PANEL DISCUSSION

Homografts in otology

Chairman: MR. A. W. MORRISON (London)

Panel: DR. E. BRANDOW (U.S.A.)
DR. J. MARQUET (Antwerp)
DR. R. PERKINS (California)
DR. J. PULEC (Los Angeles)
MR. G. SMYTH (Belfast)

Mr. Morrison: About four years ago I saw Howard House putting in a homograft drum and was very impressed. Dr. J. Marquet has been doing this homograft work for about a year longer and now has experience of over 600 of these cases. Electron microscope studies of the normal tympanic membrane have been done at the London Hospital. This has shown that the membrane does not contain collagen but microfibrils whose amino acid content is quite different to both collagen and elastin. So, if this tissue would survive implantation, it should be an ideal replacement. What technique does the Panel use for the routine replacement of a subtotal perforation?

Dr. Brandow: Large perforations are closed with a homograft drum with the canal skin placed over it covering at least 70 per cent of the drum. A homograft drum is very good graft material to work with.

Mr. Morrison: Are most of these operations performed post-aurally or trans-meatally?

Dr. Brandow: Mostly trans-canal, but if the canal is narrow they must be opened post-aurally.

Dr. Marquet: These cases are done as a two-stage procedure. They are prepared for about a year beforehand and a general anaesthetic is given. Sixty to seventy per cent are done post-aurally. The meatal skin was removed to 1 cm. from the annulus and was placed on top of the graft. Now, however, a large piece of fascia is put on top of the graft.

Dr. Perkins: In all large perforations a homograft is used. It is important to get the ear dry first. The grafts are prepared with small suture loops of 10·0 momofilament nylon to fit around the handle of the malleus of the patient. It is very important to place the canal skin accurately just over the edge of the graft to obtain rapid epithelialization, and the post-aural approach gives a better view for this.

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Dr. Pulec: Almost all operations are performed through a speculum under local anaesthetic so the patient only needs to be in hospital for one day. For a large dry central perforation, the canal skin method of House is used. About a third of cases have an anterior bulge and this is removed with a curette rather than a drill as it does not run the risk of damaging the graft. If the case is difficult to close either a homograft or temporalis fascia is placed under the canal skin to strengthen it. All the skin must be removed in one piece or one runs the risk of producing an iatrogenic cholesteatoma. If fascia is used routinely about a 97 per cent take rate is obtained. The results with canal skin are not quite so good but the hearing results seem to be better.

Mr. Smyth: Most large perforations are closed with the canal skin technique through a speculum. If the canal is very narrow, either an endaural or post-aural incision is used. This enables one to obtain the fascia, but the angle with the post-aural approach is often too oblique and the stapes cannot be seen and it is important to examine the middle ear and ossicles. The only controversial point is whether the fascia should be put over or under the drum remnant. If it is put over, the middle ear space can be maintained and there is a good surface to put the graft onto. The underlay of technique is easier and quicker to do but it does require some form of support for the graft. It avoids the iatrogenic squamous cyst formation and also the terrible problem of anterior blunting which is very difficult to cure once produced.

Mr. Morrison: You have all used homografts and other materials, how do the results with these compare with other materials in your hands?

Mr. Smyth: Two series of 21 homografts were done in humans. Those preserved in alcohol $3\frac{1}{2}$ years ago and in Cialit $1\frac{1}{2}$ years ago. There was no difference between these two groups, but fascia was more successful than homografts in both wet and dry ears. Results with fascia were better in dry than in wet ears, but the homografts were about the same. These cases were taken at random, not specially selected.

Dr. Pulec: In 1968, 158 repairs were done, and there was a 98 per cent take rate with fascia, so take rate is not really the problem. The homograft drum should be used for problem hearing ears. The take rate with 55 selected homograft cases in dry ears was 85 per cent, but when they were put in indiscriminately the take rate was only 50 per cent.

