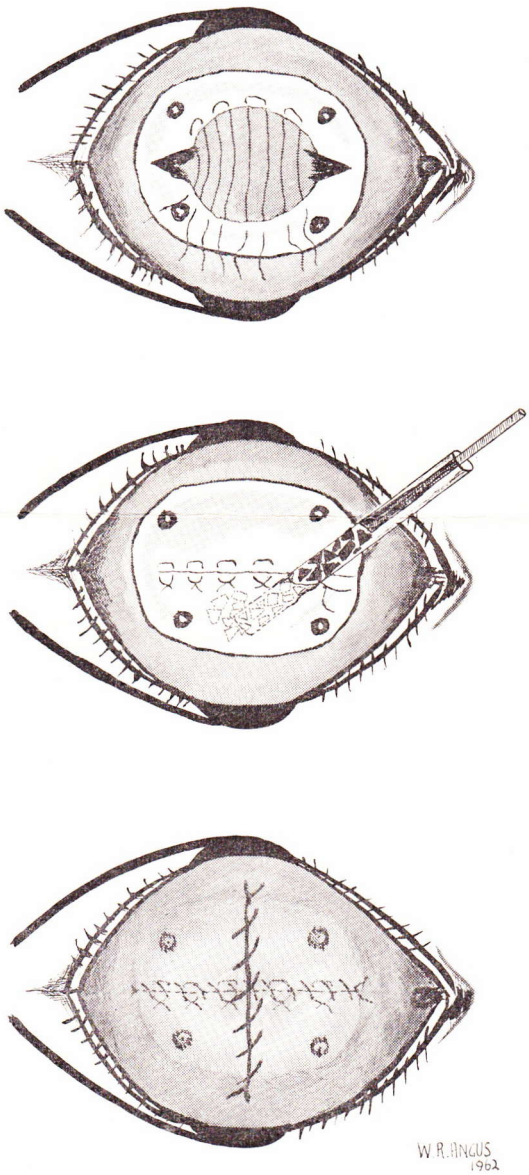

FIGURE II: Operation for living intrascleral implants (diagrammatic). Stage I: Wedge resection of sclera, mattress sutures and trephine holes (guy-ropes not shown). Stage II: Packing cartilage chips into closed scleral cavity. Stage III: Conjunctival and scleral wounds sutured at right angles.

were placed 5 mm. behind the limbus in the vertical and horizontal meridia. Four trephine holes were made with a mechanical trephine 1·5 mm., about 8 mm. behind the limbus at 10.30, 1.30, 4.30 and 7.30 positions to allow any oozing to escape and also to allow vessels to grow through the sclera to nourish the cartilage chips. The cornea and 1 mm. of sclera were excised. The contents of the scleral cavity were eviscerated with a scoop and sent for pathological examination.

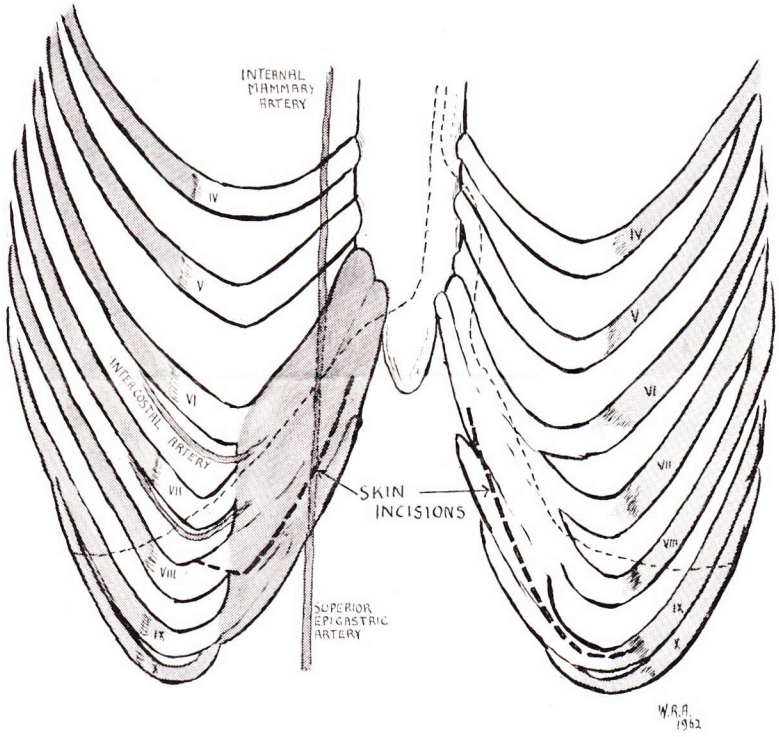

FIGURE III: Diagram showing anatomy, hazards and incisions for obtaining rib cartilage grafts.