Dr. Perkins: Some thought should be given to the way these homograft drums are prepared as this may account for some of the difference in take rates. In a small series there is a 90 per cent take rate. Eighty per cent of ears were dry at the time of surgery and three of the four perforations which did occur were in infected ears. The thinness of

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the homograft makes it more liable to break down by proteolytic enzymes than the thicker fascia.

Mr. Morrison: This take rate would compare well with fascia.

Dr. Perkins: The take rate with fascia would be better, but this does not mean that the total outcome is better.

Mr. Smyth: Is this in total or subtotal perforations?

Dr. Pulec: If a homograft is put in all the drum remnants are removed first.

Dr. Marquet: At first only a flap of skin was placed over the graft and 78 per cent took. Now fascia is placed on top of the whole drum. Homografts are never put into a really discharging ear, the ear is either not closed or closed temporarily with fascia, and now the take rate is 96 per cent.

Dr. Brandow: In 106 cases there was an overall success rate of 76 per cent. The first 29 cases were done by elevating the epithelium from the drum and the graft was just laid down on top of the remnant. When meatal skin was placed on top of the drum, the rate was about 83 per cent.

Mr. Morrison: Would the panel agree that the homograft drum used indiscriminately does not give such satisfactory results as fascia? The panel is covering the graft at least partly with skin or fascia. What about the function of this drum, is it any better than collagen?

Dr. Brandow: There was very little difference between the functional results with homografts and with fascia.

Dr. Marquet: With a simple perforation the results are similar.

Dr. Pulec: Only 55 cases are not enough for statistical analysis. But taken individually this homograft technique has produced complete closure of the air bone gap in people whose hearing is very important and who may have had several previous operations which were not successful.

Mr. Smyth: The trouble is that one cannot have two identical ears to compare. When they do take they function really well and if they close to 10 dB they usually close to 0 dB.

Dr. Perkins: Using an impedence meter or a pneumatic otoscope the mobility of these drums can be checked and it is usually very good. The membrane is thin and moves crisply. Closure to within 10 dB was 40 per cent in a small series.

Mr. Morrison: There is no statistical evidence about the functioning of these drums, but there is general impression that the hearing, when they do take, is better. A series of measurements of compliance of both fascia and homografts was done and about half of each group

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had normal compliance. The next question is what happens to this drum, is it incorporated, or is it dead tissue that is replaced?

Dr. Marquet: At first it works as a scaffold to support growing tissue. After about twelve months new fibrous tissue gradually grows into it and replaces it. The original shape is maintained. A piece of tympanosclerosis which was implanted with a drum could still be seen five years later, so some of the original drum must remain.

Mr. Morrison: There are many different ways of preserving these drums. Dr. Marquet uses an organic mercurial, Cialit; other people use 70 per cent ethyl alcohol and Dr. Perkins uses buffered formaldehyde, the results with this would seem to be better.

Dr. Perkins: This technique has been adapted from a method of preserving heart valves. The drum is sterilized and the formaldehyde interacts with the drum and stiffens it. This makes it more manageable. At present the core is removed from the cadaver within 24 hours, is put in buffered formaldehyde pH 5·6 and then put in a tissue bank for up to six months. This bank supplies tissue to participating physicians. It is resterilized and prepared before being sent out, the buffered formaldehyde is changed to half per cent whose pH is 7·0, this prevents de-ossification of the ossicle. The graft is removed from the bottle and placed into 500 ml. of physiological irrigating solution for half-an-hour and then into another 500 ml. before it is inserted. This removes any excess formaldehyde which is on the surface but not the bound formaldehyde. Any otolaryngologist can participate in this scheme, and a National Tissue Bank is going to be developed for this, called Project Hear. It has a system for mailing, collecting, and keeping details of each core and when requested the specimen is dissected and mailed back.

Dr. Pulec: At least half the drums we use come from this bank.