The cavity was cleaned with gauze and hæmostasis secured. Two scleral wedges were removed medially and laterally in the horizontal meridian. The scleral edges were then approximated with four 4/0 mild chromic catgut mattress sutures, and three were tied, the lateral one being left loose. This suture line was reinforced with a 2/0 white silk continuous suture, the lateral end also being left loosely tied around a glass tube with a shoulder to prevent it slipping out or in.

The cartilage chips, which were prepared by Mr. Fisher, were fed into the tube and packed into the scleral cavity with a small plunger. When the cavity was filled, the remaining mattress suture and the silk suture were tied and completely closed the cavity. The conjunctiva was sutured vertically to avoid the suture line being superimposed over the horizontal scleral suture line. The orbital cavity at the completion of the operation was well filled. Antibiotic ointment, together with a small vaseline gauze pack, was placed between the lids. An eye dressing was applied and held in position with an "Elastoplast" patch, and a four-inch open crepe bandage was applied for pressure.

In obtaining the cartilage chips the following details should be observed:

1. The sixth, seventh and eighth costal cartilages are exposed on the right side to avoid the pericardium by an incision, as in Figure III.

2. The internal mammary, ascending branches of the superior epigastric and intercostal vessels should be avoided by not

going too deeply and avoiding intercostal spaces.

3. An ample supply of cartilage chips can be obtained by slicing them off with a scalpel as slivers and then dicing them on a piece of board.

4. As the cartilage is avascular and not rich in nerves, little discomfort or trouble is experienced with the wound.

The result in this case so far has been very satisfactory.

Some may ask what justification there is for such an improved technique since excellent results can be obtained with plastic implants.

As a result of my limited experience, and after extensive research, I would claim the following advantages for the new technique:

1. Enucleation can still be done if the pathological report proves unfavourable.

2. Living implant can mould itself to the prosthesis and improve its function.

3. The flattened anterior surface gives greater mechanical advantage to the movement of the prosthesis.

4. There is no rotation of the implant.

5. Discharge, foreign body tissue reaction and post-operative complications are absent.

6. The 6% of plastic implants that are at present rejected could be reduced.

7. Excision of cornea avoids necrosis, with loss of irritation of trigeminal nerve and less post-operative pain and reflex lachrymation.

8. There is less orbital inflammation and tenosynovitis with greater freedom of recti muscle action, and therefore greater mobility.

9. There is lessening of the supratarsal sulcus and less enophthalmos.

10. Pressure necrosis is avoided.

11. Easier fitting of prosthesis is possible.

12. A living implant has a greater psychological appeal to patients.

13. Sensitivity to plastic material is eliminated.

14. Rejection of autogenous graft is highly improbable.

15. In young patients the graft may continue to grow so long as the growth factor is present in the host.

In conclusion, I would like to emphasize that this is only a preliminary report of factual material with suggestive desiderata that reveals a new line of thought for the improvement of the final cosmetic results after evisceration, now that scientific progress has removed some of our past difficulties and fears. It opens up a large potential for research, which the Ophthalmic Research Institute could promote and, who knows, may add a valuable Australian contribution to this field of ocular surgery.

In the words of Oliver Wendell Holmes: "Many ideas grow better when transplanted into another mind than in the one where they sprung up."

There is a painting in the National Gallery, in Melbourne, by James Gleeson, entitled "We inhabit the littoral of corrosive habit", and if this paper, in but a small way can prevent such corrosion, my efforts will not have been in vain. We can with renewed vigour enjoy the spirit of adventure and research in the fields of ophthalmology and science.

I should like to thank all those who have assisted me in the preparation of this preliminary report, and also express my appreciation to the scientific committee for granting me the honour of delivering it.

On Tuesday Mr. Harold Ridley referred to the fact that "All innovations are met with opposition". I trust that the giants of the cities will be sympathetic to the man from the country in their midst.

SUMMARY

A method of using living intrascleral implants is described with indications that advantages of a new technique may lead to an improvement in this branch of ophthalmic surgery.

Details of three cases in the development of this technique are recorded.

ACKNOWLEDGEMENTS

I would like to thank Dr. Gregory Roberts of Sydney, who first suggested that I should give this preliminary report.

Also I have to thank Sir Macfarlane Burnet and Dr. Robert Fowler (Junior) of the Walter and Eliza Hall Institute of Medical Research, Melbourne, and Dr. Edward Ryan, Dr. Hugh Greer and the staff of the Lions International Research Unit of the

Eye and Ear Hospital, Melbourne, who, with Mr. Cottier of the Clinical Photographic Department, gave their valuable help in the preparation of material and slides. To Mr. Wirth, of Hodgson-Wirth Laboratories, and Miss Heather Rankine, Librarian of the Dental School of the University of Melbourne, I express my appreciation of their help.

I have to thank my colleagues for their assistance, and in particular express my appreciation to my secretary, Mrs. Cyril Hayward, for her tolerance and untiring work in the preparation of the typescript.

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