Dr. Brandow: The morgue attendants put the specimens straight into Cialit, and the residents dissect these cores. This is an excellent teaching aid.

Dr. Marquet: Is Dr. Perkins sure that formalin is not toxic to the ear?

Dr. Perkins: The amount of formaldehyde remaining in the graft after washing is very small and it is felt that this would not be toxic.

Mr. Morrison: Mr. Smyth has said at the Workshop that to do a revision after a homograft drum has broken down is very difficult.

Mr. Smyth: A second operation is always more difficult than the first. If there is a homograft present with an annulus, there is a lot of reaction around it and it is very difficult to remove all this fibrous tissue. It also leaves very little meatal skin for the second repair. The

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tissues appear much less vascular than when revising a fascial graft. There has been a high proportion of blunting in the anterior recess.

Mr. Morrison: Would the panel agree that if they break down then the drum is thicker and rather beefy?

Dr. Pulec: Many of the failures tend to be rather thin with a hole in the graft. This is repaired either with fascia or canal skin.

Mr. Morrison: Is there any case in which you would use a tympanic membrane only without any of the ossicles?

Dr. Pulec: This is another method of replacing the whole membrane and it is especially useful if the fibrous annulus has been lost. Normally a fascial repair retracts as soon as a grommet is removed, but the homograft can withstand the 3 cm. of water pressure which normally develops before the tube opens.

Mr. Morrison: Does it make any difference in what solution you store your homograft ossicles?

Mr. Smyth: The *p*H is very important. If you want to maintain the mineral content of ossicles stored in Cialit, you must add some mineral to replace that which is washed out. But what are we really looking for? Is it important to have a piece of bone or is it better to have a dead piece of tissue which will be replaced by the patient's own tissues more rapidly?

Dr. Pulec: It doesn't make much difference what we use to store ossicles; they can be autoclaved, kept in alcohol. Homograft ossicles have been used since 1964 and out of 450 cases only three were found to have been extruded. In cats there is no immunological response to homograft ossicles. Histologically with a homograft in humans, after two years there is evidence of re-ossification and new vascular channels growing back into the old channels containing live blood cells. They take well and function for up to seven years. Homografts re-vascularized more quickly than autografts unless both are put in alcohol, but this is only a minor difference.

Mr. Smyth: Work done in other parts of the body has shown that autologous bone stimulates the production of new bone around itself to a very much greater degree than does homologous bone. There is, however, no real evidence that this is so in the middle ear, it would tend to cause fixation if it did.

Mr. Morrison: Cartilage has been used in the middle ear extensively too, what happens to this in the long term?

Mr. Smyth: It maintains its status quo for a very long time. There has been no histological evidence of any loss of cartilage up to six years after insertion or indeed change in its histological appearance. It does

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not behave in the same way as in the nose; it is, however, not buried in tissue in the middle ear but suspended in the air. The only thing that will interfere with cartilage is invasive squamous epithelium. If a retraction pocket touches it, it fragments, and is destroyed.

Mr. Morrison: What methods of assembly may be used?

Mr. Smyth: When the stapes superstructure is absent, the most satisfactory method of reconstruction is to use an L-shaped piece of cartilage placed between the footplate and the tympanic membrane. This cartilage is strengthened by inserting 38 French gauge wire. The head of the malleus may be used to fill in the gap between the head of the stapes and the malleus. This is not affected by lateral healing nor does it interfere with aeration and so gives better results than a transposed incus.

Dr. Pulec: A similar assembly is used but about 30 per cent have not closed the airborne gap either because of fixation to the promontory or laterally.

Dr. Brandow: When there are no crura a homograft malleus is placed between the footplate and the malleus.

Dr. Marquet: It is important when drilling the ossicles to keep them cool with water and bone dust makes a very good cement. Tiny metal plates and screws may be used to fix the homograft malleus head to the body of the incus.

Mr. Morrison: May we now go on to discuss the reconstruction of radical and modified radical cavities.

Dr. Perkins: The use of homograft membranes and ossicles will really be the cornerstone of our work in the next ten years. They have recently been used to reconstruct radical cavities. The posterior bony canal wall is rebuilt with formaldehyde prepared homologous dura strengthened posteriorly with some autogenous bone paté. The bone paté is bone dust from cortical bone. The bone cells interspersed in this become osteoblasts and over a matter of months, the paté becomes a solid piece of bone. The paté must be contained by the dura or it will not become solid bone. The dura is covered with mastoid bowl skin and the complex produces a firm bony posterior wall.

Mr. Morrison: Mr. Smyth, how would you reconstruct a radical cavity?

Mr. Smyth: A soft tissue flap is used to fill in the cavity. This is hinged on the back of the pinna and muscle is avoided as it shrinks. One can also use a piece of cartilage to replace the posterior wall as long as it is fixed in place and aerated with silastic. This is combined with a tympanic cavity reconstruction using fascia. This must cover the meatal surface of the cartilage so there is no bare area of soft tissue exposed where granulations will form.

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Dr. Marquet: Cartilage tends to disappear after three or four years as a posterior wall replacement. Now a homograft drum plus meatal wall is taken from the cadaver as a core and at operation as much of the circumference as is necessary is used and fixed in place with bone dust. Epithelialization is complete over this and the ossicles remain mobile. In congenital deformed ears only the malleus and drum are used, though if the cavity is too large, a small piece of posterior wall may be included. None of these ears has yet had its second stage as none has gone for more than a year so details of functional results are not available.

Dr. Pulec: A similar procedure has been used on five cases so far, using a homograft complex with meatal wall membrane, malleus and incus. At revision the bony wall is firm and a tympano-meatal flap can easily be made for ossicular reconstruction. It is a good idea to cut a groove to place the bone wall in so it can be slotted into place. It is very important to cover this homograft entirely with fascia or skin will not grow over it. You see how much effort we go to to reconstruct these cavities and I hope that this will tend to urge more of you not to make radical cavities.

Mr. Wilson (Dublin)*:* Do you insert a whole bony circle of meatus?

Dr. Pulec: It is as well to have a complete sleeve of graft available and then at operation to cut off as much as necessary, as each cavity is different. Only the posterior one-half or two-thirds is used. It is also a good idea to leave a hoop along the front of the tympanic membrane to hold the membrane firm. You must first drill out a groove anteriorly in the patient to fit this into.

Dr. Perkins: Using this bony wall is not so good as it takes so long to prepare it and also it is not possible to get such an optimal position of the drum.

Dr. Brandow: I have used the preserved homograft and posterior canal wall in three cases in wet cavities and all three have taken. The only problem is that as a new canal wall has been built up, retraction pockets may form, and so follow up is necessary.

Mr. Morrison: What does the panel feel is the place of homografts at present in ear surgery?

Mr. Smyth: The really important thing is to improve hearing and not what material is used. Cartilage and bone have already proved themselves for reconstruction and the homograft drum has not yet. These new techniques should be carefully evaluated before being widely used.

Dr. Pulec: This type of work should be done by the surgeon who has mastered other types of chronic ear surgery and gets good results.

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It is then reasonable to attack the special problems. Homografts do not take in violently draining ears, they fall out. They are ideal in the case of loss of malleus or annulus. It is also very convenient to be able to pick one off the shelf for a simple myringoplasty in a subtotal perforation.

Dr. Perkins: This should be a supplement to our armamentarium. Ears must be carefully prepared, however, and operative technique must be good.

Dr. Marquet: A homograft is very good material. It is, however, very important not to leave pathology in the middle ear and so the posterior approach is better. I am trying to restore the ear as near as possible to normal and the only way to do this is to use the original material.

Dr. Brandow: I will continue to use these preparations, especially where there is a missing malleus and especially in reconstructing mastoid cavities as the stiffness of these grafts is most useful.

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